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Reick et al.

[11] **3,729,255**

[45] **Apr. 24, 1973**

[54] **PHOTODEVELOPMENT APPARATUS INCLUDING TRAY ASSEMBLY AND RETAINING MEANS THEREFOR**

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[52] **U.S. Cl.** **355/10,** 95/94, 355/27, 355/100

[51] **Int. Cl.** **G03g 15/10**

[58] **Field of Search**.....355/10, 27, 100, 355/106; 95/94, 95, 96

[56] **References Cited**

UNITED STATES PATENTS

3,587,429	6/1971	Morse	95/95
3,461,788	8/1969	Tiger et al.	95/95
3,076,399	2/1963	Limberger	355/100
3,330,197	7/1967	Boeger et al.	95/94
3,435,749	4/1969	Cauwe et al.	95/94

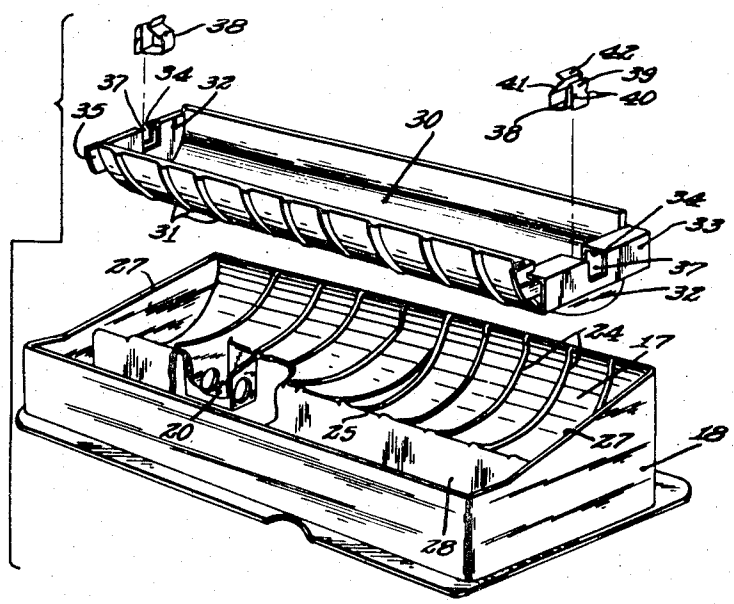
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[57] **ABSTRACT**

A liquid developer tray is arranged to be supported to receive copy sheets to be developed from feed rollers and has a removable insert cooperating to guide the sheets through developer in the tray and to take-off and squeeze rollers. The guide insert also limits the volume of toner in the tray, improves circulation thereof and reduces the toner surface exposed to evaporation. Cooperating with the insert guide structure are means for positioning and retaining the tray properly oriented with respect to the rollers but enabling ready sliding of the support for the tray assembly into and out of position in a photocopy machine.

