ABSTRACT: A charging device for an electrostatic copier has at least two parallel corona wire sections with each two wire sections being sections of a single continuous corona wire, at least one U-shape cross section housing shell of electrically conductive material, and insulating mountings at the ends of the device. One mounting includes a double-acting clamping mechanism clamping both opposite ends of the single corona wire, and the other mounting includes an abutment member having the corona wire trained therearound and spring biased away from the ends of the single corona wire. The clamping mechanism is a wedge type clamping mechanism which is readily adjustable, and the abutment member has a conical section engaging the single corona wire and is axially adjustable for setting the wire tension.
CHARGING DEVICES FOR ELECTROSTATIC COPIERS

BACKGROUND OF THE INVENTION

The present invention relates, as indicated, to a charging device for electrostatic copying apparatus with at least two parallel corona wires, the supports of which comprise resilient means and at least one housing shell or cover with U-shaped cross section made of a conducting material and insulating mountings at the end of this arrangement.

Such apparatus is already known in the art and arranged at one end of a paper guide, wherein the U-shaped housing shell covers the side remote from the guide. It is also known to provide twin arrangements in such a manner that corona wires are arranged above and below the paper guide, wherein the U-shaped housing shells are provided on the top and bottom of the outside. It is also known in this arrangement to equip the facing sides of the apparatus with paper guide means. Such means have, for example, the form of plastic films wound around the whole device.

In known apparatus the individual wires extend over the entire length of the apparatus and have both their ends mounted in springs which give rise to a certain wire tension. This suspension is rather complex, because the very thin corona wire, having for example, a thickness of only a few hundredth of a millimetre, must be cut and fixed by comparatively complicated fixing means on the springs, which is difficult even if the wire were only fixed in eyelets. It must be taken into account that the wire, which is very highly stressed in operation, tends to become damaged or fractured at points of high mechanical stresses, especially at bends and kinks. Moreover, in the known arrangement, the spring tension cannot be adjusted.

Special problems are encountered when the corona wires are to be installed or exchanged, especially in view of the fact that the known devices necessitate always the separate and complicated fitting of each individual wire section. Where every wire section is suspended between two springs, different tensions of different wires may easily occur.

Apart from these drawbacks, known devices have comparatively complicated constructions. In these, the housing shells, made from conducting materials, are simultaneously acting as distance members and supports for the mounting which are again themselves in several parts. Thus, the housing shells are connected by screws to mounting members which are held together in twin arrangements by means of spacers and retained in a caplike member. In this construction, the accessibility to the wire mounting is very difficult and requires the while arrangement to be dismantled.

SUMMARY OF THE INVENTION

The invention has the object of improving the wire mounting so that the fitting of the wires is facilitated and the entire device is substantially simplified.

According to the invention, one mounting at one end of the apparatus has a double-acting clamping mechanism for the ends of the wire, and the other mounting at the other end comprises a spring-loaded abutment movable in the axial direction of the wires, about which the wire is positioned.

In this manner, the hitherto used two wires are replaced by a continuous wire loop, the ends of which can be fixed in an easily operated clamping mechanism which requires no kinking of the wires, while the tension is achieved by removing the spring from the wire and positioning it in the mounting, wherein the abutment is of such construction as to ensure the smooth course of the wire.

Preferably, the clamping mechanism has the form of a wedge lug in which the facing flanks approach each other towards the center of the device, and comprising a wedge member adapted to be fitted between these flanks, wherein the wire ends can be clamped tightly between the wedge member and the flanks. This also improves the reliability of the mounting for tensioning the wire.

In a further, particularly preferred embodiment, which can be combined with the previously described, a spreading clamping member is arranged between two retaining surfaces, and a conical screw is guided within the clamping member in an orifice having appropriately shaped conical edges, two edge sections of which are formed by different portions of the clamping member. The screw is fitted into a thread in the mounting, enabling the clamping pressure to be accurately adjusted, while the wedge-shaped configuration of the clamping member serves to ensure that the fixed ends of the wire are not positioned exactly in the direction of the wire tension. In addition thereto, this embodiment has further advantages for introducing the ends of the wire which can be located in the wedge pocket by moving the spreading member before the screw is finally tightened. Naturally, the screw within the spreadable clamping member, which can also be reliably secured in profiles, can also be replaced by an equivalent wedge-shaped spreading member.

