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[54] **WHITEPRINT DUPLICATING MACHINE LIQUID SUPPLY SYSTEM**
 3 Claims, 1 Drawing Fig.

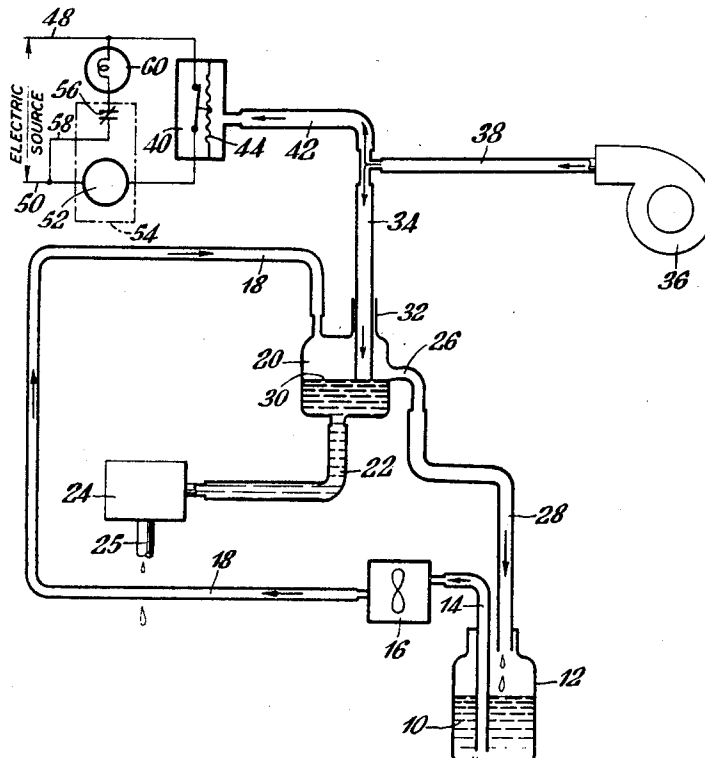
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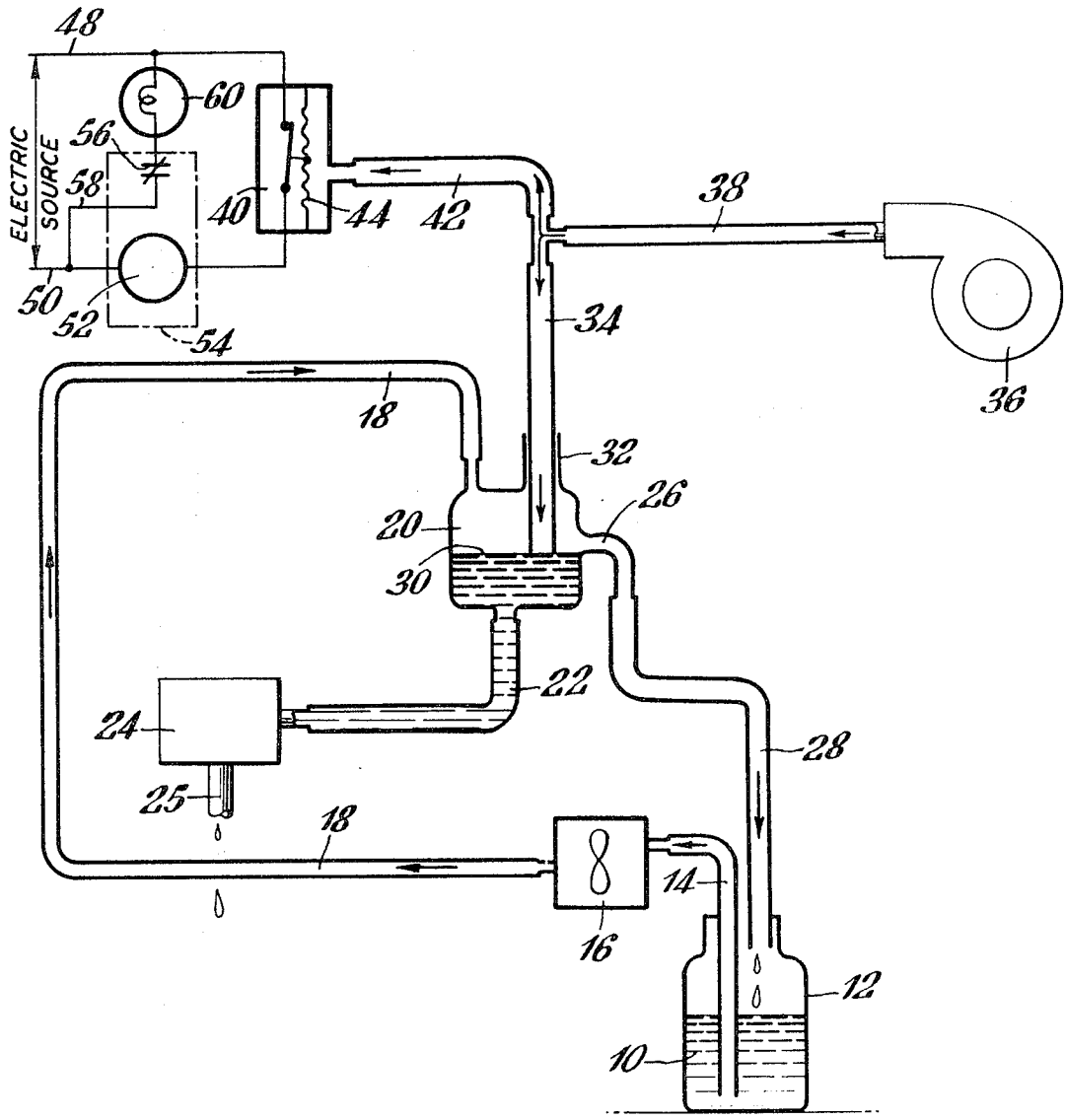
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ABSTRACT: Liquid developer is piped through a metering device to which the liquid flows by gravity from a reservoir. The open lower end of a vertical air pipe extends downwardly into such reservoir, terminating at the normal level of the liquid therein. Liquid is supplied to the reservoir from a liquid supply container through a conduit containing a pump which elevates the liquid from the bottom of the container to the top of the reservoir. An overflow outlet in the side of the reservoir returns any liquid rising above such normal level back to the reservoir. An overflow outlet in the side of the reservoir returns any liquid rising above such normal level back to the container by gravity. The upper end of the air pipe is in closed air communication with an air pressure sensitive switch and a source of air, under pressure, preferably the blower, or air exhaust of the machine. Thus, should the liquid level in the reservoir fall below the vertical air pipe, air flows out of the pipe, and thereby lowers the air pressure effectively acting on the switch. This, in turn, operates a fail-safe relay, and the latter closes contacts to apply electrical current to a suitable signal device, such as a lamp, buzzer, indicating the low status of the liquid developer in the system.



