May 1, 1951 L. E. WALKUP 2,550,738

APPARATUS FOR APPLYING POWDER TO ELECTROPHOTOGRAPHIC PLATES

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Fig. 1

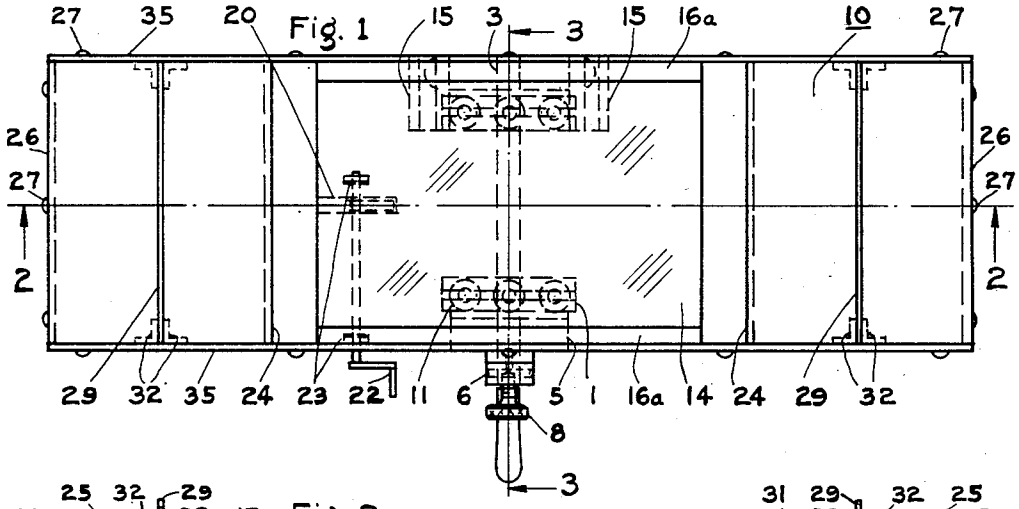


Fig. 2

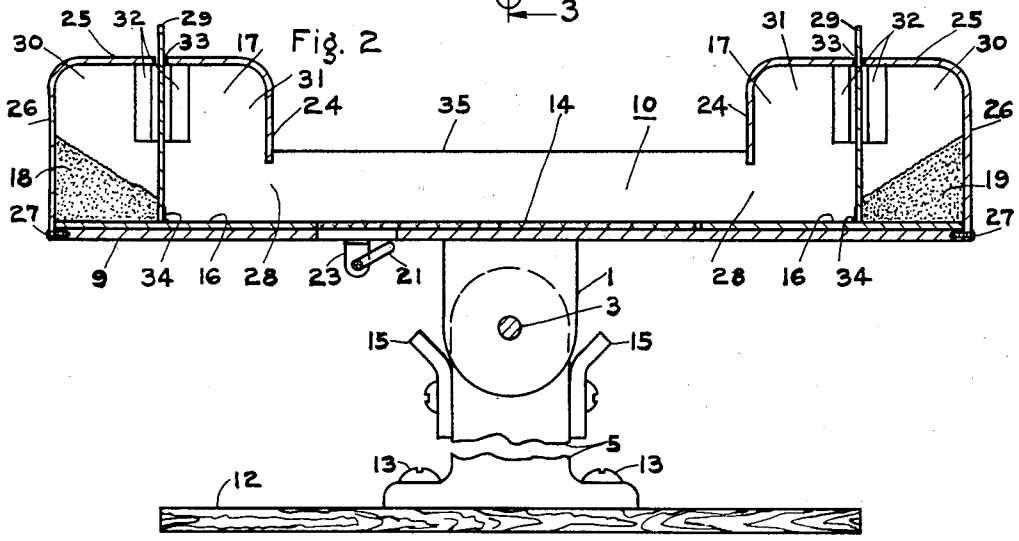
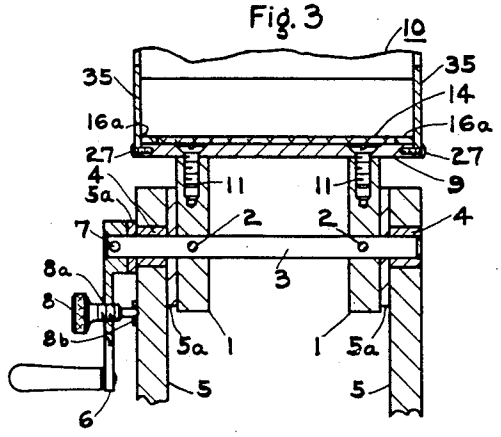


