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G. MATKOVICH ET AL

3,468,604

LIQUID LEVEL INDICATOR MEANS

Filed May 31, 1966

2 Sheets-Sheet 1

Fig. 1

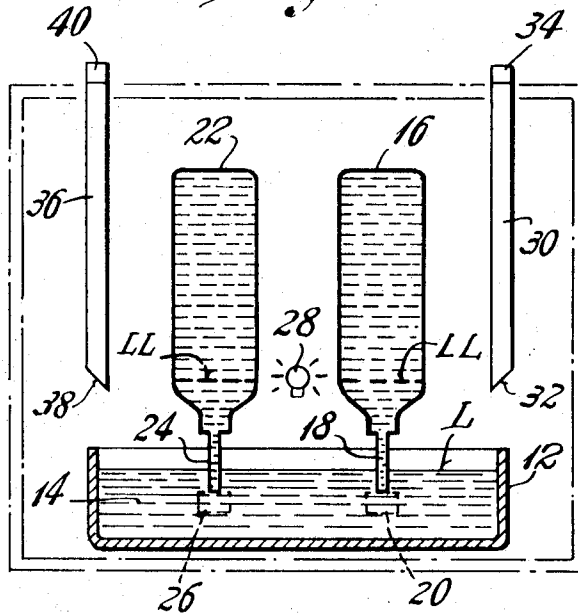
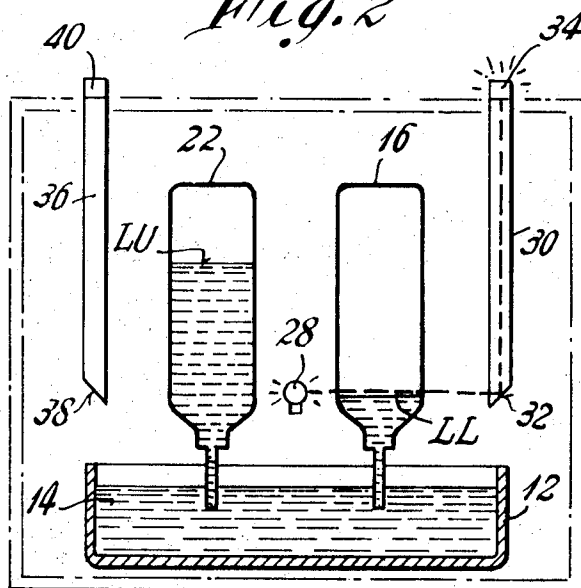


Fig. 2



INVENTORS
George Matkovich
Walter J. Hanson
BY
Charles J. Trickey
ATTORNEY

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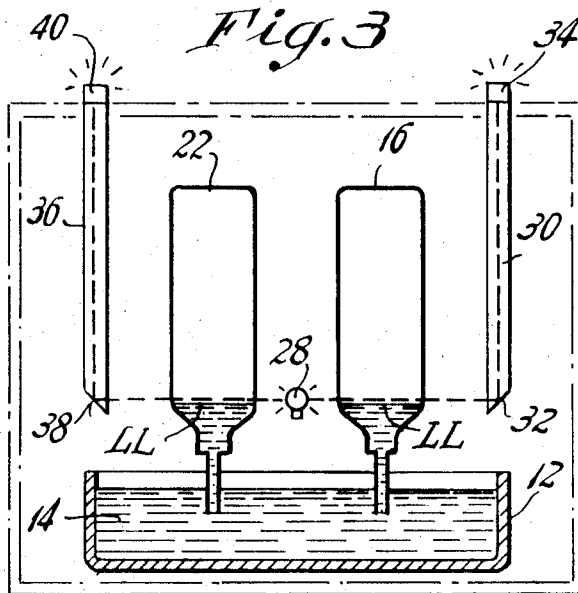
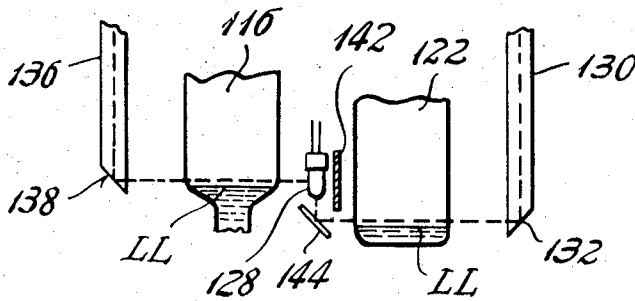