Preferably, at least one of the flanks is provided with a contact strip which automatically makes contact with a terminal contact when the mounting is fitted. This is important for automatically making the connection of the apparatus to the fitting, and has also the further advantage of providing a comparatively long contact path on the contact strip, thus preventing any local over stressing of the wire.

According to yet another feature of the invention, the abutment is a roller, mounted rotatably on a spindle which is located on a reciprocable support. This arrangement ensures, on the one hand, the smooth guiding of the wire at the abutment, while preventing on the other hand frictional movement during the fitting of the wire at the abutment end. A further advantage is that the two wire sections can expand differentially under the action of slight differences in the material properties, and this differential expansion is fully absorbed by the arrangement according to the invention, while, in known devices, one of the wires would be slackener than the other.

For facilitating the arrangement of the very thin wire, the roller has a cylindrical and a conical section which expands from the cylindrical section. Thus, the wire can first be fitted over the conical section and can then be moved by manipulating the wire end along the conical section down to the cylindrical section, while the position in height is determined by cross members in both mountings.

Preferably, the guide pins are arranged parallel to the wire run in the roller-side mounting and the support is adapted to reciprocate on these guide pins, wherein the ends of the guide pins, facing the center, have flanges serving as abutments for the springs and the support has a bearing web on the outside, forming the abutment for the other ends of the springs. These springs have, however, also another object. In order to simplify the assembly, the mounting has, in the axial extension of the pins, transversely extending head members against which rest the flanged ends of the pins, the other ends of which are received in bores in the mounting. The springs serve to press the fitted pins against the head members.

According to yet another feature of the invention, the roller has fitted thereto a pointer, extending across the longitudinal direction of the apparatus, and associated with a marker on the mounting. This enables a mean or desired spring tension to be accurately preset at all times.

According to an essential feature of the invention, the two mountings at both ends are constructed as integral frames, open at both sides, wherein the open side facing the paper guide is bridged by laminations or segments of insulating material, providing a continuous plastic support or carrier. Preferably, the U-shaped housing shell is equipped with end members and insulating material adapted to be the flanged end of the other opening of the frame, the sidewalls of which have recesses into which extend the sidewalls of the U-shaped shell.

A preferred embodiment of the invention comprises a two-part construction comprising a frame forming the mountings at its ends and a detachable housing shell, which substantially simplifies the access and assembly.
According to the invention, in connection with a frame for mounting the apparatus, the mutually facing frame sidewalks have profiles extending substantially in the horizontal direction, and associated with a web projecting in spaced relationship towards the center, while corresponding mating profiles are provided on the mountings and the spacing between the web and the mutually interengaging profiles is so dimensioned that the web retains the outer rear wall of the housing shell on the frame. Thus, the frame and wall fulfill with their interengaging parts not only the object of acting as assembly aids, but also act as fixing means for the individual parts of the apparatus.

In the twin construction mentioned herebefore, comprising two frames and two housing shells, wherein the mutually facing frame openings are equipped with guide sheets, the webs arranged in the sidewalks above and below the profiles are connected by a vertical web so as to form a laterally open pocket, into which both devices can be introduced from the side, wherein the vertical web forms an abutment for the individual apparatus after their insertion.

With regard to the contact strip, there is provided according to the invention, a contact plate in one sidewalk of the frame, extending at the level of the contact strip on the clamping mechanism into the path of the frame, recessed at the end at this height and making contact with the contact strip when the frame is fitted. Thus, during the assembly of the apparatus, not only is the mutual location of the parts fixed, but at the same time the contact is made.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will be further described, by way of example, with reference to the accompanying drawings, showing an embodiment thereof and in which:

**FIG. 1.** is a side elevation of the apparatus according to the invention, in partial cross section along the centerline;

**FIG. 2.** is a cross section along the line II-II in FIG. 1;

**FIG. 3.** is a cross section along the line III-III in FIG. 1, but with the housing shell detached, showing a roller-shaped abutment and a clamping screw not in cross section, and a housing lug adapted to receive a pressure pin for a contact plate in cross section, although this housing is below the section line;

**FIG. 4.** is a cross section along the line IV-IV in FIG. 1;

**FIG. 5.** is a cross section along the line V-V in FIG. 4;

**FIG. 6.** shows a detail of the abutment and its arrangement in top view, corresponding to the item shown at VI in FIG. 3; and

**FIG. 7.** is a front elevation of FIG. 6.

**DESCRIPTION OF THE PREFERRED EMBODIMENT**

In all FIGS, identical parts are designated by the same reference numerals.