Fig. 3



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UNITED STATES PATENT OFFICE

2,550,738

APPARATUS FOR APPLYING POWDER TO ELECTROPHOTOGRAPHIC PLATES

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7 Claims. (Cl. 95—1.9)

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This invention relates to electric photography and to apparatus for supporting an electrophotographic plate while an electrostatic image formed on the plate is developed by flowing electroscopic developing powder over the image and while the plate is cleaned after development and transfer of the image. More particularly this invention relates to a tray for holding a surface capable of retaining such an electrostatic image and for holding and for permitting the selective application of the electroscopic developing powder and of the cleaning powder used respectively in developing such an image when it is flowed across it and in cleaning the electroscopic powder from the image bearing surface after development of the image.

When making copies by electrophotography, the customary practice is to charge electrostatically a suitable sensitive surface such as a photoconductive insulating layer coated on a conductive backing as disclosed in Carlson Patent #2,297,691, issued October 6, 1942. This surface or plate is then exposed to a pattern of light and shadows which form an electrostatic image on the photosensitive surface which is a reproduction of the object desired to be reproduced. The plate is then dusted with electroscopic developing powder to form a powder image thereon corresponding to said electrostatic image and the powder image is transferred to a paper or other sheet following which any electroscopic powder remaining on the plate is cleaned by means of suitable cleaning powder which is dusted over the plate.

This invention relates to apparatus for performing the development of such an image by dusting it with an electroscopic developing powder and for cleaning the residual powder left on the image bearing surface after the image has been transferred to another surface and has for a specific object thereof to afford a conveniently operable apparatus in which the plate can be positioned after charging and exposing to receive the electroscopic developing powder that is cascaded over the plate to form the powder image from the electrostatic image, and also to receive the plate after the powder image has been transferred to permit cascading over the plate a cleaning powder that acts to remove any adhering electroscopic powder from the plate to prepare the plate to receive another electrostatic charge.

More specifically the invention has for its object to afford a tiltable or rockable plate support provided with a powder receptacle at each end communicating with the surface of the support and of the electrophotographic plate positioned thereon, the powder receptacles each having a movable closure that is selectively operative to permit movement of the powder from the selected receptacle over the plate upon oscillating the plate support.

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Another object of the invention is to provide an apparatus of the character mentioned such that the receptacle at one end of the plate support may be supplied with electroscopic powder and the receptacle at the other end of the support supplied with cleaning powder, thus enabling the plate to be positioned in the support to have applied to it either electroscopic powder immediately after the charging operation, or cleaning powder after the powder image has been removed from the plate, the character of the powder operation depending on which receptacle closure is opened after the plate is positioned.

An additional object of the invention is to afford a structure in which the powder, either electroscopic or cleaning, is effectively confined within its receptacle except when being applied to the surface of the electrophotographic plate, the mechanism enabling the powder to be easily returned to its receptacle after the plate dusting operation is completed and to be retained therein so as not to interfere with a subsequent operation when the alternative powder is applied to the plate.

For a better understanding of this invention, together with other and further objects thereof, reference is now had to the following description taken in connection with the accompanying drawing, and the scope of the invention will be pointed out in the appended claims.