15 Claims, 4 Drawing Figures



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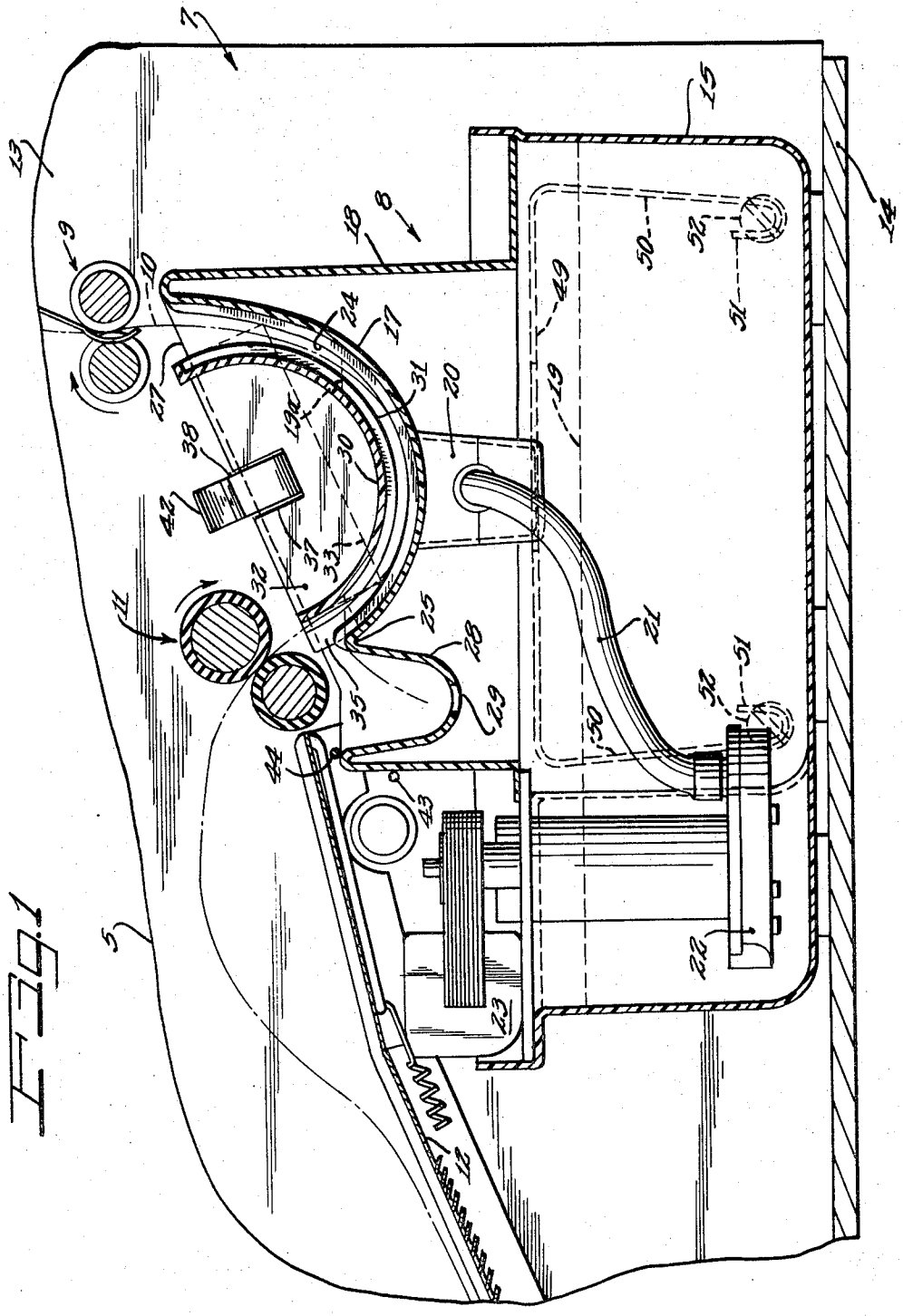
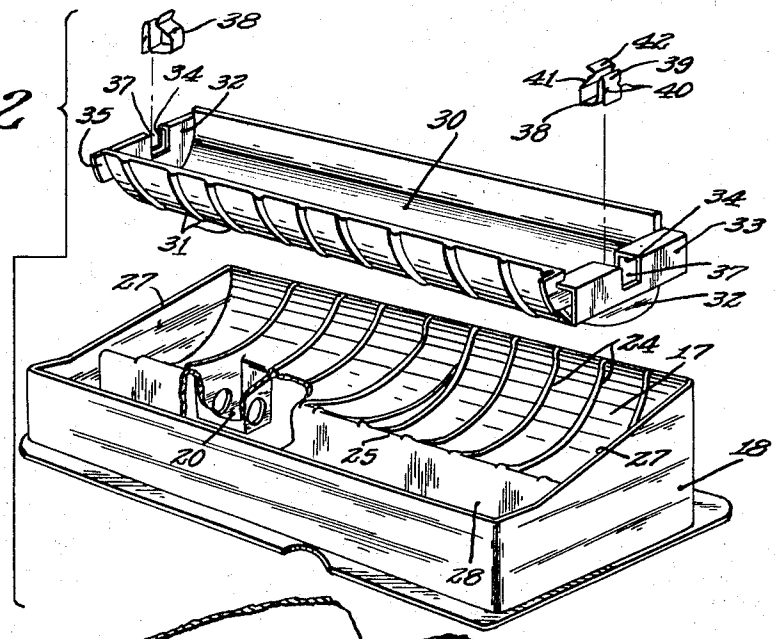


