

Feb. 20, 1951

F. E. WILLISON
PAINT SUPPLY SYSTEM

2,542,855

Filed May 25, 1946

2 Sheets-Sheet 1

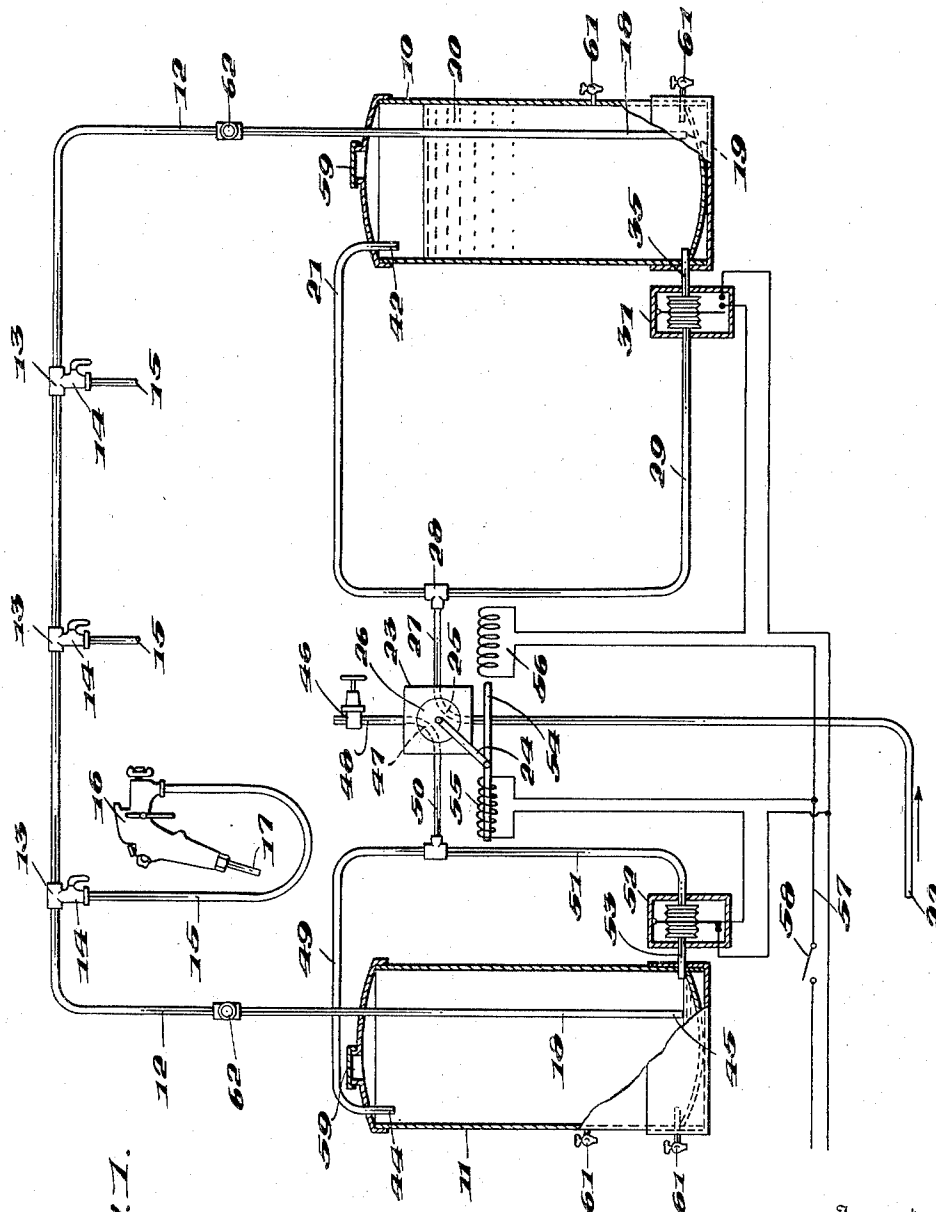


Fig. 1.

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2 Sheets-Sheet 2

Fig. 2.

