A three piece developer tank and trough assembly, for use in connection with an electrostatic photocopy machine, has a two piece trough member nested within a tank having a developer fluid therein. The trough member includes, as one of its members, paper guide means removably mounted therein, and such subassembly is removably mounted in the tank. Pump means delivers developer fluid from the tank to the trough and paper guide means during operation of the machine. The three pieces are held together in assembled relation preferably by quickly removable fastening means, such as spring clips.

2 Claims, 6 Drawing Figures
DEVELOPER TANK AND TROUGH ASSEMBLY

BACKGROUND OF THE INVENTION

The invention relates in general to electrostatic copiers and particularly to a novel tank and trough assembly for use in such machines, which is economical to manufacture, easy to assemble and which may be quickly disassembled for cleaning and like purposes.

The liquid toner used in electrostatic copiers has the toner particles in suspension, and it has become the practice to use pump means for pumping the liquid toner during use of the machine from a storage tank to a trough through which the copy paper passes, and from which it drains back into the tank, thereby keeping the toner agitated and the particles in suspension during use.

Various arrangements to accomplish this result have been provided in the past, an example of which is shown in the U.S. Pat. to Tiger, et al., No. 3,461,788. In such prior art structures, however, the trough and paper guide have been formed integrally with each other, and, although separable from the tank in which it is mounted, it is nevertheless not easily and quickly removed.

Toner particles tend to separate out from the carrier and adhere to parts of the tank and trough when not in use, thereby necessitating cleaning of the parts frequently, and it is advantageous to be able to do this quickly and to separate all of the parts from each other for a more thorough cleaning.

BRIEF SUMMARY OF THE INVENTION

The invention provides a three piece assembly of a tank, a trough and a paper guide for use in electrostatic photocopying machines, and a principal object is to provide such an assembly which is economical to manufacture and which may be easily and quickly assembled and disassembled.

Another object of the invention is to provide a tank for containing a quantity of developer fluid in which a plurality of supports are located for supporting thereon a trough on which is mounted pump means for pumping fluid from the tank to the trough while the machine is in use.

A further object is to provide quickly releasable fastening means for securing the trough in place within the tank and for securing the paper guide means within the trough.

Still another object of the invention is to provide a trough with overflow means, thereby to limit the depth of the developer fluid in the trough and consequently in the paper guide.

Other objects and purposes of the invention will appear more fully as the description proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view through the assembled tank, trough and paper guide embodying the present invention and which is taken along the plane of line 1—1 of FIG. 2;

FIG. 2 is a longitudinal vertical sectional view through the assembly of FIG. 1;

FIG. 3 is a top plan view of the assembly with a part of the trough broken away to show certain details;

FIG. 4 is an enlarged fragmentary sectional view illustrating an alternative form for connecting the pump to the trough;

FIG. 5 is an exploded view in transverse section of the tank, trough and paper guide and taken along the plane of line 5—5 of FIG. 2; and

FIG. 6 is an enlarged fragmentary sectional view of the right end of FIG. 1 showing one of the removable fastening means for securing the trough in place in the tank.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment of the invention as illustrated herein, referring particularly to FIGS. 1 and 5, the tank is indicated generally by the numeral 1, the trough by the numeral 2, and the paper guide by the numeral 3. FIG. 5 illustrates each of these members separately in an exploded fashion, and FIG. 1 shows these same members in assembled relation. It will be noted that the paper guide 3 is nested within the trough 2 which, in turn, is supported within the tank 1.

The tank includes a bottom 4, end walls 5 and 6, a front wall 7, and a rear wall 8. A plurality of relatively thin fin members are formed preferably integrally with the walls of the tank and extend inwardly therefrom for the purpose of supporting the trough thereon. It will be evident that the placement of these fins must be such as to be able to engage the underside of the trough at suitable locations so as to rigidly support the trough within the tank.

These fins are preferably formed as an integral part of the walls and two of these fins 9 and 10 are shown as being integral with the end wall 5 and extending inwardly therefrom. Similar supporting fins 11 and 12 extend inwardly from the end wall 6. Fins 13, 14 and 15 are provided as an integral part of the front wall 7 and extend inwardly therefrom. The rear wall 8 has as an integral part thereof similar fins 16, 17 and 18 extending inwardly therefrom. In FIG. 1 it will be noted that the fins 14 and 17 may be seen in elevation and in FIG. 2 the fins 9 and 11 may likewise be seen in elevation.

The front and rear walls 7 and 8 of the tank 1 preferably slope upwardly and outwardly from the bottom 5 to enable the trough to be nested therein. The front and rear walls 5 and 6 likewise slope outwardly and upwardly. The front wall 5, however, has an outwardly flared portion 19 and the wall then continues upwardly at a lesser angle to provide the portion 20. In a similar manner the rear wall 6 has the outwardly flared part 21 between the top and bottom thereof whereupon the wall then continues upwardly as at 22. This construction enables the supporting fins 9, 10, 11 and 12 to be formed in the upper part of the wall portions 20 and 22 and with the outwardly flared parts 19 and 21 so that the inner edge of these fins appear as a continuation of the lower parts of the walls 5 and 6.

