

- [54] CHARGING APPARATUS FOR
ELECTRO-PHOTOGRAPHIC COPYING
MACHINES**

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- [52] **U.S. Cl.**..... **250/324, 250/326**

- [51] **Int. Cl.**..... **G03g 15/00**

- [58] **Field of Search**..... 250/49.5 ZC

- [56]
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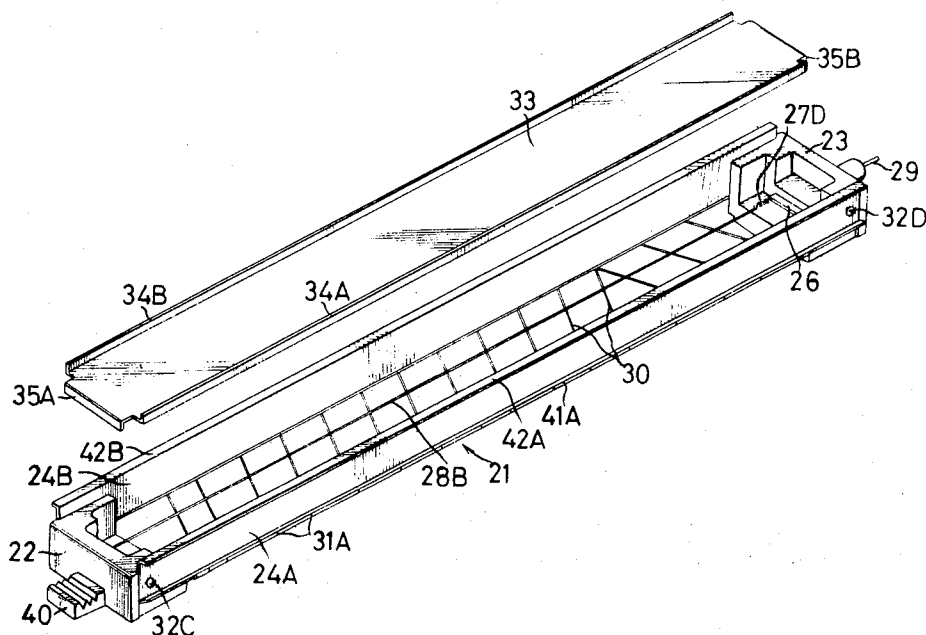
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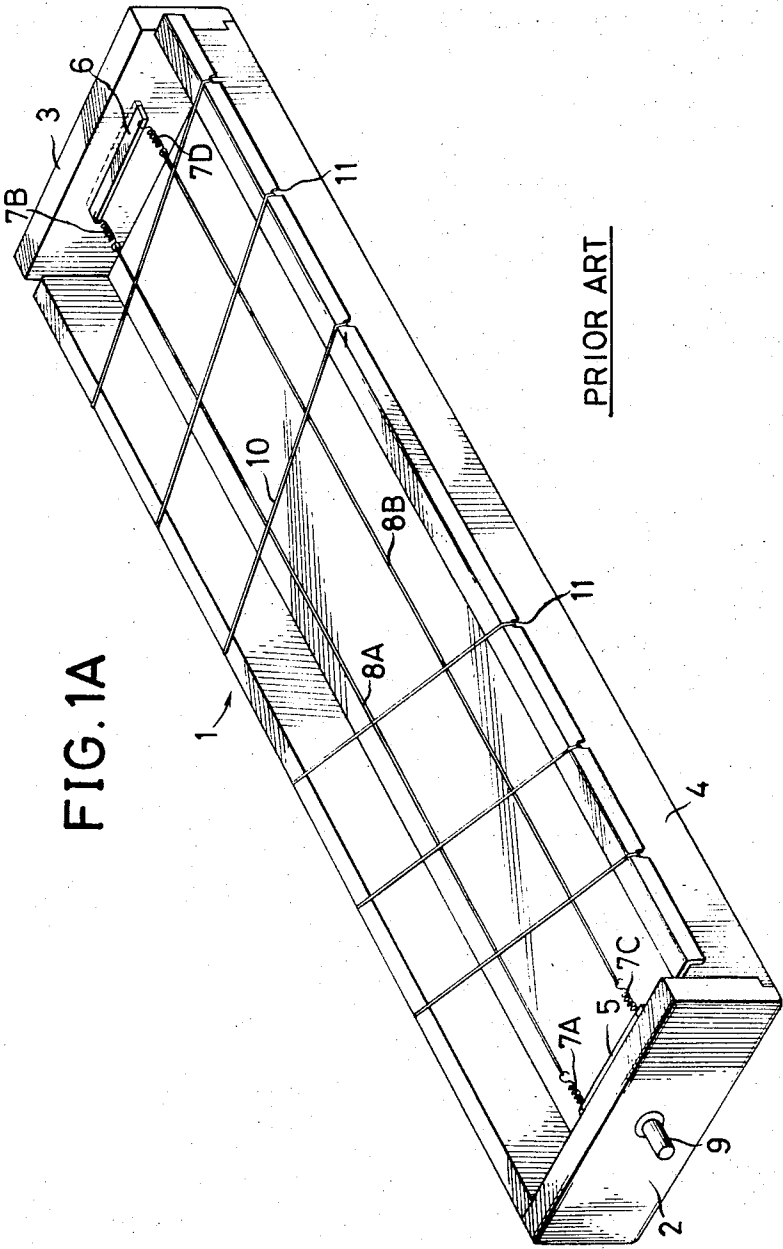
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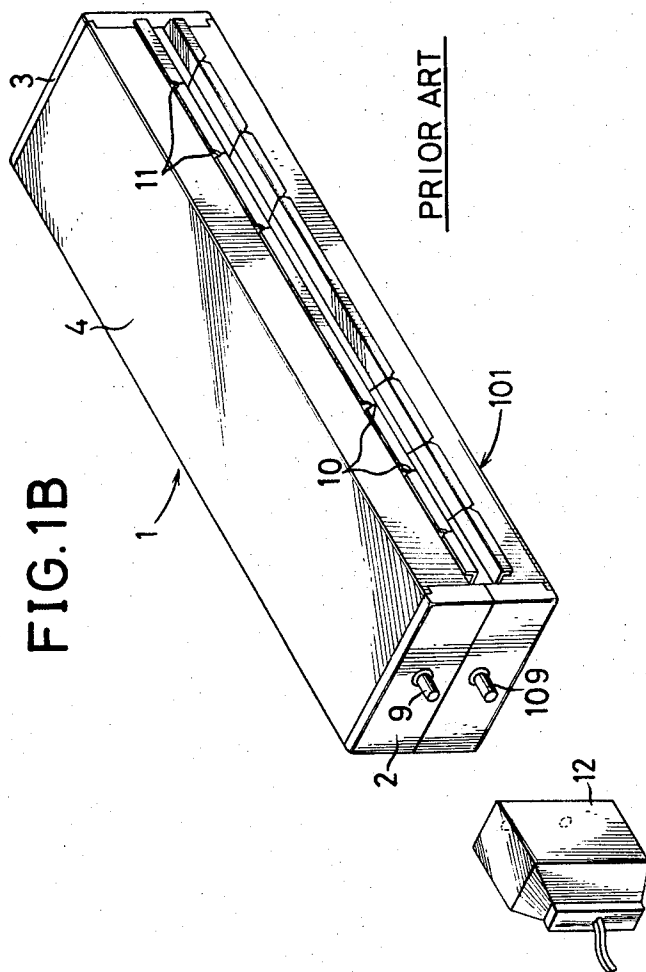
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- ABSTRACT**