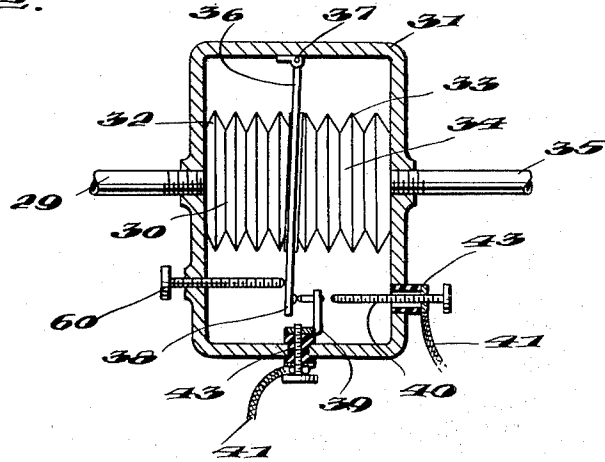
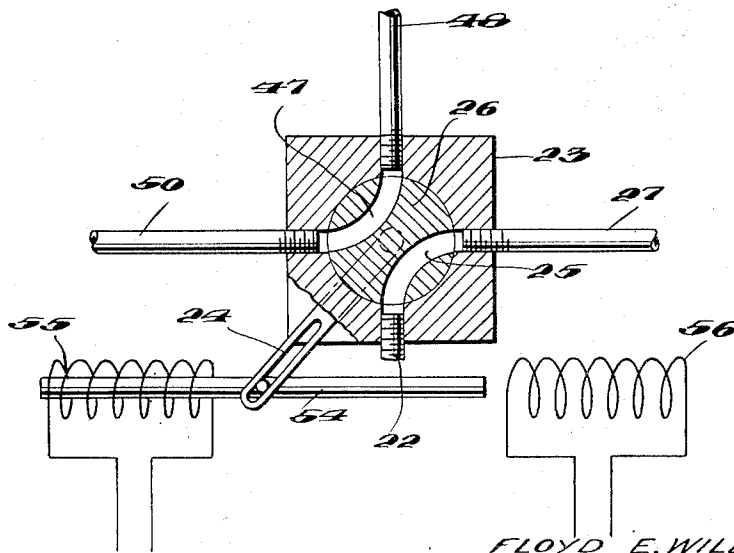


Fig. 3.



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UNITED STATES PATENT OFFICE

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PAINT SUPPLY SYSTEM

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9 Claims. (Cl. 299—58)

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My invention relates to an improved liquid circulating system and more particularly to a closed pressure system in which paint, lacquer, or like fluids, can be kept constantly agitated without the use of a circulating pump.

It is customary practice in the operation of a supply system for paint spray guns to provide a mechanically operated circulating and mixing pump so as to assure a steady flow of fresh paint to the point where it is picked up for use by the gun. Such a system serves a number of useful purposes in that it overcomes the natural tendency of the heavy paint pigments to settle as well as to prevent clogging of the lines which would result if the paint is not circulated. However, one of the problems presented and remaining unsolved by the prior art is that of providing a circulating system capable of satisfactorily circulating paints containing high abrasive materials such as zinc chromate. Paints of this type, known as abrasive paints, have a wide field of application as protective coatings for various metals, but they are so highly abrasive as to quickly wear away and render useless the ordinary system equipped with a circulating pump.

The present invention comprises a supply line adapted to supply paint, or like fluid, to one or more spray guns from sealed storage tanks interconnected with a pressure line control means capable of regulating the pressure in the storage tanks to cause liquid stored therein to flow to and fro through the supply line under constant agitation without exposure to the air or any of the moving parts.

It is among the objects of this invention to provide a liquid supply system in which a liquid is maintained in motion by being automatically forced through a connecting supply line alternately from one storage tank to another.

An object of this invention is to provide a fluid circulating system extremely simple and highly efficient in operation capable of delivering a supply of fluid to a given point as a constantly moving body.

Another object of this invention is to provide a circulating system by which a fluid can be maintained in motion at a predetermined pressure.

A still further object of this invention is to provide a circulating system for use in connection with spray guns in which an air pressure is utilized to constantly agitate the paint by causing it to automatically flow from one storage tank to another thereby preventing the paint from settling and forming into a thickened mass.

Other objects of this invention will become ap-

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parent from the following description when taken in conjunction with the drawings in which like numerals refer to like parts in different views.

In the drawings:

Figure 1 is a diagrammatic view of the circulating and agitating system of this invention.

Figure 2 is an enlarged sectional view of one of the pressure operated control switches.