The trough 2 is provided at the front part thereof with a relatively wide ledge 23 and at the rear part thereof with a narrower ledge 24. The forward ledge 23 rests upon the fins 13, 14 and 15, while the rear ledge 24 is adapted to rest upon the rear fins 16, 17 and 18. Between the front and rear ledges 23 and 24 the trough is provided with a bottom part 25 which, as will be seen in FIG. 1, slopes downwardly and forwardly. Also, as may be seen in FIG. 2 the bottom 25 slopes inwardly and downwardly from both ends thereof toward a centrally disposed inlet-outlet opening 26 to which is connected a flexible hose 27. The other end of the hose is
connected in a suitable manner with a pump 28 driven by a motor 29, said motor and pump being mounted upon the forward ledge 23. In operation, the motor drives the pump which pumps fluid in the tank 1 upwardly into the trough 2 through the opening 26. Baffle members 30 extend downwardly from the underside of the trough and extend from front to rear to help prevent splashing of the developer fluid as it is pumped into the trough.

The ends of the trough are likewise supported on fins connected with the end walls, as may be more clearly seen in FIG. 3. For example, one end of the rear ledge 24 rests upon the fin 10 and the other end is supported by the fin 12. At the front of the assembly one end of the ledge 23 is supported by the fin 9, while the other end is supported by the fin 11. Another baffle 31 extends between the ends of the trough and extends downwardly therefrom to aid the baffles 30 in preventing splashing of the developer fluid as it is being pumped into the trough.

The ledge 23 also provides a support for other parts of the device which form no part of the present invention. For example, a fluid developer level indicator 32 may be mounted thereon as well as a rotatable gate 33 which may be opened to permit the addition of toner if desired.

The trough 2 is also provided with a pair of upwardly extending walls 34 and 35, the wall 34 extending upwardly from the rear edge of the ledge 23 and the wall 35 extending upwardly from the forward edge of the ledge 24. The paper guide 3 is provided with a contoured bottom 36 which accepts the exposed copy sheet having a latent image thereon and guides it by suitable drive rollers through the developer fluid which is in the trough and at a level above the bottom 36. Said bottom is provided with a plurality of openings 37 each positioned between a pair of ribs 38 extending angularly from front to rear of the paper guide as shown in FIG. 3. Developer fluid pumped from the tank 1 into the trough 2 will also pass upwardly through the openings 37 as the level of the fluid is rising so that the fluid will also be above the bottom 36 of the paper guide 3 enabling the exposed paper to pass therethrough and having the image thereon developed. When the machine is turned off and the pump is not operating, fluid then will drain downwardly through the openings 37 and through the opening 26 in the trough back to the tank.

The level of the liquid toner in the trough and paper guide is controlled by reason of the fact that the rear ledge 24 has portions thereof which slope downwardly toward openings therethrough, or cut-out portions, which allow the fluid to drain back into the tank. For example, viewing FIG. 3, the ledge 24 may have the two areas 39 and 40 slope downwardly and rearwardly in the manner shown in FIG. 5, and the rear edge of the ledge 24 may have the cut-out portions 41 and 42 in the respective areas 39 and 40. Also, the rear wall 35 of the trough has cut-away portions or openings 35a in the vicinity of the areas 39 and 40, as shown, for example, in FIG. 5, so that when the level of the fluid reaches this depth it will overflow through the openings 35a to the areas 39 and 40 and through the openings 41 and 42 back to the tank.

The paper guide means 3 is provided at each end thereof with a plurality of abutment members which cooperate with releasable retaining means to hold the paper guide and trough in assembled relation. There may be one or more of these abutment members, as desired, at each end of the trough, but for purposes of illustration there is shown herein a forward abutment member 43 and a rear abutment member 44 at each end of the paper guide. While it will be evident that the specific form of the quickly releasable retaining means may vary, nevertheless the preferred form, as shown herein, constitutes in each instance a spring clip member. One of these members may be seen in its entirety in FIG. 6 and is identified by the numeral 45. This particular spring clip may also be seen at the rear of the assembly and is the left-hand one shown in FIG. 3. There are two such spring clips or other suitable type of releasable retaining means at the rear of the assembly, the other one being indicated by the numeral 46. The portion of the rear wall 8 intermediate the ends thereof extends upwardly as shown in FIG. 3 so that only the front and rear sides of the spring clip may be seen in FIGS. 1 and 6.

Similar retaining means 47 and 48 are provided at the front of the assembly, as may be seen in FIGS. 1 and 3, and bear at their inner portions against the ledge 23 to hold it in place.