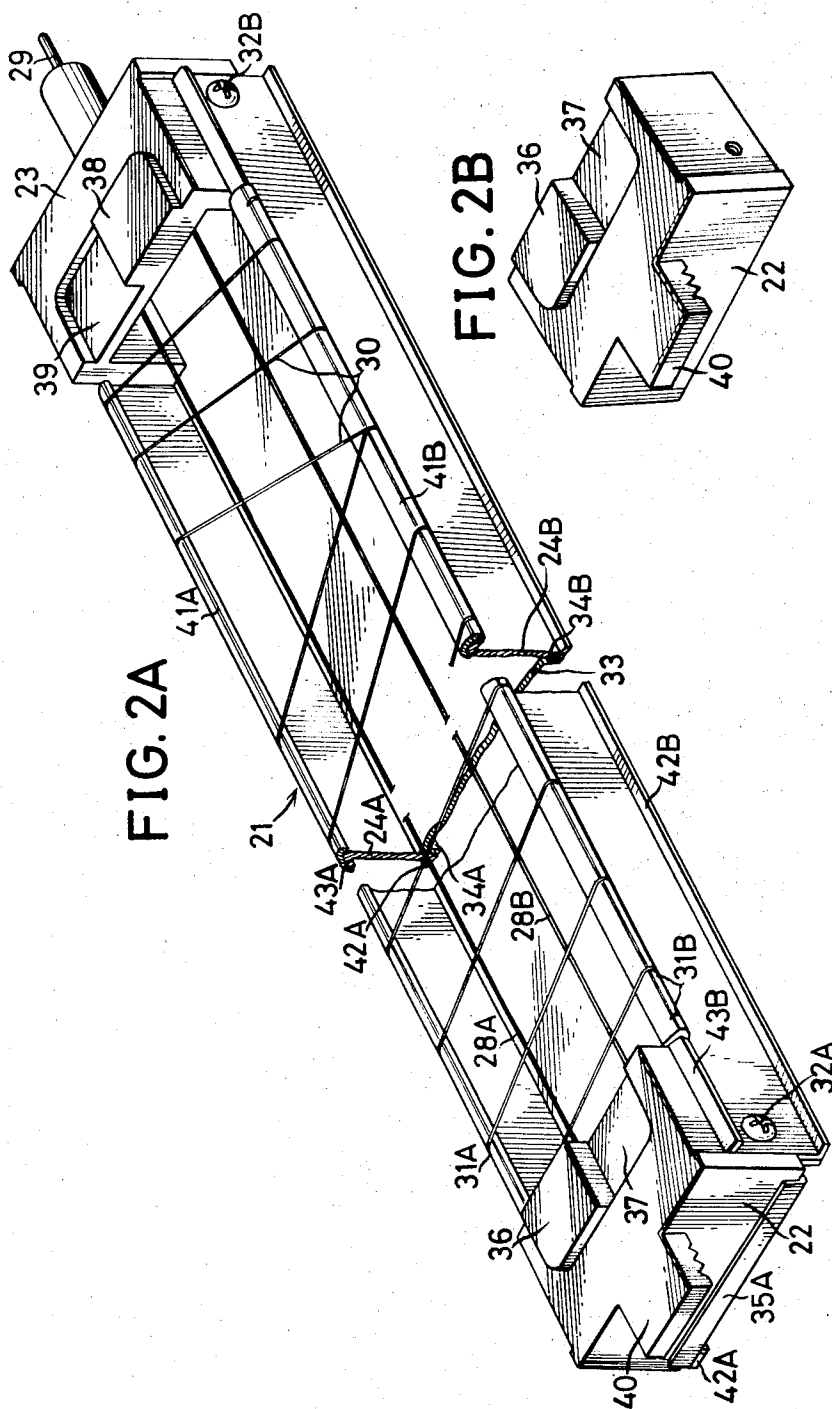
A charging apparatus for electrostatically charging copying material in an electro-photographic copying machine includes a receptacle with its bottom plate fitted detachably and held in place by a spring. This receptacle holds a tungsten wire to produce a corona discharge and the wire can be easily replaced by removing the bottom plate.