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WHITEPRINT DUPLICATING MACHINE LIQUID SUPPLY SYSTEM

This invention relates to automatic copying machines, and more particularly to the liquid developer supply systems of whiteprint duplicating machines.

While float controlled valves are well known for shutting down a copying machine when the level of the liquid in a developer tank falls below a desired level, they are not entirely satisfactory due to sticking in use.

Therefore, the main object of this invention is to provide a novel liquid supply system which entirely avoids the use of float controlled valves, by air pressure sensitive means for monitoring the liquid level of the available liquid developer, and indicating when such liquid falls below a safe level.

Another object is to provide a low liquid level indicator which avoids the use of any moving mechanical parts, such as floats.

A further object is to provide a liquid developer supply system for whiteprint duplicating machines, that is simple, yet safe, and more efficient and effective than any known to the prior art.

The system comprises a liquid section and an air section. The liquid section includes a liquid supply container, a reservoir located above such container, a metering device located below the reservoir, a conduit including a pump for drawing liquid from the bottom of the container to the top of the reservoir, and an overflow outlet in the side of the reservoir for determining the normal level of the liquid therein. A pipe connects the bottom of the reservoir to the metering device, and another pipe returns any overflow of the liquid back to the top of the container.

The air section of the system comprises a vertical air pipe the lower open end of which is positioned so that it is closed by the liquid in the reservoir when at the desired normal level as determined by the lateral overflow outlet. Such air pipe is in communication with a suitable source of air under pressure, and with a pressure sensitive switch. Thus, when the level of liquid in the reservoir falls below the air pipe, the resulting drop in air pressure causes the switch to operate and, in turn, result in the setting off of any suitable low liquid level indicating device, or stopping of the machine, or a part thereof such as the liquid evaporator heater.

An unexpected advantage of the invention is that the pressure sensitive switch is also operative in case of failure of the air pressure supply, such as the blower, setting off the indicator, or alarm as in the case of a low liquid supply.

In any event the invention avoids the use of liquid level float controlled valves along with the sticking and/or fouling troubles associated therewith.

In the drawing, the single FIGURE is a schematic diagram illustrative of the invention.

