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RECIRCULATING PAINT SPRAY SYSTEM

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2 Sheets—Sheet 2

[Diagram of a recirculating paint spray system with various parts labeled from 10 to 70.

Fig. 2 and Fig. 5 are shown, illustrating the system and its components.

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[Signature of Peter F. Knowles, attorney, at the bottom of the page.]
This invention relates to fluid distribution systems and more specifically to a system of the recirculating type for supplying coating materials such as paints, enamels, lacquers and the like to a plurality of spray guns located at a plurality of spaced spray painting stations.

In conventional practice a paint circulating system for use in spray painting consists essentially of a paint mixing and storage tank, a main pipe line extending from the tank along a series of painting stations or spray booths and returning to the tank, pump means for circulating paint in the paint line under pressure, a spray gun at each station connected to the main pipe line by means of supply ducts such as a hose and a pressure regulating device connected in the supply ducts for insuring that paint is supplied to each spray gun at a satisfactory spray gun operating pressure.

A paint circulating system of the type described above is inadequate for use in spray painting having a tendency to settle rapidly such as the acrylic type paints and where the various spray guns may be used intermittently, because the paint pigment and other solids in the paint within the supply ducts leading from the main paint supply line to the spray guns tend to settle out when a particular spray gun is not in use for a substantial period of time with a result that the spray gun is again put into use the paint is off-color.

It is, therefore, the basic object of this invention to provide a circulating system for use in spray painting at a series of painting stations wherein the paint in the system is caused to move at a predeterminded minimum rate sufficient to prevent settling of the pigments and other solids of the paint regardless of the number of spray guns in operation, and wherein the paint is supplied to each spray gun at a constant predetermined pressure. This and other objects of this invention are accomplished by providing a circulating system including a mixing and supply tank, a main supply line leading from the supply tank, extending along a series of paint spraying stations or booths and returning to the supply tank, and pump means for circulating paint in the main supply line at a predeterminded relatively high pressure. A separate secondary return line is provided which extends along the main supply line and leads to the supply and mixing tank. A cross circuit or line is provided having an inlet portion connected to the main supply line and an outlet portion connected to the secondary return line at each of a series of spray stations situated along these lines whereby paint may flow therebetween from the main supply line to the secondary return line. A spray gun is connected in each of the cross circuits to the inlet and outlet portions thereof by means of a Y-type connection whereby paint may flow into the spray guns when the latter are in operation while maintaining continuous paint flow through the main supply lines from the main supply line to the secondary return line. A pressure regulator is connected in each of the cross circuit inlet portions to insure that the paint is fed into each spray gun at a predeterminded pressure below the main line pressure. Each cross circuit is further provided with a restricted portion in the outlet portion thereof to control paint flow and avoid by-passing of all of the main supply line capacity through the first few branch lines.

An important feature of the system resides in the aforementioned separate secondary return line which is progressively graduated or varied in diameter in accordance with the number of cross circuits feeding paint to it to insure that the paint is at all time flowing at all points of the return line toward the supply tank at a predeterminded minimum rate in linear feet at which rate the solids of the paint will not tend to settle. Thus, the return line is provided with a relatively smaller portion at the point where but a single cross circuit feeds paint to it such that the paint will flow therethrough at at least the predetermined minimum rate, and with progressively increased diameters at points downstream as the number of cross circuits feeding paint to the return line increase to maintain the minimum flow rate in the entire line. By maintaining the pressure in the main supply line at a predetermined flow and by properly adjusting the pipe diameters of the secondary return line and the size of the aforementioned restriction in the cross circuits, the paint is caused to flow in all lines of the circulating system at least the predetermined line rate whether or not the various spray guns are in use and while spraying paint to the various spray guns at a predetermined pressure.

Other objects and advantages of this invention will be apparent from the following description of a preferred embodiment, reference being made to the accompanying drawings in which:

FIGURE 1 is a perspective view of the circulating system.

FIGURE 2 is an enlarged view of a branch line involved in the system.

FIGURE 3 is an exploded view of a spray gun and portions of a branch line including a restricted portion.

FIGURE 4 is an exploded view of a connection of a branch line including a restricted portion.

Referring to FIGURE 1 the paint circulating system of the present invention includes a pair of mixing and supply tanks 10 and 12. Within each tank is a mixing or agitating member (not shown) of suitable configuration attached to a shaft 14 and driven by an electric motor 16. Conduits 18 and 20 are provided for venting the tanks. The tanks 10 and 12 are each connected to a pump 22 through a two-way valve 24 whereby either tank may be used to feed paint to the pump. The pump may be of any suitable design, and preferably an air pump such as the Binks Manufacturing Company type 314 air pump which is capable of moving the paints without adversely affecting their quality. A compressed air supply means 26 is provided for operating the pump.

Leading from the pump is a main relatively high pressure supply line 28 which includes a surge tank 30, a check valve 32 and encircles a series of spray painting stations or booths indicated generally at 33, 34, 35, 36, 38, 40, 42 and 44 and then leads back to the mixing tanks 10 and 12 through a two-way valve 46 whereby the return flow of paint may be directed to either tank. A back pressure valve 48 is provided in the return portion of the main supply line 28, the purpose of which will be hereinafter fully described.