Figure 3 is an enlarged view of the solenoid operated pressure air valve.

Referring in detail to the drawings, Figure 1 illustrates the system of this invention in which sealed storage tanks 10 and 11 are interconnected by means of a gun supply duct 12. The supply duct 12 is positioned and adapted to be tapped at one or more convenient points by tap fittings 13 supplied with shut-off valves 14 through which connecting hoses 15 supply paint, or like fluid, to the gun 16. The gun 16 is operated by air furnished through air supply line 17 connected to any convenient air supply (not shown).

Suitable sealable openings 59 are provided in the tops of the tanks 10 and 11 for the introduction of the paint to be sprayed. The ends 18 of supply duct 12 are arranged to extend substantially to the bottom of each of the respective tanks with outlets 19 and 45 adapted for removal of the paint as it is forced thereinto under pressure.

Pressure is imposed upon the paint 20 to force it through duct 12 by air introduced into the top of tank 10 through air flow duct 21. Air to operate the system is supplied from a convenient pressure source to air line 22 connecting with a four-way solenoid operated control valve 23 of conventional design. As shown in Figure 1, the solenoid actuated arm 24 of valve 23 has been moved to an extreme left position with passage 25 in the rotor 26 connecting air line 22 with an intervening nipple 27 that extends from the valve 23 to a T fitting 28. The T fitting 28 provides a take-off source for a pressure line 29 which terminates in chamber 30 of the pressure actuated switch 31 (Figure 2). Switch 31, as shown in detail in Figure 2, is formed with two counterpoised bellows 32 and 33 formed with closed cavities as chamber 30 connecting with the pressure line 29 and a second chamber 34 connecting with a tube 35 that provides a passage leading into the bottom of tank 10. The arrangement of the pressure line 29 connecting chamber 30 with the air flow duct 21 and tube 35 connecting the second chamber 34 with the interior of tank 10 is such as to allow for equalization of the pressures in chambers 30 and 34 except for the additional pressure in the second chamber 34 caused by the

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static head of paint 20 in the tank. It is obvious that this difference in pressure will be gradually reduced as paint 20 is forced out of tank 10 through supply duct 12 to the gun 16 with the unused paint flowing into tank 11.

The bellows 32 and 33 are separated by a bellows plate 36 hinged at one end 37 to the housing of switch 31 with the opposite end 38 positioned to bear against a spring contact 39 capable of being moved into contact with an adjustable contact 40 so as to complete the electrical circuit through the switch between wires 41. These two electrical contacts are suitably insulated from the switch case by bushings 43, or like insulating means. This arrangement of counterpoised bellows separated by a plate positioned to actuate switch contacts is utilized to provide a pressure sensitive switch capable of closing an electrical circuit upon the pressure in tank 10 dropping to a pressure equal to or substantially equal to the pressure of the air supply line. The pressure exerted upon bellows 33 by the fluid in chamber 34 connected by tube 35 with the interior of the bottom of tank 10 is equal to the static head of paint 20 in the tank plus the air pressure impressed upon the top of paint 20 introduced through air inlet 42 of duct 21. This pressure is sufficient over the resultant range of pressure established between a full tank and an empty tank to expand bellows 33 moving plate 36 away from spring contact 39 causing the circuit between wires 41 to be broken. As the paint 20 is removed from tank 10, pressure on bellows 33 will be decreased with respect to the air pressure in chamber 30 of bellows 32 and the tendency of the bellows 33 and 32 is to assume their balanced or neutral positions as the pressures in chambers 30 and 34 become balanced. In this neutral position the air pressure in chamber 30 is effective upon plate 36 to force contact 39 against point 40 thereby establishing an electrical circuit therebetween. Means for adjusting the gap between the contact points 39 and 40 is provided in the threaded mounting of the point 40 so that the flow reversal of the fluid may be varied.

When operated normally with paint 20 being forced through duct 12 into the second tank 11, the air remaining in the second tank 11 is allowed to escape back through the air inlet 44 of line 49 and a second nipple 50. Arrangement is made for this escape of air by the provision of a relief valve 46 of conventional design adjacent the control valve 23 and connecting with passage 47 therein through a duct 48. I have found it highly desirable to use a relief valve in which the pressure relief setting may be varied to compensate for variations in the bellows construction and electric switch adjustment.