A frame adapted to receive the apparatus according to the invention, has frame sidewalks 1 and 2, parts of which serve as mountings. The apparatus shown in the drawings is a twin apparatus with corona wires above and below a guide for copying paper; this guide is shown at 3. Since both halves of the apparatus, that is to say, the parts on either side of the guide, have identical construction, only one of these halves will be described in the following.

The apparatus consists of a frame 4 of insulating material, open at the top and at the bottom, and having longitudinal sidewalks 5 and 6 (FIG. 2). Both ends of the frame form mountings, closed at the lower end 7 and 8. At the end of the mounting 8, the frame is closed by an end wall 9, while the end wall at the end of the mounting 7 is recessed at 10.

The mounting 7 contains a clamping mechanism for fixing two wire ends. From the sidewalks 5, 6, there extend inwardly directed projections 11, 12 whose mutually facing flanks 13, 14 are inclined towards the centerline so that they approach one another in the direction of the center of the apparatus. The ends are rounded. The flanks 13, 14 form a wedge pocket. A clamping member, consisting of two spreadable parts 15 and 16, is located in this wedge pocket. These parts (FIG. 5) form the conical edge portions 17, 18 of an opening, wherein the taper extends perpendicularly to the extent of the wedge pocket. The two parts 15, 16 may be held together by an elastic web 19.

Into the said opening engages a screw 20, the cylindrical threaded end 21 of which engages into a thread 22, for example, into a captive nut located in the bottom 23 of the mounting. The shaft of this screw 20 has a conical section 24. This conical section cooperates in such a manner with the edge portions 17, 18 that the parts 15 and 16 are spread apart or relieved according to whether the screw 20 is screwed in or out.

One of the flanks, namely the flank 14, is lined with a contact strip 25, which extends over the outer, rounded off, end 74 of the flank and thus into the zone of the recess 10 in the end face of the frame.

In the other mounting, two guide pins 26 and 27 extend from the end face 9. These guide pins are inserted with their ends into holes provided in this end wall. The other ends of the guide pins, projecting into the apparatus, have expanded heads 28, 29, serving as abutments for springs. Within the mounting, there are arranged head members 30, 31, in front of the heads 28, 29.

The pins guide a support or carrier 32, adapted to rest on the base plate 33 of the mounting, and equipped with at least one bearing web 34, guided, through orifices, on the pins 26, 27. Between the web 34 and the heads 28, 29, there are compression springs 35, 36, tending in the one hand to urge the carrier 32 to the left, as viewed in FIGS. 1 and 3, and on the other hand, to press the heads 28, 29 on to the head members 30, 31. In this way, the pins are automatically retained after the assembly, while the assembly can be effected by interengaging the parts with the springs compressed.

The carrier has arranged thereon a perpendicular pivot pin 37 on which is mounted, possibly via a bearing bush, a freely rotatable roller 38; this roller 38 has a cylindrical section 39 and adjacent thereto an upwardly conically expanding section 40.

In order to fix the height of the fitted wires, each mounting is equipped with crossmembers 41, 42, along the upper edge of which the wire sections are drawn.

As shown in FIG. 3, the two wire sections 43, 44 form part of one wire which passes about the roller 38, and the ends of which are fixed at 45, 46 on the flanks 13, 14, making simultaneously contact with the contact strip 25.

During the installation, a slight clamping takes place prior to the tightening of the screw 20, enabling the wire to be tensioned in a certain manner in order to compress and to tension the springs 35, 36 by a certain amount. The roller 38 or the carrier 32 carry, according to FIG. 6, a pointer 47 which cooperates with a marking or pointer 48 on a crossmember 49 of the mounting 8. The wires are so tensioned that the pointers indicate the same values.