In the accompanying drawing, Figure 1 is a top view of an apparatus constructed in accordance with a preferred embodiment of the invention. Figure 2 is a sectional elevation of the apparatus of Figure 1 taken along the line 2—2; and Figure 3 is a sectional view of the apparatus of Figure 1 taken along the line 3—3. Similar elements in each figure are identified by identical numbers.

Referring now to the drawing, a pair of flanges 1 are fixedly attached, as by pins 2, to an elongated cylindrical shaft 3 which is suitably horizontally mounted for pivotal movement in a pair of bearings 4 set in the end portion of a pair of spaced apart pedestals 5.

An L-shaped crank arm 6 may be attached, as by pin 7, to one end of the shaft 3 so that the shaft may easily be rotated about its horizontal axis, and preferably a portion of the crank arm 6 is adjacent to and extends parallel to but in

spaced apart relationship with one of the pedestals 5 so that a thumb screw 8 may protrude through a suitably threaded opening 6a in the crank arm 6 and thereby hold the crank arm 6 and thereby the shaft 3 and the flanges 1 in a predetermined position with respect to the pedestals 5 when the thumb screw is extended into a notch 5b in the adjacent pedestal 5, or into a washer between the adjacent pedestal 5 and the parallel portion of the crank arm 6.

This predetermined position at which the flanges 1 are held by the thumb screw 8 is such that a base member or bottom wall 9 of a plate supporting tray 10 to which the flanges 1 are attached, as, for example, by the bolts 11, is kept substantially level horizontally with a horizontal support platform 12 on which the pedestals 5 may be suitably mounted as by bolts 13.

The base member 9 of the plate supporting tray 10 forms a substantially flat surface on which an electrophotographic plate 14 may be positioned to be subjected to a powder dusting operation by rocking or oscillating the tray 10 attached to the flanges 1 back and forth on the pedestals 5 about a horizontal axis of oscillation corresponding to the axis of the shaft 3. The maximum angle of oscillation is determined by the stop 15 which may be a part of one of the pedestals 5 or which, as illustrated, may be a metal strip projecting angularly from one of the pedestals 5 which engages one of the flanges 1 when it is rotated to a predetermined angle about the axis of the shaft 3, preferably at least a swing of 50° should be permitted.

Suitable washers 5a may be provided between each of the flanges 1 and each of the pedestals 5 and between the crank arm 6 and the pedestal 5 which it is adjacent to for insuring a close fit and for permitting smooth movement.

A pair of substantially flat elongated base plates 16 are mounted, as by welding, in spaced apart relationship at opposite ends of the base member 9 and extend across the base member 9 parallel to the horizontal axis of oscillation thereof to form the base of a pair of elongated compartments 17 which extend across the tray 10 parallel to the axis of oscillation thereof, one of the compartments being at one end of the tray 10 and the other of said compartments being at the other end of the tray 10.

The base plates 16 extend across the base member 9 on the upper surface thereof and leave in the area between them a central portion of the base member 9 which is outlined by the shoulders of the base plates 16 and the strip members 16a extending between the plates 16 to form a recessed portion in the center of the tray 10. This central portion is open from the top to permit a cleaning powder 18 and a developing powder 19 to be introduced respectively into one or the other of the compartments 17 which are on opposite sides of this central portion which portion is adapted to receive and hold the electrophotographic plate 14.

An opening 20 is provided in the base member 9 in the central portion thereof through which an object may be inserted to lift the electrophotographic plate from its seat in the recess formed by the base plates 16 and strip members 16a. As illustrated, such an object may be a cam 21 operated by a lever arm 22 mounted on the under side of the base member 9 of the tray 10 in the bearings 23.