Liquid 10 is drawn from near the bottom of a liquid supply container 12 through a pipe 14 by a liquid pump 16 and pumped upwardly through a conduit 18 which discharges into the top of a reservoir 20 located above the container 12. From the reservoir such liquid 10 flows downwardly through an outlet pipe 22 at bottom thereof to a metering device 24 from which the liquid is fed through pipe 25 to the developer (not shown) of the duplicating machine. In order always to provide a sufficient amount of liquid in the reservoir 20, the pump 16 is operated to deliver more than the maximum amount of liquid needed by the metering device 24, and the excess liquid is returned to the liquid supply container 12 through a lateral overflow outlet 26 located in the side of reservoir 20, which is connected to the container 12 by a liquid return tube 28. The overflow outlet 26 also serves to maintain a normal or constant liquid level 30 in the reservoir 20. Such level serves to indicate the liquid supply.

Through a throat 32 in the top of the reservoir 20 a vertical air pipe 34 depends so that the throat 32 is also open to the atmosphere. The lower end of the air pipe 34 normally is closed by the liquid level 30 in the reservoir 20. The air pipe 34 is in closed air communication with a source 36 of air under pres-

sure through pipe 38, and an air pressure sensitive switch 40 via pipe 42. The switch 40 is connected to a diaphragm 44 in an air closed air chamber, so that as long as the air pressure therein is maintained by the source 36 with the lower end of the pipe 34 closed by the liquid level 30, the switch is also kept closed. The air pressure is very low and only a small amount of air is required from the source 36. Such source 36 may be any suitable one available in the machine, such as the air blower, or air exhaust thereof.

The switch 40 is connected to leads 48 and 50 of a suitable source of electric power through coil 52 of a fail-safe relay 54 the normally closed contacts 56 of which are opened by the resulting energization of such coil 52. The contacts are in a circuit 58 which also contains a lamp 60 which lights when the contacts 56 close due to the opening of switch 40 when the air pressure in pipe 42 drops. Such air pressure drops when the liquid level 30 in reservoir 20 falls below its normal position and opens the lower end of the pipe 34 to the atmosphere.

The lamp 60 is only an example of a low liquid supply indicator. Other types include buzzers and horns. Also the circuit 58 may also control the operation of any vital part of the machine, such as the liquid evaporator heater (not shown).

In operation liquid developer 10 is pumped from the liquid supply container 12 by the liquid pump 16 into the liquid supply gauge reservoir 20. Required quantity of liquid is then metered through the metering device 24 and fed to the developer. In order always to have a sufficient amount of liquid in the liquid supply gauge and reservoir 20, the pump 16 is made to deliver more than the maximum amount of liquid needed, and the excess liquid is allowed to return to the liquid supply container 12 through tube 28.

Source 36 supplies a very small amount of air at very low pressure through pipe 38. When the liquid level 30 is at the level where liquid is overflowing, the lower end of pipe 34 is blocked off by the liquid and the air pressure is exerted against the diaphragm 44.

When the liquid level 30 in the reservoir 20 goes down due to lack of liquid 10 or some other reason, such as a vapor lock, the lower end of pipe 34 is opened to the atmosphere, allowing the air pressure to vent into atmosphere, rather than against diaphragm 44. This causes switch 40 to open, thereby deenergizing the coil 52 and closing the contacts 56 of relay 54, resulting in placing the lamp in the "ON" position. The operator then sees the light and refills the supply container 12, or remedies any other problem that may exist.

This invention greatly reduces the down time of the machine by always notifying the operator immediately when the liquid supply has run out.

Also, it serves to prevent any undue damages to vital elements, such as the liquid evaporator of the machine.

What we claim is:

1. A liquid supply indicator for the liquid developer supply system of whiteprint duplicating machines, comprising: a metering device for supplying liquid to a developer; a liquid reservoir for feeding liquid by gravity to said device; a liquid supply container located below said reservoir; means including a liquid pump for conveying liquid from the bottom of said container to the top of said reservoir; a low liquid level indicator; an air pressure sensitive switch; and means including an air pressure supply for applying a small amount of air under very low pressure in parallel to said switch and to a selected level of the liquid in said reservoir which is open to the atmosphere, whereby in case such selected level falls therebelow, such air under pressure is vented, causing the air pressure applied to said switch to drop, operating the switch, and energizing the indicator, thereby indicating such low level condition of the liquid in the reservoir.
2. The invention as defined by claim 1, wherein: the air pressure sensitive switch includes a diaphragm comprising a wall of a closed chamber that is in closed air communication with a vertical pipe the lower end of

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which normally is closed by the level of the liquid in said reservoir, so that the normal air pressure is sufficient in the chamber to keep said switch closed, and fail-safe relay means operative upon the opening of said

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switch to connect said indicator to a source of electrical power.

3. The invention as defined by claim 2, wherein:
the air pressure supply comprises the machine air exhaust.

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