A second tank 11 is similarly equipped with an air inlet 44 by which air under pressure may be introduced into the top of tank 11, so as to force the excess paint not used by the spray gun 16 back through duct 12 arranged with an apertured end 45 spaced upwardly from the bottom of tank 11. Also, a second pressure actuated switch 52, identical in construction with switch 31, is positioned adjacent the bottom of tank 11 with a conduit 53 leading from the bottom of tank 11 into the bellows of the switch.

Rotation of the control valve 23 is attained by the arrangement of a conventional double acting solenoid in which two field coils are positioned opposite each other to act upon and motivate an armature 54 as each field coil is respectively

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energized by an electrical current. Arm 24 of the control valve 23 is suitably attached to armature 54 so that as the armature is drawn within the left coil 55 arm 24 is moved to the left, to assume the position shown in Figure 1, and vice versa as the armature 54 is drawn within the right coil 56 the arm will be moved to the right.

The solenoid coils 55 and 56 are energized by electrical energy supplied from any suitable source connected to feed circuit 57 equipped with a disconnect switch 58 for disconnecting the system when not in operation. As shown in Figure 1, the electrical circuit to the control switches and solenoid coils is such that with disconnect switch 58 closed the closing of switch 52 adjacent tank 11 will energize the left solenoid coil 55 and the alternate closing of switch 31 adjacent tank 10 will energize the right coil 56.

When ready for operation, the right storage tank is filled with paint 20 to a predetermined level. The static head of this paint, plus the air pressure thereabove, is such as to place sufficient pressure upon bellows 33 of switch 31 to cause expansion thereof, which expansion acts to open contacts 39 and 40 by movement of plate 38 provided with an adjustable stop 60 positioned to restrict movement of the plate to a predetermined limit. The second storage tank 11 being free of paint presents a balanced condition to the switch 52 so as to maintain a neutral attitude with its plate 36 bearing against contact 39 to hold the solenoid 55 and the valve in full line position shown.

Operation of the system is as follows: The electrical circuit 57 is energized by the closing of disconnect switch 58. The control switch 52, being in a closed position, permits electricity to flow through and energize left solenoid coil 55 which acts to rotate rotor 26 of the air control valve 23 to the position shown in Figure 1 with port 25 aligned with air line 22 and passage in nipple 27, and opposite passage 47 aligned with the passage in the second nipple 50 and duct 48 connecting with relief valve 46. Air under pressure is then introduced into air line 22 to be directed through control valve 23 and air flow duct 21 into the top of tank 10. This pressure must be sufficient to force paint 20 upward through duct 12 to supply a gun 16 at a pressure conventional to spray gun operation. The diameter of the pipe 12 is proportional with respect to the demand of the spray guns so that the supply through 12 exceeds the gun demand and the surplus flows into the second tank 11. An air pressure line 29 taken off the air flow duct 21 and terminated in bellows 32 of switch 31 is utilized as a counterbalancing force against any excessive pressure that might otherwise be developed in the opposed bellows 33 connected by tube 35 to the interior of tank 10. During periods of inoperation, or if for any reason air pressure in bellows 32 is dropped, unusual displacement of the bellows is avoided by means of stop 60 adjacent the bellows plate which is adjusted to permit only a predetermined movement of the bellows plate.

Flow of paint 20 from tank 10 will continue until substantially all of the paint 20 is removed therefrom. As the paint level approaches the bottom of the tank 10, the combined pressure of the paint and air acting on switch 31 is reduced to cause the bellows 33 to assume a neutral position whereby plate 36 moves contact 39 into engagement with point 40 closing this electrical circuit to energize right solenoid 56. The static