Each of the compartments 17 has a front wall 24, a top wall 25, a back wall 26, and side walls 35, which latter two walls may be attached as by screws 27 to the base member 9 of the tray 10, or, as one alternative, the back and side walls may be suitably attached to the base plates 16. These walls form a closed compartment at either end of the tray 10 except that the front wall 24 is cut away at the portion of the compartment where the front wall 24 would contact the base plates 16 to form an opening 28 which extends across the tray 10 for at least the length of the electrostatic image bearing portion of the electrophotographic plate 14 and permits the powders 18, 19 to flow freely from the compartments 17 across the central portion of the tray 10. The back wall 26, front wall 24, and the opening 28 extend lengthwise across the tray 10 in parallel relationship with the aforementioned horizontal axis of oscillation.

A pair of closure walls 29 selectively movable from open to closed position are spaced apart from and parallel to the front walls 24 and back walls 26 and divide each of the compartments 17 into a pair of receptacles 30, 31, one of which, for example receptacle 30, is outlined by back wall 26, base plates 16, top wall 25, the side walls 35, and the closure wall 29, and forms a completely enclosed receptacle in each of the compartments 17 in which the powders 18 and 19 can be respectively confined when the closure wall 29 is in closed position; and the other of which, receptacle 31, opens onto the central portion of the tray 10 through the opening 28.

The movable closure walls 29 are fixed in place within the compartments 17 by means of the guides 32 which are affixed to the side walls 35 of each of the compartments 17. As illustrated, each wall 29 is slidable between the guides 32 and may be selectively moved to open or closed position by sliding upward between the guides 32 and through a slot 33 in the top wall 25.

When either of the walls 29 is in open position, an unobstructed surface is provided between the the interior of the respective powder receptacle 30 and the central portion of the tray 10 in the recessed portion of which the electrostatic plate 14 is positioned; the recessed central portion of the tray 10 being of sufficient depth that the electrostatic image bearing portion of the plate 14 forms a level surface with the upper faces of the base plates 16. Means (not shown) for holding the walls 29 in open or closed position could be provided; and rather than the slot 32 through the top wall 25, the doors could open by sliding lengthwise through the guides 32 or in another suitable manner.

The side wall 35 extends above the base member 9 of the tray 10 and above the electrophotographic plate 14 when positioned within the recessed portion of the tray 10 at opposite sides adjacent to the powder opening 28, the walls 35 thereby confining the powder within the tray 10 when the tray 10 is rocked on the pedestals 5 with one of the closure walls 29 in its opened position.

It will be understood that the parts just described are mechanical details in the formation of the complete structure, which may be variously designed and connected without departing from the invention.

To operate the apparatus as has been described to develop an electrostatic image and to clean the image bearing surface, the cleaning powder 18 and the developing powder 19 are individually confined in the powder receptacles 30 at each end of the tray 10. The receptacle 30 at one

end of the tray 10 containing the cleaning powder 18 which may be a granular material, such as is disclosed in Copley Patent #2,484,782 and the receptacle at the other end of the tray containing the developing powder 19 which may be a powder-carrier mixture as disclosed in the copending application of Lewis E. Walkup, Serial #55,645, filed October 20, 1948, entitled "Developer for Electrostatic Images."

After the electrophotographic plate 14 is electrostatically charged and exposed to a pattern of light and shadows to produce an electrostatic image on the photosensitive surface which is a reproduction of the object to be copied, it is placed within the recessed portion of the plate support or tray 10 with the electrostatic image bearing surface facing upwardly, and the closure wall 29 to the compartment 17 containing the developing powder receptacle 30 is opened.