The trough 2 in addition to the front and rear walls 34 and 35, respectively, is also provided with end walls 49 and 50. Similar quick-release retaining means 51 and 52 are provided at one end of the assembly, and like retaining means 53 and 54 are located at the other end. These four retaining members or spring clips receive the upper edge of the walls 49 and 50 between the resilient legs thereof, and the inner legs of these spring clips bear against the aforementioned abutments. For example, as may be seen in FIG. 1 the retaining 51 bears against the upper edge of the abutment 43 on the paper guide, and retaining 52 bears against the upper edge of the abutment 44 of the paper guide. The retainers 53 and 54 likewise bear against the abutments at the other end of the paper guide and, as may be seen in FIG. 3, are identified by the numerals 55 and 56.

Thus it will be evident that, from viewing FIG. 1, the upper front and rear edges of the paper guide extend outwardly as at 57 and 58 to provide a ledge adapted to rest upon the upper edge of the front and rear wall members 34 and 35. This permits the paper guide to be inserted within the confines of the trough. The members 51-54 act as quickly releasable retainers members to securely hold the paper guide in assembled relation with respect to the trough.

In a similar manner the spring clip or quickly releasable retaining means 45-48 will maintain the trough and paper guide assembly in assembled relationship with the tank. When it is desirable to disassemble these parts it is only necessary to remove these clips and separate the trough subassembly manually. The subassembly of the paper guide with the trough has the advantage that, if it is desired to clean the trough or for some reason gain access thereto it is merely necessary to remove the four clips 51-54 and lift out the paper guide and permit the trough to remain in assembled relation with the tank. On the other hand, if it is desired to gain access to the tank, then the retainers 45-48 can be quickly removed and the subassembly of the paper guide and trough may be removed therefrom.

Referring for a moment to FIG. 4, there is illustrated a modified or alternative form of hose connection between the pump and the trough from that disclosed in
FIGS. 1 to 3. In this instance instead of there being an opening 26 in the vertical wall of the trough there is an opening 26a extending through the bottom 25 of the trough. The flexible hose 27 may still be connected from the pump to the opening 26a in substantially the same manner as that described heretofore.

From the foregoing it will be evident that we have provided a novel developer tank and trough assembly construction for use in photocopy machines, particularly in two respects. One novel feature resides in the provision of a three piece assembly whereby the paper guide is not an integral part of the trough but may easily and quickly be removed therefrom, and wherein the trough may be assembled and disassembled from the tank. Thus, if it is desired to gain access to the trough only, then the paper guide may be removed by itself. Furthermore, this construction has the advantage that all three parts may be separated for purposes of cleaning which is not possible when the paper guide and trough are formed as an integral unit.

Still further, the other feature is the novel releasable retaining means utilized herein for maintaining the paper guide in assembled relation with the trough, and for maintaining the trough in assembled relation with the tank. Any or all of these parts may be quickly disassembled without the use of tools, which is time-consuming as far as the operator of the machine is concerned, because such tools are not always available and when they are the removal of fastening means by the use of tools always takes more time than the mere manual removal of a spring clip.

Changes may be made in the form, construction and arrangement of parts from those disclosed herein without in any way departing from the spirit of the invention or sacrificing any of the attendant advantages thereof, provided, however, that such changes fall within the scope of the claims appended thereto.

We claim:
1. A developer tank and trough assembly for photocopy machines comprising, in combination,
a. a supply tank adapted to contain a developer fluid and including
   i. a bottom wall,
2. upstanding end walls, and
3. upstanding front and rear walls,
b. a plurality of thin fins extending inwardly from said walls and integral therewith,
c. a trough member removably supported on said fins and having
   1. a bottom wall,
   2. upstanding end walls,
   3. upstanding front and rear walls, and
   4. front and rear ledges extending forwardly and rearwardly from said last named front and rear walls respectively and below the upper edges of said walls and resting on said fins,
d. a plurality of removable spring clip members supported on the walls of said supply tank and yieldably engaging said ledges for releasably holding said trough member on said fins,
e. paper guide means removably mounted in said trough member and having a contoured bottom within the confines of the walls on said trough member, and having
   1. openings therein communicating with said trough member, and
   2. abutment means at each end thereof and extending upwardly therefrom,
f. a plurality of removable spring clip members supported on the end walls of said trough member and yieldably engaging said abutment means for releasably holding said paper guide means in said trough member, and

g. pump means in said tank communicating with said trough member to pump developer fluid from said supply tank into said trough member and said paper guide means.

2. The combination of elements defined in claim 1, including overflow openings in the rear wall of said trough member through which developer fluid may pass to said rear ledge drain openings in said rear ledge through which developer fluid may drain into said supply tank, and portions of said rear ledge on either side of said drain openings being inclined toward said drain openings to direct overflow developer fluid thereto.

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