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head of the paint accumulated in the second tank 11, plus the air pressure maintained by the relief valve is effective to cause switch 52 to open, deenergizing the left hand solenoid coil 55. The right hand coil 56 pulls armature 54 to the right rotating valve 23 to move passage 47 into registration with the air line 22 and the passage leading through second nipple 50 and second line 49 into the second tank 11. Air thus admitted into tank 11 will force paint 29 therein back through supply duct 12 returning any unused portion thereof into the first tank 10. Such rotative movement of the valve 23 brings passage 25 into registration with the passages in nipple 27 and duct 48 allowing for escape of the air in tank 10 displaced therefrom as the level of paint in tank 10 rises. These reoccurring cycles of operation will automatically continue with a change of direction or air flow from one tank to the other determined by the pressure on the pressure responsive control switches placed at the base of each storage tank in the system until substantially all of the paint has been removed by the spray guns. Thus, as long as there remains a sufficient amount of paint in the system to unbalance the control switches, paint will be forced to flow to and fro through the supply line in an agitated condition for use at the guns. By use of the term "substantially all of the paint" is meant all of the paint in the tanks except for that quantity remaining in the tank below the level of the outlets 19 and 45 spaced from the bottom of each respective tank a sufficient distance to allow for the free passage of fluid into said outlets. Test means for determining the paint level in the tanks is provided for by installation of conventional pet cocks 61 in the sides of the tanks at different elevations, as shown in Figure 1. In working operation with the system supplying paint to the spray guns located a considerable distance from the tanks, or at a substantially greater elevation above the tanks, the operating pressure must necessarily be increased in accordance with the lift and friction requirements of the system. However, I have found that with the conventional lay-out with a relatively short supply line that fifteen pounds pressure at the tanks is sufficient and that the control switches unbalance to cause reverse flow of the paint at a pressure differential between the bellows of a fraction of a pound. Such a system assures that the agitated paint will be constantly moved past the spray gun taps providing paint in satisfactory condition for use. By utilizing air under pressure over the liquid surface in the tank as a fluid moving medium the instant invention eliminates revolving or reciprocating pump parts, or sliding surfaces, that would be rapidly worn out by the abrasive pigments carried by the paint.

The arrangement of cut-off valves 62 in the spray duct 12 between each tank 10 and 11 and the spray gun supply taps 13 provides for operation of the system as a standard pressure line spray gun supply system in case it may be desirable to replenish the fluid supply without shutting down the guns. Such simplification of operation is attained by closing the shut-off valve 62 between the tank to be refilled and the spray gun tap so as to remove this tank from pressure operation and by deenergizing the control switches to avoid automatic operation of the system during refilling. With the system in this condition, the closure of the empty tank opening 59 may be readily removed for the admission of an additional supply of fluid after which reclosure of the

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tank, opening of the shut-off valve in the supply duct, and reenergization of the control switches will again return the system to automatic operation, while in the meantime permitting air pressure to be maintained in the other tank to force a supply of fluid to the spray gun 16.

While I have described my invention in detail in its preferred embodiment, it will be obvious to those skilled in the art after understanding my invention that various changes, alterations, modifications and substitutions can be made therein without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. A liquid handling system comprising two tanks, a connecting liquid supply duct with ends terminating near the bottom of each tank, an air pressure inlet into each tank, a source of air pressure, a vent means to atmosphere associated with the inlet to each tank, a diverter valve having opposed passages adapted to alternately connect said air pressure inlets with the source of air pressure and the vent means to lead air pressure into one tank and at the same time vent the other tank, and switch means responsive to a low liquid level condition in each tank connected to a source of electrical supply, a power means associated with said switch means and operatively connected to the diverter valve for movement of said diverter valve to vent the tank having a low level condition and direct air into the opposite tank.

2. A liquid handling system comprising two supply tanks, a connecting liquid supply duct with ends terminating near the bottom of each tank, an air pressure supply, an air pressure inlet into the top of each tank, a vent means to atmosphere associated with each tank, a diverter valve formed with passages adapted for alternate connection of said inlets with the air supply and said vent means to lead air pressure into one tank and at the same time vent the other tank, switch means energized from a source of electrical supply and disposed for actuation in response to a low liquid level condition in each tank, solenoid means operatively connected to the diverter valve and electrically connected in circuit with said switches to operate said diverter valve to successively lead air into each tank to force a liquid from said tank through the duct connecting the tanks with the other tank vented to atmosphere.

3. A liquid handling system comprising two tanks adapted for pressurized operation, a connecting liquid duct with ends terminating near the bottom of each tank, air pressure supply lines leading into said tanks, a source of air supply under pressure, a control valve associated with the supply lines and said air source having a vent to atmosphere and passages disposed for connection with said lines and adapted to alternately direct said air under pressure into each tank and at the same time vent the other tank, valve actuating means having switches in an electrical supply circuit operative in response to a low liquid level condition in each tank and power means associated with the switches and supply circuit operatively connected to the control valve and adapted to operate said control valve to direct air pressure into one tank at a time to force the liquid contained therein through the connecting duct with said other tank vented to atmosphere.