FIG. 1

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2 Sheets-Sheet 2

Fig. 2



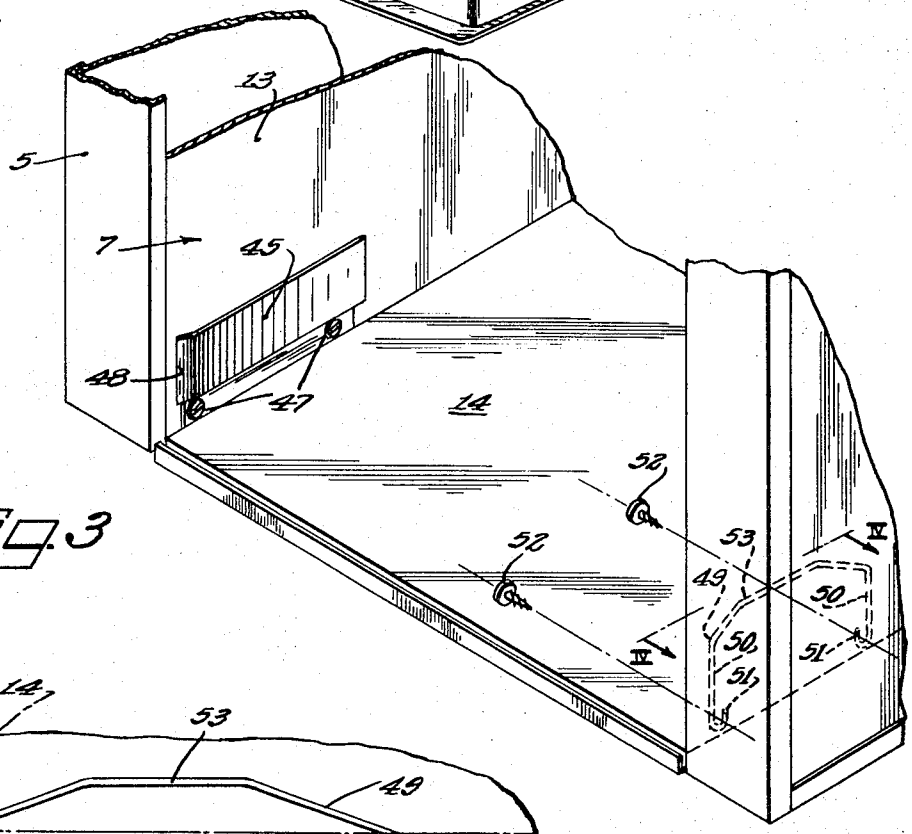


Fig. 3

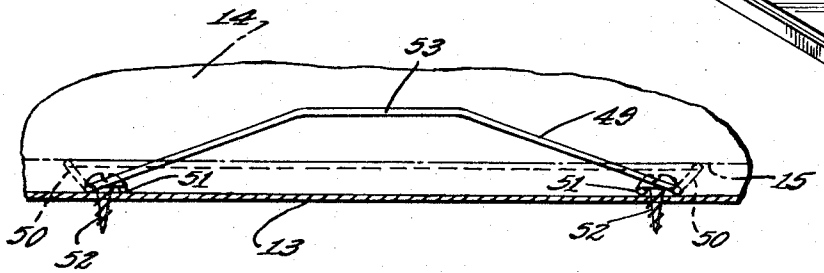


Fig. 4

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PHOTODEVELOPMENT APPARATUS INCLUDING TRAY ASSEMBLY AND RETAINING MEANS THEREFOR

This invention relates to photodevelopment apparatus and is more particularly concerned with such apparatus especially useful in photocopy machines such as electrostatic copiers utilizing liquid toner for development as distinguished from heat fused toner.

As background for the present invention, reference may be had to U.S. Pat. No. 3,345,926 as representative of the type of photocopy machines, and more particularly electrophotographic copying machines with which the present invention is especially useful. In addition, attention is directed to U.S. Pat. No. 3,461,788 disclosing the prototype of the tray structure for which the present invention provides valuable developments and improvements.