12 Claims, 12 Drawing Figures









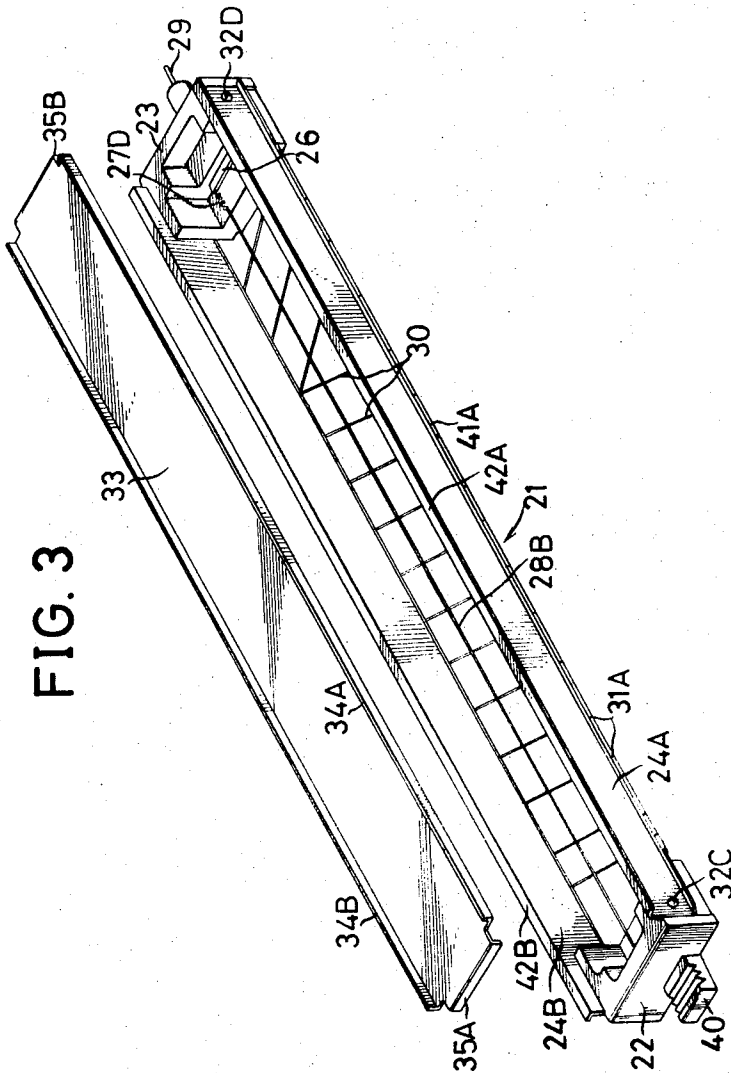


FIG. 4A

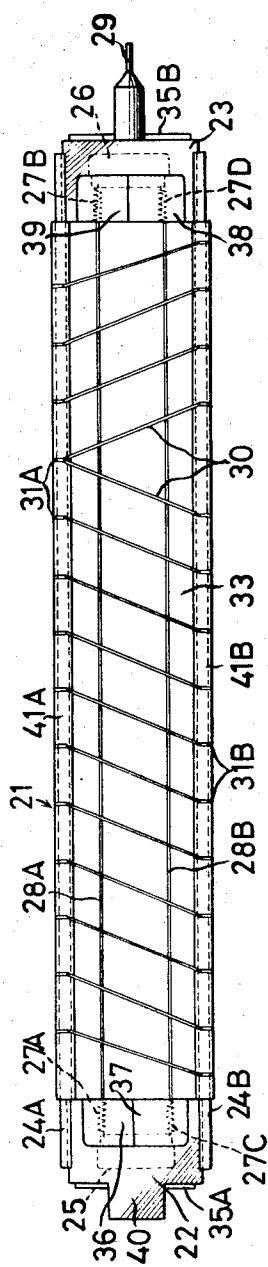


FIG. 4B

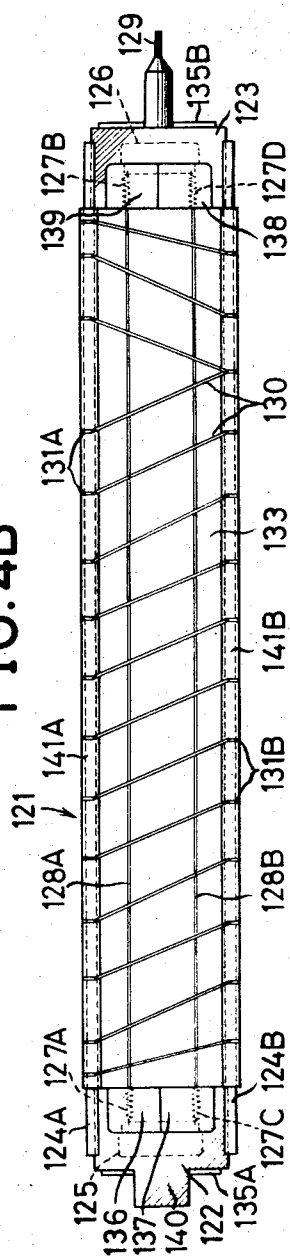


FIG. 4C

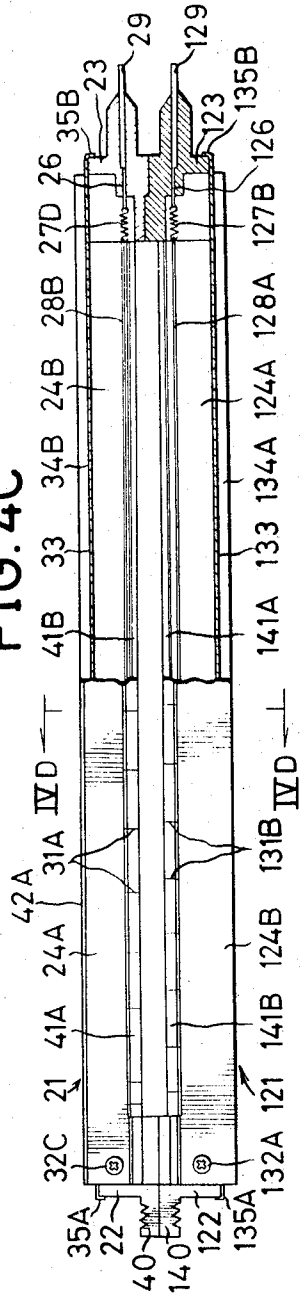
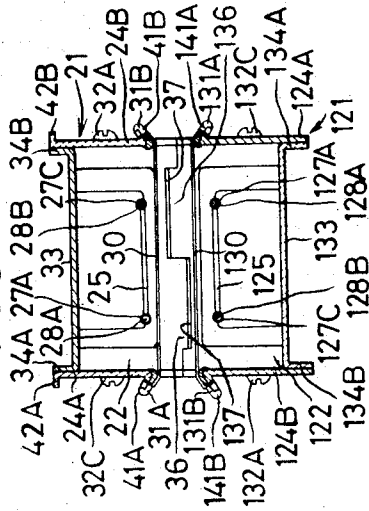