4. A liquid handling system comprising a plurality of closed tanks, a connecting liquid supply duct with ends terminating near the bottom of each tank, an air pressure inlet into each tank,

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a control valve connected between said inlets and a source of air supply under pressure having passages positioned to selectively direct air pressure into said tanks to force the liquid therefrom, a vent means associated with the control valve adapted to release air displaced by movement of said liquid into each tank, and a switch means of an electrical circuit responsive to a low liquid level condition in each tank, and solenoid means disposed for energization from said electrical circuit operatively connected to a control valve.

5. A pressurized paint supply system comprising two supply tanks connected with a supply duct opening into said tanks, a spray gun with supply means connected to said duct, the supply duct being dimensioned to provide flow capacity in excess of the gun supply requirements, an air pressure supply line with inlets leading into the top of each tank, an electrical supply circuit, an electrically actuated control valve connected with said circuit having passages disposed for communication between the air supply and said inlets to selectively direct air from said air supply line under pressure into either tank to force the supply of paint contained therein through the supply duct, vent means associated with said control valve having a passage to atmosphere adapted for communication with the other tank for venting of air displaced by the excess paint deposited therein from said supply duct, switch means responsive to a low level of the paint in either tank connected to selectively energize the electrically actuated control valve to reverse the direction of air flow into and out of the respective tanks for automatic alternate removal of the paint from one tank to the other.

6. A pressurized paint supply system comprising two supply tanks connected together by a supply duct, a spray gun having supply means connected to said duct, said supply duct having a flow capacity in excess of the gun demand, an air pressure supply, an electrically actuated control valve connected with the pressure supply and provided with inlets into each tank, a vent to atmosphere, and passages disposed for selectively connecting either of said inlets to said pressure supply and the other of said inlets to the vent to lead air into one of said tanks while providing vent means for the other tank, an electrical supply circuit, a pair of electrical switches connected to said supply circuit having pressure chambers communicating with the interior of each tank and adapted to close the contacts of the switch of either tank on a drop of pressure therein below a predetermined value due to the removal of paint from said tank to energize the control valve and effect movement thereof to direct a flow of air into the other of said tanks whereby to alternately reverse the flow of the paint through said supply duct.

7. A pressurized paint supply system comprising two supply tanks, a connecting liquid supply duct with open ends terminating near the bottom of each tank, spray gun supply means connecting with said duct, air pressure inlets into each tank, an air pressure supply line, a

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control valve connected with the air supply line having passages adapted for communication between the air inlets and said air supply and the atmosphere to selectively direct air pressure through the pressure inlet to either tank and at the same time vent the inlet of the other tank, an electrical supply circuit, a valve actuating means connected to said electrical supply circuit with switch means responsive to the quantity of paint in each tank, said switch means being arranged to energize said valve actuating means upon removal of substantially all of the paint from the tank under pressure to cause said valve to direct air into the other tank and vent the first tank to atmosphere.

8. A pressurized paint supply system comprising two supply tanks, a connecting liquid supply duct having spray gun tap points spaced from the open ends of said duct with one of said ends positioned in each tank to receive and convey paint between said tanks, an air inlet into each tank, an air pressure supply, a diverter valve having a plurality of passages disposed to selectively direct air under pressure into one of said tanks and at the same time vent the other tank, a source of electrical power supply and power means connected in circuit with switch means responsive to a low liquid level condition in either tank operatively connected to the diverter valve to operate said valve to direct air into the opposite tank and at the same time vent the tank previously communicating with said air pressure supply.

9. A liquid agitating system comprising a plurality of tanks connected with a liquid supply duct having openings spaced from the bottom of each tank, a source of air under pressure, air ducts having open ends opening into each of said tanks, a valve means having passages adapted for movement into communication between said air source and said air ducts to selectively direct air into certain of said tanks, vent means controlled by said valve disposed for selective connection with said air ducts to at the same time vent the other of said tanks to atmosphere, a source of electrical supply, an electrical power means in electrical circuit with said source of electrical supply positioned for movement of said valve on closure of said circuit, switch means associated with the tanks and disposed to close the circuit to said power means on removal of liquid from one of said tanks below a predetermined level for operation of the valve to selectively disconnect said tank from the air source and vent said tank to atmosphere.

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