Fig. 4



INVENTORS
George Matkovich
Walter J. Hanson
BY
Charles J. Frickey
ATTORNEY

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LIQUID LEVEL INDICATOR MEANS

George Matkovich, Stamford, and Walter J. Hanson, Old Greenwich, Conn., assignors to Pitney-Bowes, Inc., Stamford, Conn., a corporation of Delaware
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8 Claims

ABSTRACT OF THE DISCLOSURE

A liquid level indicating means for use in an electro-photographic copying machine having a developing tank and containers associated therewith for replenishing the supply of developing liquid and toner intensifier as these are depleted in the tank. A light source is directed through the separate containers so as to be visible to an operator of the machine only when the level of liquid in the respective containers drops below a predetermined level, thereby indicating the need for replacement of one or both containers.

This invention relates to apparatus for indicating the level of liquid in containers, and more particularly to containers in a photocopy machine for providing developing fluids to a developing tank. The invention more specifically relate to mean to indicate the level of liquid toner and concentrate in an electrophotographic copying machine.

Machines are known in the prior art for producing copies of original documents based on the electrostatic principle. In one such type of machine, a copy is made directly on a copy paper having a photoconductive layer, e.g. zinc oxides in a resinous binder. The paper is first given an electrical charge on the photoconductive layer, usually by means of a corona discharge device. The charged sheet is then exposed to a light image caused by shining light on the original document to be copied so as to cast light from the image onto the copy paper. Light will be reflected in the light background areas of the original, but not from the dark image areas.

Where the reflected light strikes the charged copy sheet, the photoconductive layer will become conductive, and the electrostatic charge will be dissipated, leaving an electrostatic charge pattern on the sheet corresponding to the original image. The latent electrostatic image is then developed by application of finely divided toner powder having a charge opposite to the electrostatic image on the copy paper.

The toner may be finely divided particulate material suspended in a dielectric liquid, for example carbon black in kerosene. Development then takes place by bringing the photoconductive layer into contact with the developer fluid either by immersion of the paper in the fluid or by applying the fluid to the coated side of the paper by any other suitable means. In liquid development, it is generally the practice to put a negative charge on the copy paper and develop the image with positively charged toner. In machines using liquid toner developer, the developer is usually in a tank, and provision is made for adding additional toner to replace fluid which evaporates due to its volatile nature. It has been proposed to add additional toner from a container automatically as the level in the developing tank requires.

In the development of images, toner particles are attracted from suspension in the dielectric liquid to the charged areas of the copy paper and deposited there. Thus, as copies are developed, the amount of particles suspended in the liquid toner becomes less. With less concentration of toner particles, the developed image be-

comes less black since not as much can be deposited on the image areas. It is therefore preferable to add toner particles to the toner tank bath as needed to maintain the concentration at the necessary level.

Moreover, in order to maintain the concentration of toner particles in the liquid, which are removed in the development of images, it has been proposed to add periodically toner concentrate which is a paste-like mixture of toner particles in a small amount of the dielectric liquid used in the liquid toner.

Where the toner liquid and toner concentrates are added automatically, they are generally provided in containers which are replaced with full containers when empty. Thus it is convenient to know the amount of material remaining in the containers for toner liquid and toner concentrate. In prior art machine, this could be determined by opening the cover of the machine and visually inspecting the containers. However, where this is overlooked, the containers can become empty with the result that the toner system begins to operate less efficiently since the toner particles are depleted and the copies become poorer.

It is therefore an object of thi invention to provide a simple apparatus to indicate the liquid level in a supply container in a copying machine.

A further object is to provide an indicating means for showing liquid levels in a supply container in a copying machine, where the indicating means is readily visible outside the machine without it being necessary to disturb the machine covers.

Another object is to provide a simple apparatus to indicate fluid level in a multiple number of containers.

A further object is to provide apparatus for visually indicating when the liquid level in containers in a copying machine has reached a predetermined level.

These and other objects of my invention will become more apparent as the description thereof proceeds.