FIG. 4D



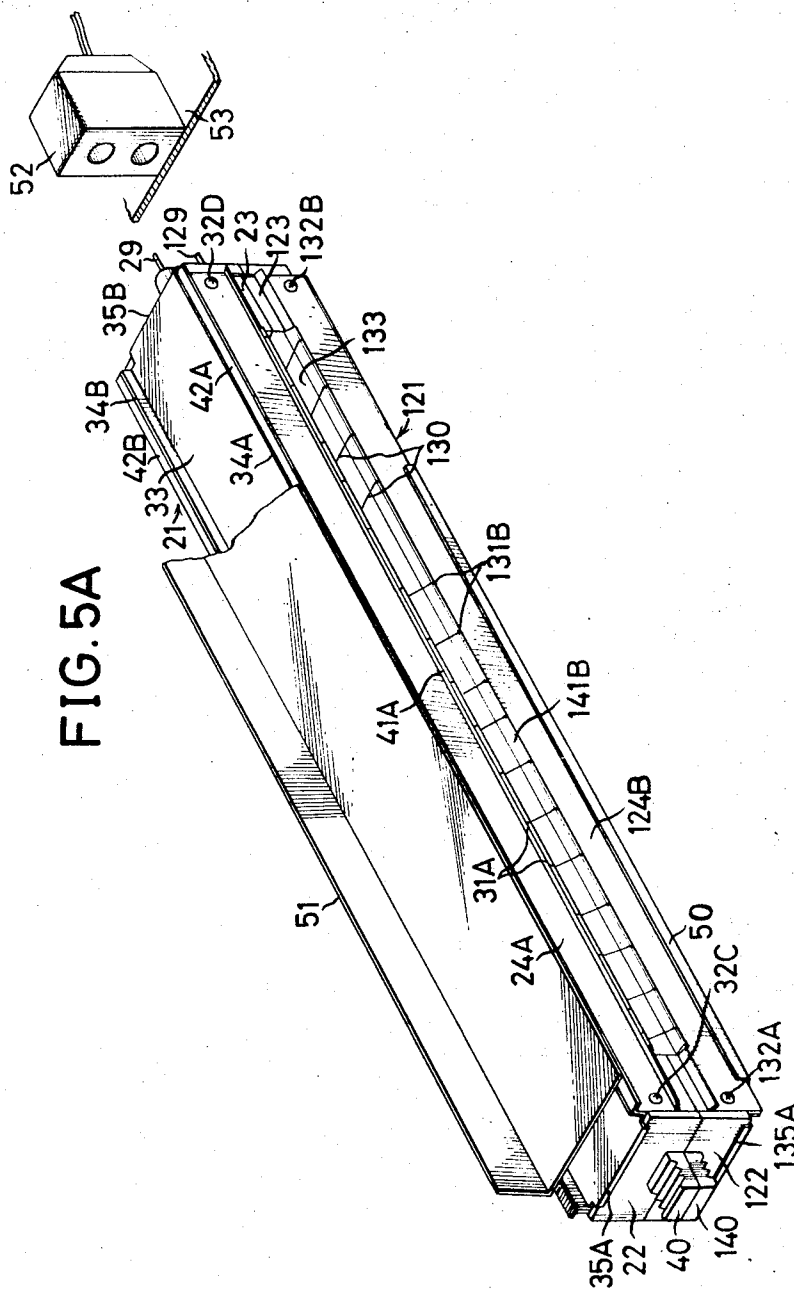


FIG. 5B

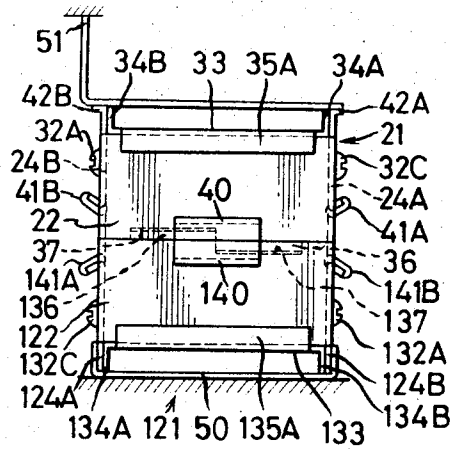
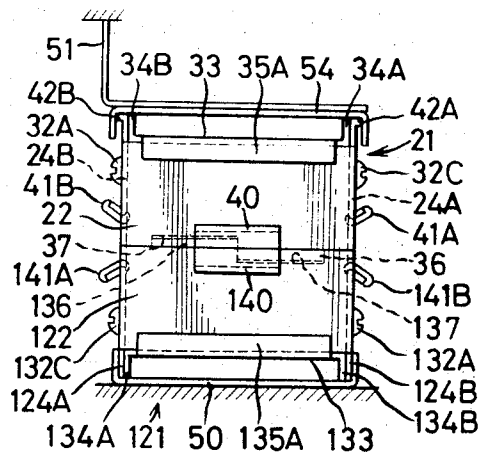


FIG. 6



CHARGING APPARATUS FOR ELECTRO-PHOTOGRAPHIC COPYING MACHINES

FIELD OF INVENTION

This invention relates to a charging apparatus in an electro-photographic copying machine for electrostatically charging a photo-sensitive surface.