The support or tray 10 can then be rocked or oscillated about its axis of oscillation when the thumb screw 8 is removed from the notch 8b so that the developing powder receptacle 30 passes above and below the axis of oscillation so causing the developing powder 19 to flow or cascade alternately in opposite directions over the exposed surface of the electrophotographic plate 14 so that the developing powder 19 adheres to the electrostatic image on the plate. During the dusting operation, the compartment 17 opposite to the compartment 17 containing the electroscopic developing powder receptacle 30 receives the powder when it flows in that direction and its front wall 24 and side wall 35 prevent the overflow of the powder over the edges of the tray 10 and confine the dust while its closure wall 29 prevents the developing powder 19 from mixing with the cleaning powder 18 which is enclosed in its respective receptacle 30. When the dusting operation for development of the image is completed, the surplus developing powder 19 that is not retained by the electrostatic image on the plate 14 is permitted to flow back into its receptacle 30 by holding the tray 10 in inclined position with the developing powder receptacle 30 below the axis of oscillation and with its closure wall 29 in open position, and after the powder is all returned to the receptacle 30, the closure 29 is moved to closed position and the plate 14 is removed from the support by turning lever arm 22 operating the cam 21.

After the powder image is transferred from the plate 14 to a sheet of paper or other surface, it is desirable to clean the plate thoroughly before subjecting it to another charge and exposure, and this is accomplished by again placing the plate 14 in the tray 10 as already described and opening the closure wall or door 29 to the cleaning powder receptacle 30 at the other end of the support, permitting the cleaning powder 18 contained in the cleaning powder receptacle 30 to flow back and forth over the plate 14 when the tray 10 is rocked or oscillated on the pedestals 5. After several such operations, the plate 14 is cleaned and the cleaning powder 18 can be permitted to flow back into its receptacle, following which the door to the cleaning powder receptacle 30 is closed, and the electrophotographic plate 14 can be removed from the support to be recharged for receiving another image.

While I have described and illustrated a particular embodiment of my invention, it will be understood that various omissions, substitutions, and changes in the forms and details of the device illustrated and in its use and operation may be made by those skilled in the art without departing from the broad spirit and scope of the invention, and I, therefore, contemplate by the following claims to cover any such modifications as fall within the true spirit and scope of the invention

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for applying powder to an electrophotographic plate comprising an oscillatory support on which the electrophotographic plate can be mounted, a powder receptacle at one end of the support extending thereacross, said support extending into and forming the bottom for said receptacle and having a recess spaced from said receptacle in which the electrophotographic plate can be positioned with its top surface flush with the top surface of the support, the receptacle having an opening in its inner wall permitting movement of powder from the receptacle over a plate positioned on the support, powder-confining means extending along the sides of the support, and a slidable closure for said opening mounted between guide members and slidable between an open and a closed position.

2. Apparatus for applying powder to an electrophotographic plate comprising an oscillatory support on which the electrophotographic plate can be mounted, a powder receptacle at each end of the support extending thereacross, said support extending into and forming the bottom for said receptacle and having a recess spaced from said receptacle in which the electrophotographic plate can be positioned with its top surface flush with the top surface of the support, one of said receptacles being adapted to contain developing powder and the other of said receptacles being adapted to contain cleaning powder and each receptacle having an opening in its inner wall permitting movement of powder from the receptacle over a plate positioned on the support, powder-confining means extending along the sides of the support, and a slidable closure for said opening mounted between guide members and slidable between an open and a closed position.

3. Apparatus for supporting a surface capable of retaining an electrostatic image and for holding and permitting selective application of powders for developing said image and for cleaning said surface after development of said image when flowed across said surface comprising, a base member having a recessed central portion for holding said image bearing surface flush with the surface of the base member, said base member being mounted on a horizontal axis of oscillation, a first elongated compartment on said member extending parallel to said axis and beyond one edge of the recessed portion for said image bearing surface, a second elongated compartment on said member extending parallel to said first compartment beyond the opposite edge of the recessed portion for said image bearing surface, each of said compartments opening onto said central portion for at least the length of said recess, and dividing means slidably mounted and movable from opened to closed position for separating each of said compartments into a pair of receptacles, one of which is completely separated from the other when said dividing means is in closed position.