Two problems which are overcome by the present invention may be particularly mentioned. One such problem concerns the occasional failure of the exposed copy sheets dipping entirely down into the developer solution as fed to the tray by the feed rollers following exposure of the sheets, and the occasional missing of the squeeze rollers by the advancing ends of developed sheets on emerging from the developer as guided by the concave bottom of the tray. Another problem overcome by the present invention relates to the tendency for the tray support to shift due to vibrations in the operation of the machine, and more particularly to shift rearwardly and thus move the tray out of relative alignment to the feed and squeeze rollers.

Accordingly, it is an important object of the present invention to provide new and improved photodevelopment apparatus for copying machines and more particularly electrophotographic copymaking machines.

Another object of the invention is to provide new and improve photodevelopment apparatus wherein the photocopies to be developed are effectively guided through liquid developer.

A further object of the invention is to assure thorough liquid development of photocopies in a copying machine.

Still another object of the invention is to provide a new and improved guide insert for liquid photodevelopment trays.

A still further object of the invention is to provide new and improved means in photodevelopment apparatus to maintain a liquid developer tray accurately aligned with feed and take-off rollers in a photocopy machine.

It is also an object of the invention to provide improved means for maintaining a photodevelopment tray assembly against unintentional displacement from proper operative position in a photocopy machine.

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts embodied in the disclosure, and in which:

FIG. 1 is a fragmentary vertical sectional detail view through the photodevelopment apparatus of a photocopy machine illustrating features of the invention;

FIG. 2 is an exploded detail view of the developer tray assembly and guide insert;

FIG. 3 is a fragmentary isometric view showing the tray-receiving and supporting rear end portion of the photocopy machine;

FIG. 4 is an enlarged fragmentary sectional plan view taken substantially along the line IV—IV of FIG. 3.

On reference to FIGS. 1 and 3, a housing cabinet 5 of a photocopy machine, and more particularly an electrophotographic copying machine, has a rear opening 7 thereinto through which a developer tray and supply tank assembly 8 is adapted to be removably inserted. In the particular arrangement selected for illustration, electrostatographically charged and exposed copy sheets are delivered to photodevelopment apparatus of which the tray and tank assembly 8 is a part, there being a pair of cooperatively related infeed transport rollers 9 by which the copy sheets are fed downwardly in a path indicated by the dashed line 10 for development and then to and between out-feed transport and squeeze rollers 11, whence the path of the developed sheets continues downwardly and forwardly along a ramp 12 to a collection point. Support for the rollers and the ramp is desirably provided by opposite, spaced, vertical, parallel front-to-rear wall panels 13 providing with a bottom wall panel 14 a photodevelopment apparatus chamber space to which the rear opening 7 provides the entrance.

Construction and relationship of the tank and tray assembly 8 is in the form of a self-contained unit which is adapted to be inserted into position through the rear opening 7 by sliding it inwardly and forwardly on and along the base panel 14. To this end, a developer or toner solution tank 15 opens upwardly and supports separably on its upper end portion a tray 17 provided with a supporting skirt 18 which rests on the tank. Liquid toner 19 is supplied to the tray 17 through a well 20 in the bottom of the tray by way of a duct 21 from a pump 22 immersed in the toner and driven by means including an electrical drive motor 23. In a preferred arrangement, the in-feed rollers 9 are located at a higher elevation than the out-feed rollers 11 and therefore the tray 17 is provided with a relatively high back for guiding the copy sheets downwardly into the tray which is provided with a generally semi-cylindrical trough bottom having upwardly off-set spacer ribs 24 which terminate at the front ends at a spill-over curb 25 which is substantially lower than the back of the tray and lower than the adjacent portions of respective opposite trough end closing side walls 27 which slope downwardly from the top of the back and past the curb 25 to that portion of the side walls which close the opposite ends of a spill-over gutter 28 which drains through one or more openings into the tank 15. In length the trough 17 is sufficient to accept the widest copy sheet that may be passed therethrough, and in width the trough is correlated to receive the copy sheets efficiently from the in-feed rollers 9 and to guide the same to the nip of the out-feed rollers 11.