Electro-photographic copying machines in which a static charge is given to a photosensitive surface, then selectively discharged by projecting an optical image on to the photosensitive surface, whereafter a permanent image is formed by suitable development and fixing, are well known. In such machines, the charging apparatus which charges the sensitive surface, for example photosensitive paper, performs a very important role. This charging apparatus comprises a conductive wire, for example tungsten wire, producing a corona discharge by being subjected to high voltage, a receptacle holding the conductive wire and having an open side. A guide arrangement, for example several nylon threads spanning the open side of the receptacle guides sensitive paper as it moves across the receptacle.

In the known charging apparatus, however, replacement of the conductive wire that produces the corona discharge has been extremely troublesome when it gets dirty or breaks due to some reason.

Accordingly, the object of this invention is to provide charging apparatus in an electro-photographic copying machine which is easy to repair and service, the apparatus nevertheless being simple and adapted to give a good electro-photographic print.

SUMMARY AND OBJECT OF THE INVENTION

According to the present invention, there is provided charging apparatus for electrostatically charging a photosensitive surface in an electrostatic copying machine, comprising a receptacle open on one side, a wire in the receptacle for producing a corona discharge, at least one guide member spanning the open side for guiding a photosensitive material across the open side to be charged by the corona discharge, the receptacle including a removable plate on the side opposite the open side, this plate being held in place by resilient means.

The invention will be described in more detail by way of example with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a perspective view of half of a charging apparatus as used in the prior art;

FIG. 1B is a perspective view of the complete charging apparatus of FIG. 1A;

FIG. 2A is a perspective view, partially broken away, of one embodiment of a charging apparatus in accordance with this invention;

FIG. 2B is a perspective view of an insulating end member of the charging apparatus shown in FIG. 2A;

FIG. 3 is a perspective view of the charging apparatus shown in FIG. 2A with its bottom plate detached;

FIG. 4A is a plan view of the charging apparatus shown in FIG. 2A;

FIG. 4B is a plan view of another charging apparatus making a pair with the charging apparatus shown in FIG. 4A;

FIG. 4C is an elevation partially in section, showing the charging apparatus of FIGS. 4A and 4B put together to make a pair.

FIG. 4D is a sectional view taken on line IVD — IVD of FIG. 4C;

FIG. 5A is a perspective view, partially broken away, of the charging apparatus shown in FIG. 4C and 4D as installed in the copying machine;

FIG. 5B is an end elevation of FIG. 5A; and

FIG. 6 shows a modification of FIG. 5B.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1A, in the charging apparatus 1 as used in the prior art, a metal terminal plate 5 is fixed on an insulating end member 2 while a metal terminal plate 6 is fixed on an insulating end member 3. Between the terminal plates 5 and 6, a metal wire 8A (such as tungsten wire) for producing corona discharge is tensioned by coil springs 7A and 7B attached at both ends while another metal wire 8B is tensioned by coil springs 7C and 7D. A connecting terminal 9 is provided on the insulating end member 2 to apply a high voltage to these tungsten wires 8A and 8B. Further the wires 8A and 8B are encircled on 3 sides, i.e. bottom and both sides, by a channel shaped case or receptacle 4 made of metal, whose section takes the form of a rectangular "U." On the upper end of the case 4, insulating thread 10, for example nylon thread, is wired zigzag through notches 11 to form a guide arrangement allowing photosensitive paper to slide over the apparatus without entering the receptacle.

FIG. 1B shows the charging apparatus 1 confronting a similar complementary charging apparatus 101. A plug socket 12 is fitted on the connecting terminals 9 and 109 to supply negative and positive high voltage to these terminals respectively. As the result, corona discharge occurs around the wires 8A and 8B. By passing sensitive papers through the space between the charging apparatus 1 and the charging apparatus 101 on (+) side, using the nylon threads 10 as guide members, the papers can be charged negatively. By projecting optical images upon the sensitive papers that have been charged (—) in a manner stated above, charged and non-charged portions are formed. After developing and fixing the sensitive papers, permanent images become available.

When the wires 8A and 8B get dirty or break, they must be replaced. In the charging apparatus shown in FIG. 1A, however, unless the nylon thread 10 be taken away or cut off, replacement of the wire is impossible. The charging apparatus is fixed to the main body of the electro-photographic copying machine by means of a fixture which is arranged so as to fix a pair of charging apparatuses in the state shown in FIG. 1B by clamping them from above. Fixing and detaching the charging apparatus therefore has been a troublesome job, necessary whenever a wire has to be changed.