4. Apparatus for supporting a surface capable of retaining an electrostatic image and for holding and permitting the selective application of powders for developing said image and for clean-

ing said surface after development of said image when flowed across said surface comprising, a base member having a recessed central portion for holding said image bearing surface therein flush with the surface of the base member, said base member being mounted on a horizontal axis of oscillation and stops mounted at said axis to limit the angle of rotation around the axis, a first elongated compartment on said member extending parallel to said axis beyond one edge of said recessed portion, a second elongated compartment on said member extending parallel to said first compartment beyond the opposite edge of said recessed portion, each of said chambers opening onto said central portion for at least the length of said recessed portion, powder confining means extending approximately perpendicular to each of said compartments and raised above the surface of said image bearing surface on each other side of said surface, and dividing means slidably mounted and movable from opened to closed position for separating each of said compartments into a pair of receptacles, one of which is completely separated from the other when said dividing means is in closed position thereby to isolate the contents of said completely separated receptacle so that the contents of one of said receptacles only can be flowed across said central portion when said base member is oscillated about said axis.

5. Apparatus for supporting a surface capable of retaining an electrostatic image and for holding and permitting the selective application of powders for developing said image and for cleaning said surface after development of said image when flowed across said surface comprising, a base member having a recessed central portion for holding said image bearing surface flush with the surface of the base member, said base member being mounted on a horizontal axis of oscillation and stops mounted at said axis to limit the angle of rotation around the axis, a first elongated compartment on said member extending parallel to said axis beyond one edge of said recessed portion, and containing electroscopic developing powder, said compartment opening onto said central portion for at least the length of said image bearing surface, a first dividing means slidably mounted and movable upwardly to open and downwardly to closed position for separating said compartment into a pair of receptacles, one of which is completely separated from the other when said dividing means is in closed position thereby to permit isolation of said developing powder from said central portion, a second elongated compartment on said member extending parallel to said axis beyond the opposite edge of said recessed portion and containing a cleaning powder, said second compartment opening onto said central portion for at least the length of said image bearing surface, and a second dividing means slidably mounted and movable from open to closed position for separating said second compartment into a pair of receptacles, one of which is completely separated from the other when said dividing means is in closed position thereby to permit isolation of said cleaning powder from said central portion and from said electroscopic powder during development of said image when said base member is oscillated with said first dividing means at open position.

6. Apparatus for supporting a surface capable of retaining an electrostatic image and for holding and permitting the selective application of powders for developing said image and for cleaning said surface when flowed across said surface comprising, in combination, a tray having a bottom wall for holding said surface flush with the surface of the bottom wall and surrounded by raised end and side walls, said tray having a horizontal axis of oscillation parallel to said end walls, a pair of closure walls selectively slidable upwardly to open and downwardly to closed position and extending parallel to said end walls and spaced apart therefrom at either end of said tray, so forming with said end walls a pair of receptacles, one of said receptacles enclosing developing powder and the other of said receptacles enclosing cleaning powder, and means for mounting said tray so that it can be rocked back and forth about said axis of oscillation so permitting powder to be applied to said surface from said receptacle having its closure wall in open position, the powder in said other receptacle having its closure wall in closed position being confined and stops mounted at the axis to limit the angle of rotation.

7. A powder developing and cleaning tray for an electrophotographic plate comprising, in combination, a bottom wall enclosed with side walls and end walls, a pair of slidably mounted closure walls spaced apart from and parallel to said end walls to provide a pair of elongated powder receptacles extending along the end walls of said tray, recessed means for supporting an electrostatic image bearing plate face up on said tray and flush with the bottom wall thereof in the area provided between said receptacles, each of said closure walls being slidably movable from a closed position to an open position to provide an unobstructed powder flow surface between the interior of its respective receptacle and the mounting area of said electrostatic image bearing plate, whereby selective flow of two separate powder materials over said image bearing plate may be effected by selectively opening said closure walls and tilting said tray about an axis parallel to said end walls.

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REFERENCES CITED

The following references are of record in the file of this patent:

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