As may be seen particularly from FIGS. 2 and 3, the sidewalks 5, 6 of the frame are provided in the zone between the mountings 7, 8 on the inside with recesses 50, 51. Into these recesses engage the sidewalks 52, 53 of a U-shaped housing shell of conducting material in such a manner that they are firmly and indelibly retained. Mounted in the ends of the upper wall 54 of this housing shell are cover sections 55, 56 of insulating material, covering at the same time also the frame 4 within the region of the mountings 7, 8 towards the outside. It may be seen that these cover sections may also have a U-shaped cross section and must comprise an end section resting, for example, on the end wall 9.

The sidewalks have profiles, consisting of a groove 57 between two inwardly projecting webs 58, 59. In addition, there is also provided an inwardly directed web 60 in spaced relation from the former. Within the frame 4, there is a projecting rim web 61, arranged at least within the region of the end wall and adapted to engage into the groove 57. The spacing of the web 60 is such that it engages in this position directly the facing cover section 56 and locates the same on the sidewalks 2, by introducing the apparatus into the mount-
ing. Thus the whole apparatus consists of two detachable parts which are held together in the operating position by the insert.

In addition, there is arranged, for example, for the upper device in FIG. 1, a contact plate 62 in the sidewall 2, extending from the side in the direction of insertion with a contact section 63 obliquely over the inner surface of the sidewall 2.

The end is bent and passes through a hole 64 in the sidewall to its outside. An extended end portion 65 engages the rim of the hole 64 and prevents the plate from being pushed too far from the sidewall. At one point, as shown at 66 for the lower apparatus, the sidewall has a cylindrical housing lug 67 open in the direction of the hole 64. This lug serves as a guide for a pressure member 68 pulled by a spring 69, resting on the bottom of the lug 67, through the sidewall and engaging the contact plate, for example in the zone of its bend, and retained thereby. The bend is at a point which coincides with the bend end 74 of the contact strip 25 so that contact is made by the insertion.

In the twin arrangement, an equivalent mounting is provided, for example, for the lower apparatus in FIG. 1. This mounting is merely arranged in reverse so that the clamping mechanism in FIG. 1 is underneath the mounting 8 such that the contact terminals are located on different sides. Obviously, the lower apparatus has a lower web 70 (FIG. 2) corresponding to the web 60 in FIG. 1, top right. Both webs 60 and 70 are interconnected by a vertical web 71, forming a pocket in the shape of a channel, the vertical web 71 of which serves as abutment during the insertion. The lower apparatus has a profile, corresponding to the groove 57.

The openings of the upper device by which FIG. 4, shows the opening 72 of the lower frame 4 in FIG. 1, are preferably bridged by moulded laminations 73. As shown in FIG. 2, these laminations may have flattened ends. Relative to a centerline, these laminations extend perpendicularly to the longitudinal direction of the apparatus in the form of an arrow so that they diverge in the direction of flow of the copying paper.

1. In a charging device for an electrostatic copier having at least two parallel corona wire sections whose supports include resilient means, at least one U-shaped cross section housing shell of electrically conductive material, and insulating mountings at the ends of the device; the improvement comprising, in combination, each two wire sections being sections of a single continuous corona wire; one of said mountings including a double-acting adjustable wedge clamping mechanism clamping both opposite ends of said single corona wire, the other mounting including a reciprocably mounted, circular cross section abutment member having said single corona wire trained therearound; and spring means biasing said abutment member away from the ends of said single corona wire.

2. In a charging device for an electrostatic copier, the improvement claimed in claim 1, wherein each of said mountings has a crossweb; said crosswebs fixing the level of the wire sections relative to the depth of each U-shaped housing shell.

3. In a charging device for an electrostatic copier having at least two parallel corona wire sections whose supports include resilient means, at least one U-shaped cross section housing shell of electrically conductive material, and insulating mountings at the ends of the device; the improvement comprising, in combination, each two wire sections being sections of a single continuous corona wire; one of said mountings including a double-acting clamping mechanism clamping both opposite ends of said single corona wire, the other mounting including an abutment member having said single corona wire trained therearound; and spring means biasing said abutment member away from the ends of said single corona wire.

4. In a charging device for an electrostatic copier, the improvement claimed in claim 3, in which at least one of said facing flanks has a contact strip extending therealong; and a terminal contact automatically engaging said contact strip upon assembly of said one mounting.