To avoid any possibility of a copy sheet fed into the tray trough 17 floating, skimming over the surface of the toner 19*a* in the trough, a complementary immersion insuring guide insert 30 (FIGS. 1 and 2) is provided which is desirably constructed as a one-piece molded plastic shell. It has a convex surface which is generally complementary to the concave surface of the trough 17, with projecting contact limiting ribs 31 which are complementary to and confront the trough

ribs 24 in copy passage gap relation such that the copy passage 10 is freely provided between the crests of the ribs, but the copy paper is guided positively into full immersion in the body of toner 19*a* in the tray trough. Entry of the copy paper into the gap between the trough 17 and the guide 30 from the in-feed rollers 9 is facilitated by a gaping entry mouth convergent relation of the upper end of the back of the trough 17 and the adjacent back edge portion of the guide 30 which is desirably in the form of a concave-convex shell. By its imperforate shell structure, the guide 30 not only reduces the volume of toner in the tray trough 17 but also enhances circulation of the toner between the tank and the trough, and reduces the area of the body of toner 19*a* in the trough exposed to evaporation.

Easy adaptation of the guide 30 to existing toner trays not already equipped with such a guide, and providing for ready removal of the guide when necessary or desirable, as for removing a copy that may on rare occasions double-up or jam within the guided portion of the path 10 or to clean the parts as may be desirable from time-to-time, the guide 30 is constructed to be mounted removably on and between the end walls 27 of the tray structure. To this end, the guide 30 is provided with integral end walls 32 which are spaced apart as measured between their outside faces a slight differential less than the spacing between the inside faces of the tray trough end walls 27, whereby the member 30 is readily received within the trough 17. To maintain the proper spaced relation of the guide 30 to the trough surface, each of the guide member side walls 32 is provided with a generally L-shaped flange extension 33 along its top edge providing respective downwardly opening hanger channels 34 at the outer sides of the side walls 32 within which the upper edges of the tray end walls 27 are received and on which the hanger flanges rest to support the guide 30 as a stable insert. Since the upper edges of the walls 27 slope downwardly forwardly, the front of the guide insert 30 is provided with respective forwardly extending spacer flange projections 35 at each end as forward extensions from the side walls 32. These spacer extensions 35 engage the trough at the curb 25 thereby maintaining proper spacing between the front portion of the curved spacer and the front portion of the curved trough against any tendency for the spacer to slide forwardly along the incline of the top edges of the end walls 27 and interfere with the intended gap for the copy path 10 as primarily established between the spacer and the trough by the hanger flanges 33.

Means are provided to prevent any tendency of the guide 30 to be displaced upwardly because of its hollow buoyancy in the body of toner 19*a*, or to be pushed upwardly by a copy sheet passing thereunder, or a combination of those forces. For this purpose, upwardly opening respective notches 37 are provided in preferably central portions of the upper edges of the walls 32 and the aligned portions of the flanges 33 and within which notches the upper edge portions of the tray walls 27 are exposed and accessible when the guide has been assembled with the tray. Onto those exposed portions of the walls 27, are attached respective separable retaining spring clips 38 each of which has a generally inverted U-shaped gripper portion which fits down over and grips the upper margin of the exposed portion of the wall 27 within the associated notch 37, with relatively sharp upwardly and inwardly projecting gripper prongs 40 providing points which resist unintentional displacement of the clip. Assisting in the spring tension of the clips but providing, in effect, a handle on each clip for intentionally removing it is a spring loop 41 having a gripping handle flange 42. This handle loop is desirably located in the assembly on the inside of each of the notches 37 relative to the side walls 32. Thus, after the guide insert 30 has been placed in position, the clips 38 are engaged on the wall 27 within the notches 37 and pressed downwardly into full gripping engagement with the associated wall 27 and also thrusting downwardly against at least one of the upwardly facing edges defining the respective notch 37 so that the guide insert is held against upward displacement relative to the trough 17. When it is desired to remove the guide insert 30, the respective handle portions 42 of the clips are grasped and the clips sprung by a generally upward force to release them and thus free the guide insert 30 to be lifted from the tray.