A separate secondary paint return line 50 is provided which is branched to form legs 52 and 54 each extending along portions of the main supply line 28 which passes along the spray booth area and which leads to portions of the supply tanks 10 and 12 through a two-way valve 56 whereby the flow of paint in the secondary return line 50 may be directed to either of the mixing tanks.

Connected across the main supply line 28 and the secondary return line 50 at each of the spray painting stations as, for example, the station generally indicated at 33, is a cross circuit 58 having connected therein a spray gun 60.

As is shown in greater detail in FIGURE 2 the cross
circuit 55 includes an inlet portion including a rigid section 62 having connected therein a shut-off valve 64 and a pressure regulating or reducing valve 66. The valve 66 is of the known adjustable automatic pressure reducing type, which when set for a given pressure on the outlet side of the valve functions to open or close with decrease or increase of pressure from the predetermined point on such outlet side of the valve to bring the pressure back to a given point. The inlet portion also includes a flexible hose section 68 connected to the rigid section 62 and to a Y section 70 connected, and a compressed air supply hose 61 is connected to the spray gun for atomizing the paint in the spray operation, in a manner well known in the art. The cross circuit also includes an outlet portion including a flexible hose 72 and a rigid section 74 connected to the secondary return line 58. Shut-off valves 76 and 78 are provided to permit the hose sections 68 and 72 to be disconnected without allowing paint to run out of the rigid sections 62 and 74.

An important aspect of the system is the provision of a restricting means in the outlet portion of the cross circuit. This restriction may conveniently be in the form of an orifice 81 connected between the Y connection 70 and the outlet hose portion 72 as shown in FIGURE 3. This restricting means may also be an orifice 82 connected between the cut-off valve 76 and the hose 72 as is shown in FIGURE 4.

A may be replaced of the system thus far described, the paint is admitted to the tanks 10 and 12 and thoroughly mixed. The pump 22 is placed into operation and the valve 24 is set to enable one of the tanks to supply paint to the pump. The dual tank arrangement described permits one of the tanks to supply paint to the pump while the other tank is used to mix fresh paint. The pump 22 then pumps the paint into the main supply line 28 which in a specific installation is 1½" in diameter, at about 80 pounds per square inch gage. This paint feed pressure may vary between 60 to 80 pounds pressure depending upon the distance between the mixing tanks and the spray booths. The paint then enters the spray booth area within the line 28 at a lineal rate of not less than approximately one lineal foot per second and returns to either tank 10 and 12 as determined by the setting of the valve 46.

The paint also flows through each of the cross circuits 58 to the return line 50 from whence it returns to one of the tanks 10 and 12 depending on the setting of the valve 56. Within each of the cross circuits 58 the pressure of the paint is reduced to about 15 pounds per square inch by the pressure regulator 66 which may be of any suitable design well known in the art. The paint, now at about 15 pounds per square inch, passes through the hose 68 to the spray gun 60. If the spray gun is in operation, a portion of the paint stream flows into the spray gun and the balance thereof flows into the secondary return line 50 through the orifices 80 or 82. Of course, if the spray gun is not in use, all of the paint stream entering the cross circuit flows into the secondary return line 50. The purpose of these orifices is to provide a back pressure in the branch line at a point after the spray gun to avoid bypassing all of the main circulating line capacity through the first few branch lines. Since only a portion of the paint through a cross circuit is utilized in the spray operation when the spray gun is in use, the pressures in the cross circuits are not appreciably affected by intermittent use of the spray guns.

The branch line portions 52 and 54 of the secondary return line are varied in diameter in accordance with the volume of the paint flowing thereinto from the various cross circuits so that the paint may flow in the secondary line 50 at a substantially lineal uniform rate at which solids in the paint will not settle. Thus, the portion 43 of the branch line 52 of the secondary return line 50 between the cross circuits of the spray stations 44 and 42, the spray station most remote from the pump 22, may be of a minimum diameter of 1¼". The pipe section 41 of the branch line 50 between the cross circuits at the paint stations 42 and 40 may be ½", the pipe section 37 between the cross circuits at the paint stations 40 and 38 may be ¾", and the pipe section 37 between the cross circuits at the paint station 38 and the joint of the branch lines 52 and 54 may be ¾". The line 54 is similarly graduated.

By adjusting the size of the restricting orifice 80, and suitably graduating the secondary return line 50, the paint flow is balanced so that substantially equal lineal flow rates are maintained in the supply and return line systems. The secondary return line 50 with the result that the paint is at all times flowing at all points of the system at at least the minimum predetermined minimum rate at which the settling of the solids in the paint will not occur, and a satisfactory volume of paint at a predetermined pressure is provided at all the spray guns whether or not they are in use.