My invention consists of providing the fluids to be added to the developer tank in translucent containers and shining a beam of light on the side of the containers at the predetermined minimum level where replacement of the container will be necessary. The light is of such intensity that it will not pass through the dark toner solution or concentrate. However, when the liquid level in a container has reached a level below the light beam, the light passes through the translucent container. The beam is picked up by a light guide such as a lucite rod, which terminates at the cover of the machine where it is visible through an opening in the cover. Fiber optic elements could also be used to conduct the light. By means of one light between two containers, and a separate light guide element on the side of each container opposite from the light, it is possible to determine when the replacement level has been reached in both a toner container and a concentrate container. Although the containers may individually reach the replacement level at different times, it is of no consequence since the single light between them shines only through the empty translucent container onto its respective light guide element and indicates visually at the end of the element at the machine cover, that the particular container has reached the predetermined level for replacement.

In the drawings, which represent certain specific embodiments of the invention,

FIGURE 1 shows a diagrammatic elevational view of the indicating apparatus when the liquid in the containers has not reached replacement level.

FIGURE 2 shows diagrammatically the apparatus of FIG. 1 when one container has reached replacement level and the corresponding indicator element is lit.

FIGURE 3 shows diagrammatically the apparatus of

FIG. 1 when both containers have reached the replacement level, and both indicating elements are lighted.

FIGURE 4 shows a second embodiment where the level for replacement is different in each of the two containers.

Referring to FIGURE 1, the cover a photocopy machine 10 is represented by broken lines. A toner tank 12 of any suitable nonconductive material, such as a suitable plastic, is located in the base of the copy machine. It will be understood that the toner tank may be located in any convenient location within the machine. Tank 12 contains a toner liquid developing bath 14 which is maintained at level L for development of latent electrostatic images on copy paper which is pressed through liquid 14 beneath surface L by means not shown, but which is well known in the art, such as guides and rollers.

In order to maintain the toner liquid level at L, a container 16 containing an amount of the same toner liquid as in toner bath 14 is provided to add toner when the toner level goes below L due to evaporation of the toner liquid 14 due to its inherent volatility and also to carry over on the copy paper surface. Toner is added from container 16 through tube 18 and an automatic dispensing means 20 shown diagrammatically which operates in response to the lowering of the level of toner in tank 12 to a desired predetermined minimum level.

A second container 22 is provided for toner intensifier, similar in composition to the toner liquid but with a higher concentration of solids, which is added to toner 14 in tank 12 periodically to maintain the density of toner particles in toner bath 14. The intensifier is added by means of a feed nozzle 24 and a control means 26, shown diagrammatically. Control means 26 can be operated manually as desired by the operator or periodically by means not shown which may be operated by the machine drive.

Both containers 16 and 22 are made of a translucent material, for example clear polypropylene. A source of light 28 is positioned between the containers in such a way that it can shine through both containers 16 and 22. When the liquids in both containers are above the height of light 28, they are of sufficient darkness that light 28 cannot shine through the containers. When the fluids at a level below the height of lamp 28, at level LL, the light will then shine through the translucent containers. On the opposite side of container 16 from light 28 is a light guide element 30 which has a plane surface 32 at an angle towards container 16 and a plane surface 34 at the top projecting from cover 10 of the machine or flush with the cover. Where the surface 34 projects from cover 10, it may be bevelled to project towards the operator position of the machine for better visibility. Alternatively, the entire guide may be bent toward the operator to project light in that direction. A similar light guide element 36 is on the opposite side of container 22 and has sloping plane surface 38 and upper plane surface 40 at cover 10.

As shown in FIGURE 2, when the toner in container 16 has reached level LL because of repeated additions to toner bath 14, light 28 shines through container 16, reflects off plane surface 32 and is reflected up the light guide element 30 to indicator plane 34 and serves as an indication that container 16 has reached the level where replacement is necessary. This indication is readily visible outside the machine, and plane 34 could be colored or masked to more readily attract attention.

Since the intensifier level in container 22 is at LU above the level of light 28, no light shines through the light guide element 36 and plane 40, the indicator for container 22, remains unlit, showing that the intensifier in container 22 has not reached the level for replacement. In FIGURE 3, both containers 16 and 22 have reached the level LL and the light 38 shines through both containers 16 and 22, reflects off of plane 32 and 36 of light guide elements 30 and 36 respectively and lights up indi-

cators 34 and 40 to indicate need for replacement of both containers.

It will be obvious that either container 16 or 22, can reach level LL first depending on the manner of use of the machine, or as shown both may need replacement at the same time.