Means are provided for properly orienting the tank and tray assembly 8 within the cabinet 5 to align the entry into the trough 17 with the in-feed rollers 9, and the exit from the trough with the out-feed and squeeze rollers 11. For this purpose, the side walls 13 of the cabinet chamber are provided with respective stops 43 which are desirably in the form of pins that project inwardly from the walls 13 into the path of and are engaged by the front wall of the skirt 18 of the tray section of the assembly. Desirably, also, an overhead gauging pin 44 is provided on each of the walls 13 to closely overlie the front extremity of the upper edge of each of the walls 27. By having the gauging pins 44 spaced rearwardly relative to the stop pins 43, should the tray section for any reason not be properly assembled with the reservoir tank, so that the front portion of the tray section is relatively raised from the normal position, the front of the tray section will strike the gauging pins 44 and prevent movement of the assembly into the fully inward assembled relationship within the cabinet, thus alerting the machine operator or attendant or service personnel that adjustment in the tank and tray assembly is necessary for proper functioning. In addition, the pins 44 hold the tank and tray assembly against upward displacement in handling of the machine, such as during shipment.

While the tank and tray assembly would normally be prevented from falling out of the machine cabinet by a closure plate (not shown) which will normally be applied across the rear opening 7, it is desirable to have reasonable clearance at the back of the tank 15. Clearance must also be provided at the sides of the tank for easy assembly thereof between the side walls 13 of the cabinet. As a result, there is tendency for vibrations of the cabinet caused by operation of the mechanisms of the machine to induce "walking" displacement of the tank and tray assembly 8 rearwardly or in a skewing manner away from the stops 43, especially where the cabinet may be mounted on a surface that tilts slightly laterally or rearwardly. Means are therefore provided to prevent such vibratory displacement of the assembly 8 from the proper alignment with the rollers 9 and 11 as determined by the stops 43 and the retainers 44, such means functioning both to avoid rearward and skewing

displacement. To this end, a fixed limited contact friction plate **45** is mounted as by means of screws **47** on one of the side walls **13** adjacent to the entry opening **7** and has a lead-in ramp end **48** such that when the assembly **8** is moved into the opening **7**, one side of the tank **15** engages the friction plate. At the opposite side, there is attached to the side wall **13** a friction spring **49** (FIGS. **1**, **3** and **4**) which is desirably made from spring wire of generally inverted U-shape in elevation having vertical legs **50** provided with turned attachment terminals **51** receptive of respective attachment screws **52** by which the spring is attached to the associated side wall **13** generally aligned with the friction plate **45** at the opposite side wall. Frictional engagement with the associated side of the tank **15** is assured by having the body of the spring **49** which connects the upper ends of the legs **50** arched away from the associated wall **13** to a greater extent than the allowed clearance gap between the wall **13** and the side of the tank **15**, with the opposite side of the tank in engagement with the friction plate **45**. As a result the arched body of the spring **49** is deflected from the full line position as shown in FIG. **4** to the dash line position indicated, with a corresponding spreading of the arched body as straightened under compression by the side wall of the tank. As this occurs, the terminals **51** turn on the screws **52**. The resulting tension of the loaded spring **49** effectively frictionally thrusts the tank **15** toward and against the plate **45** so that the combined frictional grip of the tank by and between the plate **45** and the spring **49** not only maintains the tank against skewing, but also holds the tank against unintentional rearward displacement. Action of the spring **49** is enhanced in this respect by providing a central portion of the spring body with a substantially straight section **53** of substantial length as the crest of the normally arched condition of the relaxed spring, whereby to assure a substantial area of frictional contact with the confronting side of the tank **15**.

It will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts of this invention.

We claim as our invention:

1. In combination in apparatus of the character described, including a cabinet having a photodevelopment chamber area with an opening thereinto, in-feed rollers for transporting exposed copy sheets into said area, out-feed rollers spaced from said in-feed rollers and operative to squeeze and move developed copy sheets from said area toward a collection point:

an upwardly opening developer tray assembly including a liquid developer tray adapted to support a body of liquid developer therein and having a removable guide insert defining with the tray a development path for the copy sheets from the in-feed rollers into an inlet and down through the body of liquid developer and then from an outlet into the nip of out-feed rollers; and

means operative to releasably engage upstanding portions of the tray to hold the tray assembly in said area with said inlet aligned with said in-feed rollers and said outlet aligned with said out-feed rollers and against unintentional displacement in any direction relative to said rollers.