5. In a charging device for an electrostatic copier, the improvement claimed in claim 4, in which said mountings are in the form of integral frames open on both sides, each frame having an open side facing a paper guide forming part of said device; lamination of insulating material bridging the open side of each frame facing said paper guide; said U-shaped housing shell including end members of insulating material; the sidewalls of each frame having recesses formed therein, each U-shaped housing shell having sidewalks engageable in recesses in the sidewalls of a respective frame, and each U-shaped housing shell closing the outer open side of a respective frame; said device comprising two parts, one of which is constituted by a frame having its ends forming said mountings and the other of which is constituted by a disengagable housing shell.

6. In a charging device for an electrostatic copier, the improvement claimed in claim 5, in which said laminations are molded integrally with respective frames.

7. In a charging device for an electrostatic copier, the improvement claimed in claim 3, in which said wedge member comprises two relatively spreadable parts whose facing edges define a bore having a frustoconical surface; and a screw having a frustoconical surface engageable with said bore, said screw having an end threaded into a threaded aperture of said one mounting.

8. In a charging device for an electrostatic copier having at least two parallel corona wire sections whose supports include resilient means, at least one U-shaped cross section housing shell of electrically conductive material, and insulating mountings at the ends of the device; the improvement comprising, in combination, each two wire section being sections of a single continuous corona wire; one of said mountings including a double-acting clamping mechanism clamping both opposite ends of said single corona wire; the other mounting including an abutment member having said single corona wire trained therearound; spring means biasing said abutment member away from the ends of said single corona wire; said abutment being a roller; said other mounting including a reciprocable support; and a pin on said support rotatably mounting said roller.

9. In a charging device for an electrostatic copier, the improvement claimed in claim 8, in which said roller has a cylindrical portion and a conical portion diverging from said cylindrical portion.

10. In a charging device for an electrostatic copier, the improvement claimed in claim 8, wherein said other mounting includes guide pins extending parallel to the runs of said parallel wire sections, each of said pins having a flanged inner end serving as a spring abutment; said reciprocable support having a mounting web apertured to receive said guide pins; respective springs embracing said guide pins and engaged between said flanged ends and said mounting web; said other mounting having bores receiving said guide pins outwardly of said mounting web; and transversely extending head members on said other mounting engaging the flanged ends of said pins.

11. In a charging device for an electrostatic copier, the improvement claimed in claim 8, including a pointer on said roller extending perpendicularly to the longitudinal extent of said device; and a marker on said other mounting cooperating with said pointer.

12. In a charging device for an electrostatic copier having at least two parallel corona wire sections whose supports include resilient means, at least one U-shaped cross section housing shell of electrically conductive material, and insulating mountings at the ends of the device; the improvement comprising, in combination, each two wire section being sections of a single continuous corona wire; one of said mountings including a double-acting clamping mechanism clamping both
opposite ends of said single corona wire; the other mounting
including an abutment member having said single corona wire
trained therearound; spring means biasing said abutment
member away from the ends of said single corona wire; said
device including a frame having mutually facing sidewalls hav-
ning horizontally extending profiles each associated with a
respective web, the profiles and the web extending toward the
center of the frame; said mountings have profiles mating with
said frame profiles; the spacing of each web from the in-
terengaging profiles being such that each web retains the outer
wall of an associated housing shell on said frame.

13. In a charging device for an electrostatic copier, the im-
provement claimed in claim 12, wherein each frame profile
comprises a groove between two projecting profile webs, and
is arranged to receive a rib extending from a respective
mounting.

14. In a charging device for an electrostatic copier, the im-
provement claimed in claim 12, in which said device is a twin
construction including two said frames and two said housing
shells; said frames having mutually facing frame openings
formed with guide laminations; the sidewall webs on cor-
responding sidewalls of each frame being connected by a ver-
tical web to form a laterally opening pocket; said vertical webs
forming abutments for inserted individual charging devices; a
contact strip extending along said clamping mechanism in
conducting relation with said corona wire; a contact plate in
one frame sidewall extending at the level of said contact strip
into said pocket and making contact with said contact strip
upon assembly of said frame.

15. In a charging device for an electrostatic copier, as
claimed in claim 14, a pocket on said one frame sidewall; a
spring in said pocket; a pin in said pocket engaged by said
spring and extending through an aperture in said one sidewall;
said pin engaging said contact plate; said contact plate having
a bent end extending through said orifice in said one sidewall
and forming an abutment defining the maximum deflection of
said contact plate under the bias of said spring engaged with
said pin.