In FIGURE 4, is shown another embodiment of the invention shown in FIG. 1. In FIG. 4, the containers are placed in the machine with one upside down and the other right side up. Container 116 is inverted and feeds a liquid as in FIG. 1 controlled by the level L of the liquid 14 in tank 12. Container 122 is upright and feeds by a pumping means and overflow tube not shown. In this case, due to the configuration, level LL of container 122 will be farther down below level LL of container 116 when each has reached the replacement quantity. Here, light 128 would shine through container 122 before replacement was actually necessary. A baffle plate 142 prevents the light from shining through container 122 at the level of light 128. Instead, light 128 is reflected from a mirror 144 below light 128, then through container 122, off of plane 132 and up light guide element 130. In order to position plane 132 opposite mirror 144, light guide element is longer than element 136. Light 128 passes through container 117 and reflects off of plane 138 and up light guide element 136 in the same manner as in the embodiment of FIG. 1.

While containers 16 and 22 have been described as translucent so as to transmit light, it is also contemplated within the scope of the invention that the containers are completely transparent. With transparent containers, an actual image of the liquid level will be displayed for containers 16 and 22 at indicator faces 34 and 40 respectively, thus indicating to the operator the actual level of the liquid in the containers before the level has completely reached level LL.

The invention provides a simple apparatus for indicating in a copying machine when fluid containers need to be replaced. It will moreover be obvious that the light guides may take any suitable shape and may terminate at any suitable position at the cover of the machine.

The inventive indicating system has an additional advantage. In the event that the machine has been idle for some time, the toner particles will settle in the liquid dispersant. The indicators would thus be lit when the machine was started since the light would shine through the clear dispersant. Thus, the operator would be informed that the containers were not in proper working order.

While I have described certain specific embodiments and preferred modes of practice of my invention, it will be understood that this is solely for illustration and that various changes and modifications can be made without departing from the spirit of the disclosure and the scope of the pending claims.

What is claimed is:

1. In an electrophotographic copying machine having a developing tank, means for adding liquid toner to said tank to maintain an operating level of said liquid toner in said tank and means for adding liquid toner intensifier to said tank to maintain an operating intensity of said liquid toner intensifier in said tank, the combination therewith of means to indicate the level of liquid in said means for adding liquid toner and liquid toner intensifier comprising,

a light transmitting container for storing a supply of said liquid toner and a light transmitting container for storing a supply of said liquid toner intensifier, said containers being arranged side by side and spaced apart in said copying machine;

a source of light disposed between said containers; means at the side of each container opposite said source of light for receiving light therethrough when said light is not obstructed by liquid in said containers

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and for transmitting said light externally of said copying machine; and
 a display means for indicating externally of said copying machine the transmission of light from either of said light receiving means.

2. The combination according to claim 1 wherein said light source is disposed between said containers at a predetermined location between the top and bottom of said containers and is arranged to shine light through said containers at said predetermined location to indicate when the level of liquid in each container is at said predetermined location.

3. The combination of claim 2 wherein said predetermined location of said light source is adjacent to the lower end of said containers.

4. In an electrophotographic copying machine having a developing tank, means to add liquid toner to said tank and means to add liquid toner intensifier to said tank to maintain an operating level in said tank;

means to indicate one predetermined level of liquid in said means for adding dispersant and a different predetermined level in said means for adding intensifier comprising,

a light transmitting container for said toner and a light transmitting container for said intensifier; said containers being arranged side by side and spaced apart;

a source of light between said containers;

means to maintain said source of light when said machine is operating;

means at the side of one container opposite said source of light to receive light therefrom and transmit light and a display means to indicate

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transmission of light from said light receiving means;

means for projecting light from said source of light through said other container at a different level from the level of said light source;

means at the side of said other container opposite said means for projecting light to receive light and transmit light, and a display means to indicate transmission of light by said light receiving means opposite said other container.

5. The indicating means of claim 4 wherein said light projecting means is a reflector.

6. The indicating means of claim 4 wherein said light receiving, transmitting and display means are a light guide element.

7. The indicating means of claim 4 wherein said light guide element is Lucite.

8. The indicating means of claim 4 wherein said display means is visible at the cover of said machine.

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JOHN M. HORAN, Primary Examiner

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