2. A combination according to claim **1**, in which said guide insert comprises an upwardly opening downwardly projecting shell member partially submerged in the liquid developer and having opposite edge portions located relatively closely to said in-feed and out-feed rollers, and means releasably retaining said insert shell against tendency to displace buoyantly from said liquid developer toward the rollers.

3. A combination according to claim **2**, said retaining means comprising clip structure cooperatively interengaging with said tray and said insert and projecting upwardly therefrom between said rollers.

4. A combination according to claim **1**, said tray and said shell having confronting spaced arcuate path-defining surfaces, and complementary sheet contact limiting ribs on said surfaces.

5. A combination according to claim **1**, in which said releasable retaining means for the tray assembly comprise stop means and upward movement limiting means supported by the cabinet.

6. A combination according to claim **1**, said means releasably retaining the tray assembly comprising friction gripping structure with which a portion of the tray assembly is slidably engageable when the assembly is moved into position relative to said rollers.

7. In combination in apparatus of the character described:

a cabinet having walls defining a photodevelopment apparatus area with an opening thereinto receptive of a development tray assembly including a base portion having side surfaces; and

respective frictional gripping means to engage the opposite side surfaces of said base portion and including at least one resiliently yieldable spring.

8. A combination according to claim **7**, in which said spring comprises a generally inverted U-shaped wire spring member having legs provided with terminals, means securing the terminals to the cabinet and leaving the remainder of the spring free, and a spring body connecting upper portions of said legs and arched toward the opposite frictional gripping means.

9. A combination according to claim **8**, in which said arched body portion has a central substantially straight arch crest portion to enhance frictional contact with the side of said base portion.

10. A combination according to claim **7**, the remaining of said means comprising a rigid friction plate confronting the spring in spaced relation to receive said base portion therebetween.

11. In combination in apparatus of the character described:

a photodevelopment tray assembly including a trough for a body of liquid developer into which exposed copy sheets are to be delivered from in-feed rollers in a copy making machine and from which developed copy sheets are removed by out-feed squeeze rollers, end walls at the opposite ends of said trough, and a guide insert mounted in said trough to assure full immersion of copy sheets passing through the trough;

means releasably connecting said insert to said end walls;

said end walls having sloping edges;

means supporting said guide insert on said edges; and

means spacing the guide insert relative to the trough against tendency of the guide insert supporting means to displace down the sloping edges.

12. Apparatus according to claim 11, said guide insert comprising a molded plastic shell member, said supporting means comprising integral flange means providing downwardly opening receiving slots within said wall edges are engaged, and said spacing means comprising integral spacer flanges projecting from said shell member.

13. In combination in apparatus of the characters described:

a photodevelopment tray assembly including a trough for a body of liquid developer into which exposed copy sheets are to be delivered from infeed rollers in a copymaking machine and from which developed copy sheets are removed by outfeed squeeze rollers, end walls at the opposite ends of said trough, and a guide insert mounted in said trough to assure full immersion of copy sheets passing through the trough; and

retaining clip means interengaging with said walls and said insert to retain the insert in place.

14. A combination according to claim 13, said insert having hanger flange structure thereon receptive of the walls therein and provided with notches exposing portions of the walls therethrough, said clips engaging said walls through said notches.

15. In combination in apparatus of the character described:

a photodevelopment tray assembly including a trough for a body of liquid developer into which exposed copy sheets are to be delivered from infeed rollers in a copymaking machine and from which developed copy sheets are removed by outfeed squeeze rollers, end walls at the opposite ends of said trough, and a guide insert mounted in said trough to assure full immersion of copy sheets passing through the trough;

means for supporting and spacing the guide insert relative to the trough comprising integral flange means on the insert engaging on upper edges of said end walls, to provide a clear path for movement of the copy sheets between the trough and the insert; and

means releasably connecting said insert to said end walls comprising releasable clips to hold the insert against upward displacement by the developer or copy sheets but enabling release and removal of the insert for cleaning the tray.

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