In FIG. 2A, charging apparatus 21 embodying the invention comprises insulating end members 22 and 23 made of synthetic resin positioned at left and right ends, side plates 24A and 24B fixed on the insulating end members 22 and 23 by screws 32A and 32B, a bottom plate 33 lying between the bottom edges of the side plates 24A and 24B, tungsten wires 28A and 28B spanning the end members 22 and 23, and nylon thread 30 spanning the upper edges of the plates 24A and 24B.

The insulating end member 22 is provided, as shown in FIG. 2B, with a recess 37 and projection 36 adjoining each other on the upper side while a knob 40 sticks out from the side. The insulating end member 23 has a recess 39 and projection 38 adjoining each other on the upper side while a connecting plug 29 projects from the side.

The side plates 24A and 24B have out-turned flanges 42A and 42B at their lower edges and 43A and 43B at their upper edges. The flanges 43A and 43B have insulated cappings 41A and 41B stuck to them. The cappings have slits 31A and 31B for the nylon thread. As the material for the side plates 24A and 24B, aluminium or aluminium alloy is suitable but other metals having a similar elasticity to aluminium, for example iron or a ferrous-alloy, can also be used. Aluminium side plates are desirably from 0.1 to 5mm thick, more desirably from 0.5 to 2mm thick. This is because the spring function of these plates will then be good.

The nylon thread 30 may be about 0.127mm in diameter and is tensioned so that the side plates 24A and 24B tend to bow inwardly when the bottom plate 21 is taken off as shown in FIG. 3. By this tensioning of the nylon thread 30, the side plates 24A and 24B have a maximum elastic deformation at the center while at both ends there is a minimum elastic deformation, where the insulating end members 22 and 23 at both ends, prevent elastic deformation. As a substitute for the nylon thread, insulating wire or thread made of other synthetic or natural material can also be used. If nylon thread is used, the thickness is preferably 0.05mm to about 1mm, more desirably from 0.1mm to about 0.5mm, from the standpoint of allowing good charging and its elasticity against the sensitive paper.

The bottom plate 33 that is wedged between the side plates 24A and 24B may be made of aluminium plate of about 1mm in thickness. It is desirable for the thickness to be from 0.1mm to about 5mm, more desirably from 0.5 to 2mm. Aluminium or aluminium alloys are suitable but other materials having elasticity similar to aluminium, for example iron or ferrous-alloys, or metals without appreciable elasticity can also be used. The plate 33 as shown in FIG. 3 has flanges 34A and 34B at both sides and flanges 35A and 35B at both ends. The flanges 34A and 34B facilitate smooth fixing and detaching of the bottom plate 33 while the flanges 35A and 35B position the bottom plate longitudinally by engaging outside the insulating end members 22 and 23.

The bottom plate 33 is merely wedged between the side plates 24A and 24B. When inserting the bottom plate 33 between side plates 24A and 24B, one end can be pushed between the side plates, the bottom plate 33 being inclined. While holding the inserted end in place, the rest of the bottom plate 33 is pushed in, whereby the bottom plate can force its way between the side plates 24A and 24B, springing the centre part of the side plates 24A and 24B open a little. The bottom plate 33 is then securely gripped between the side plates by the spring force of side plates 24A and 24B, assisted by the tension in the nylon thread 30. The strength of the spring force can be determined by the thickness and size of the side plates 24A and 24B and the size of the nylon thread 30.

The tungsten wires 28A and 28B can be about 0.03mm in diameter. As shown in FIG. 4A, the wires are tensioned between metal terminal plates 25 and 26 fitted in the insulating end members 22 and 23 through

coil springs 27A, 27B, 27C and 27D fitted on both ends of tungsten wires. In order to supply the high voltage, for example -3.6kv, to the tungsten wires 28A and 28B, the insulating end member 23 has its connecting plug 29.

Further, the complete charging apparatus, as shown in FIGS. 4C and 4D, employs one charging apparatus 21 on the negative side and charging apparatus 121 on the positive side.

When the two apparatuses are fitted together the recesses and projections 36 - 39 of one mate with the complementary projections and recesses of the other, thereby allowing the two to be handled as one stable unit. The two handle portions 40 lie adjacent to form one knob which can be gripped to slide the unit in and out of the machine.

Since the two apparatuses are substantially identical, the second will not be described. Its parts have the same reference numerals as the parts of the first apparatus increased by 100. It should be mentioned however that the nylon thread 130 contacts the back of the sensitive paper, so its diameter can be larger than that of the nylon thread 30, e.g., approx. 0.284mm.

As seen in FIGS. 5A and 5B, the unit formed by the pair of charging apparatuses 21 and 121 is slid longitudinally between a lower guide rail 50 of channel section and an upper plate 51 of L-shape in section, this rail and plate being carried by the main body 53 of the electro-photographic copying machine. The guide rail 50 and the upper plate 51 hold the charging unit in the correct position for the sensitive paper to enter the slot (most clearly visible in FIG. 4C) between the two apparatuses. Near the end of the guide rail 50, a plug socket 52 is fixed to the main body 53 to receive the plug-in terminals 29 and 129.