In the event that the main supply line 28 is relatively long and has a relatively large number of cross circuits 58 connected therein and therefore the pressure drop in this line is too high to provide for the proper functioning of the last cross circuit connected thereto, the restricting valve 48 is utilized to provide sufficient back pressure in the line 28 after the cross circuits to provide for a sufficiently high pressure throughout the main supply line to permit a proper functioning of all of the spray guns.

In some instances where the paint tends to clog the orifices 80 and 82 the orifice 51 is replaced by a relatively long flexible tube of restricted diameter whereby a suitable back pressure is effected using a larger restricted area. Thus, it has been found that a 0.06" orifice 80 may be replaced by a ¼" tube of suitable length.

In the event that an exceptionally long secondary return line 50 is necessary involving a large number of cross circuits 58 connected thereto, a booster pump 84 (FIGURE 1) may be used to avoid an excessive pressure build up in the line. The operating pressure in the secondary return line 50 may also be increased by providing a restricted section 86 between the spray gun 60 and the Y fitting 70. The use of the orifice at this point results in an increase in the regulated pressure through the cross circuit lines while maintaining the same fluid flow through the spray guns with the result that the pressure in the return line 50 is correspondingly increased.

In this description of a circulating system for a hot spray painting operation, heaters 88 (FIGURE 1) of suitable design are installed in the main supply line at suitable intervals and the main supply line is suitably insulated which is effective in maintaining the entire system at a suitably hot temperature.

The various dimensions, pressure, flow rates, etc., mentioned herein are for the purpose of illustration and it is readily apparent that the precise dimensions to be used will depend upon the needs of a particular paint spray operation. The various components referred to such as pressure regulator valves and the like are intended to refer to devices whose function and design are well known in the art.

While this invention has been described in terms of certain preferred embodiments it will be understood that the scope of the invention is not intended to be limited thereby except as defined in the following claims.

I claim:

1. A fluid distributing and circulating system comprising a main supply line, a separate return line, a plurality of material applying devices, a plurality of cross circuits each including inlet and outlet portions respectively connected to said supply line and return line and both connected to a said device, pressure reducing means connected in each of said inlet portions and operative to control the volume of material passing from the supply line to said devices, and a fluid control means connected in each of said outlet portions and including a constantly open passage of restricted size such that the pressure in said outlet portion is always less than the pressure at
the devices and the pressure at each of said devices is substantially equal, said return line having an increased internal cross-sectional area with an increase in the number of cross circuits feeding paint thereto.

2. A pressure balanced paint distributing and circulating system comprising a main supply line, a plurality of paint applying devices, a separate return line, a plurality of cross circuits each including inlet and outlet portions respectively connected to said supply line and return line and both connected to a said device, pressure reducing means connected in each of said inlet portions and operating to control the volume of paint passing from said supply line to said devices, and fluid control means connected in each of said outlet portions and including a constantly open passage of restricted size such that the pressure in said outlet portion is always less than at the devices and the pressure at each of said devices is substantially equal, said return line being graduated to have a greater internal cross-sectional area with an increase in the number of cross circuits feeding paint thereto; the pressure in said main supply line, said fluid control means and the graduation of said return line being adjusted so that the paint through the system flows at least at a predetermined minimum rate.

3. Claim 2 wherein said main supply line includes a restricting means downstream of the last cross circuit connected thereto whereby the pressure in said main supply line at this point is at least equal to the pressure maintained by said pressure reducing means in said cross circuits.

4. Claim 2 wherein said main supply line is insulated and includes heat transfer means for heating the paint in said main supply line.

5. A pressure balanced paint distributing and circulating system comprising a paint mixing and supply tank; a main supply line leading from said tank; encircling a plurality of spray painting stations and returning to said tank; pump means connected in said main supply line circulating paint from said tank through said main supply line, a separate secondary return line extending along said main supply line in the vicinity of said spray stations and leading to said tank; a plurality of paint applying devices; a plurality of cross circuits each including inlet and outlet portions respectively connected to said supply line and secondary return line and both said portions connected to a said device, pressure reducing means connected in each of said inlet portions operative to control the volume of paint passing from the supply line to each of said devices, and fluid control means connected in each of said outlet portions and including a constantly open passage of restricted size such that the pressure in said outlet portion is always less than at the devices and the pressure at each of said devices is substantially equal; said return line being of progressively greater internal cross-sectional area with each increase in the number of cross circuits feeding paint thereto; the pressure in said main supply line, said fluid control means and the diameter of said secondary return line being adjusted so that the paint throughout the system flows at least at a predetermined rate at which the solids of the paint circulating in the system will not settle.

6. A fluid distributing and circulating system comprising a main supply line, a separate return line, a plurality of material applying devices, a plurality of cross circuits each including inlet and outlet portions, respectively connected to said supply line and said return line and both connected to said device, pressure reducing means connected in each of said inlet portions operative to control the volume of material passing from said supply line to said devices, and fluid control means connected in each of said inlet portions operative to control the pressure in said outlet portions to be less than the pressure at said devices, said return line being graduated to have a greater internal cross-sectional area with an increase in the number of cross circuits feeding material thereto.

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