When installing the charging unit, the charging apparatus 21 and apparatus 121 are placed together to make a unit. Projections 36 and 38 mate in recesses 137 and 139 and projections 136 and 138 mate in recesses 37 and 39. The knob parts 40 and 140 come together to form one knob. The unit is put in by sliding along the guide rail 50, under the upper plate 51 as shown in FIGS. 5A and 5B, until the plugs 29 and 129 enter the plug socket 52. Then the apparatus can be used in the usual way.

When a tungsten wire, after long service, fails to produce a good corona discharge due to dirtiness, or breaks due to such a trouble as paper getting into contact with the wire because of failure of proper guiding of the sensitive paper, the pair of charging apparatuses 21 and 121 be pulled out from the main body 53 of the electro-photographic copying machine by means of the knob 40, 140, the apparatuses remaining as one unit because of the mating projections and recesses. If the tungsten wires 28A and 28B of the apparatus 21 are to be replaced, they can be replaced with new ones after the bottom plate 33 is detached from the receptacle. This can be done without difficulty as the bottom plate 33 is merely gripped between the side plates 24A and 24B. Re-fitting the bottom plate to the receptacle is simply done by pushing the former into the latter. The charging apparatuses 21 and 121 can be separated if found necessary.

In FIG. 6, a modification of FIG. 5B, is illustrated wherein a guide rail 54 or channel section is fixed to the lower side of the upper plate 51. By having upper and lower guide rails 54 and 50, the mounting of the pair

of charging apparatuses 21 and 121 is strengthened and further the sliding operation of the pair of apparatuses is stabilized better.

Various other modifications are of course possible. For example, it is not necessary to rely upon the spring action of the side plates 24A and 24B. A connecting portion, for example a ball-like projecting portion, that elastically deforms, can be formed on the bottom plate, this connecting portion being arranged to fit into a connecting portion, for example a ball-like projecting portion, formed on the side plate or insulating end member in order to hold the bottom plate. Also, in the above embodiments, the side plates are provided with nylon threads to yield spring action but other means of affording spring elasticity can also be used. In addition to these means of holding the bottom-plate by spring action, other holding means, for example hanging metal fittings, can also be jointly used.

What is claimed is:

1. Charging apparatus for electrostatically charging a photosensitive surface in an electrostatic copying machine, comprising a receptacle including walls forming openings on two opposing sides of said receptacle and a removable plate extending between an opposing pair of said walls and in resilient gripping engagement therewith so as to cover one of said openings with said plate, a wire in the receptacle for producing a corona discharge, at least one guide member spanning an opposing pair of said walls at the other of said openings for guiding a photosensitive material across the other of said openings to be charged by the corona discharge, said guide member being tensioned between said opposing walls so as to enhance the gripping engagement with said removable plate.

2. Apparatus according to claim 1, wherein another opposing pair of said walls form end members comprising insulating material, between which said corona discharge wire extends, and a knob for sliding the apparatus in and out of the copying machine being provided on one of said end members.

3. Apparatus according to claim 1, wherein said guide member comprises an insulating thread or wire tensioned between said opposing pair of said walls to enhance the grip thereof on said removable plate.

4. Apparatus according to claim 1, wherein said opposing pair of said walls comprise aluminium.

5. Apparatus according to claim 4, wherein said aluminium walls are 0.1mm to 5mm thick.

6. Apparatus according to claim 1, wherein said removable plate comprises aluminium.

7. Apparatus according to claim 6, wherein said aluminium removable plate is 0.5mm to 5mm thick.

8. Apparatus according to claim 1, wherein said guide member is formed from nylon thread.

9. Apparatus according to claim 8, wherein said thread is 0.5mm to 1mm in diameter.

10. A charging unit comprising two apparatuses according to claim 1, fitted together with their open sides facing each other but spaced apart to allow the photosensitive material to enter between the apparatuses.

11. A charging unit according to claim 10 wherein the two apparatuses have projections and recesses which mate when the apparatuses are fitted together.

12. An electrostatic copying machine comprising charging apparatus for electrostatically charging photosensitive material and guide means for supporting said charging apparatus, said apparatus being slidably mounted in the guide means and comprising a receptacle including walls forming openings on two opposing sides and a removable plate extending between an opposing pair of said walls and in resilient gripping engagement therewith so as to cover one of said openings with said plate, a wire in the receptacle for producing a corona discharge, at least one guide member spanning an opposing pair of said walls at the other of said openings to be charged by the corona discharge, said guide member being tensioned between said opposing walls so as to enhance the gripping engagement with said removable plate.

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