

SPECIFICATION

Toner fixing devices for electrophotographic copying apparatus

5 The invention relates to toner fixing devices for electrophotographic copying apparatus for fusing a toner image onto the upper side of a sheet-like copy support, and especially to such devices having a
10 heated plate for heating the underside of the copy support.

In known devices of this kind, of which one is the subject, for example, of US-PS 3 187 162, an attempt has been made to ensure adequate thermal contact
15 between the sheet of paper and the heating plate by making the upper surface of heating plate as smooth as possible. However, this arrangement has been shown to result in uneven warming of the sheet even when special measures are taken to press the sheet
20 against the heating device. The result is non-uniformly fixed copies with both areas of toner that are too strongly fixed and areas of toner that are too weakly fixed on one and the same copy.

The invention provides a fixing device for electrophotographic copying apparatus for fusing a toner image to the upper side of a sheet-like copy support, having a plate, which in use is heated for heating the underside of the copy support, the upper side of the heating plate being divided by longitudinal and
30 transverse ribs into individual sections that are separate from one another, each of which in use encloses a cushion of air, the ribs serving to space the copy support away from the heating plate, the top portions of the ribs being such that the copy
35 support is contacted by the ribs only over very narrow areas.

In this manner the sheet no longer lies with the major portion of its area in direct contact with the surface of the heating plate, but is separated from it
40 by cushions of warm air. The result is an extremely uniform heating of the underside of the sheet, which leads to a correspondingly uniform appearance of the fixed image. In addition, distortion of paper copy supports is avoided or greatly reduced as a result of
45 the uniform heating process.

Advantageously, the upstream faces of the transverse ribs are raked back.

Advantageously, suction nozzles that in use are connected to a source of reduced pressure and hold
50 copy supports in contact with the ribs open out through the surface of the heating plate. Advantageously, the suction nozzles open into one or more suction ducts that are adjacent to each section defined by ribs and extend across the entire heating
55 plate transversely to the normal direction of movement of copy supports. A channel for suction air, of which the upper closure is formed by the heating plate penetrated by the suction nozzles may be provided.

In this manner the sheet is uniformly positioned by simple means over its entire width on the ribs, the suction action being restricted to the region around the suction duct and the air cushions enclosed between the ribs remaining unaffected thereby.

65 Advantageously, the longitudinally extending ribs,

viewed in the direction in which the sheet is transported, are angled with respect to the normal direction of movement of the copy supports. Thus, individual lines of the copy support lying in the direction of movement A of the copy support are prevented from lying adjacent to the ribs throughout the entire passage of the copy support, which could lead to the formation of a visible mark in this region. Preferably, the longitudinal ribs are angled symmetrically outwardly, with respect to the downstream direction of movement A of the copy supports, from the centre of the heated plate, and it is then possible in known manner to obtain a force acting on the sheet with a stretching or smoothing action in a
80 lateral direction as the sheet passes through.

Advantageously, in a manner known *per se* at least one thermostatically controlled heating element extends through the heating plate transversely to the direction of transport. Preferably above the heating plate there is mounted in a manner known
85 *per se* a heat radiator. Advantageously, the portion of the heating plate over which a copy support first passes in normal operation of the device is a pre-heating zone provided only with longitudinal
90 ribs which are so shaped as to guide an approaching copy support onto the heating plate.

Two forms of toner fixing device constructed in accordance with the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a longitudinal section through part of an electrostatic copying apparatus including the first form of fixing device;

Figure 2 shows a perspective view of a part of the device shown in *Figure 1*; and

Figure 3 shows a plan view of part of an apparatus including the second form of device.

Referring to *Figure 1*, the first form of device comprises a heating plate 2 which is arranged in an apparatus housing 1 and forms the upper wall of a suction air duct 3 which is connected to a source of reduced pressure (not shown). Another suction air duct 4 is arranged upstream of the device as defined with respect to the normal direction of movement A of a copy support 5 to be transported through the fixing device. Around the suction air duct 4, which is provided on its upper side with suction air openings 4a, are tensioned conveyor belts 8, which are guided by guide rollers 6 and 7 and which, together with the suction air duct 4, in known manner form a vacuum-transport device for the copy support 5. This vacuum-transport device, together with transport rollers 9 and 10 arranged downstream of the fixing device between guide surfaces 15 and 16, conveys
115 copy supports charged with a toner image that is to be fixed between the heating plate 2 and a heat radiator 11 arranged above the heating plate. The heat radiator 11 is surrounded in known manner by a reflector 12 having cooling ribs 12a to 12c and which
120 is preferably of elliptical cross-section.

In the heating plate 2, which preferably consists of aluminium, there is a heating element 13 extending transversely to the direction A. The heating element 13 is connected to a thermostatic control device (not shown) of a known type. The control device causes

the heating plate 2 to be maintained permanently at a predetermined temperature, for example of 100 to 130°C, when the electrophotographic copying apparatus in which it is installed is in a state of readiness for use.

As may be seen in Figure 2, the heating plate 2 carries on its upper side two ribs 2a which are transverse to the direction A and a plurality of ribs 2b which are longitudinal to the direction A which divide the portion of the heating plate that is between the ribs 2a, above the heating element 13 and below the heat radiator 11 and 12 into rectangular, recessed sections. The ribs 2a and 2b have rounded top edges so that they have only very narrow areas of contact with the copy support 5 transported across them. The copy support 5 thus comes into contact essentially only with the cushions of heated air that have developed in the sections defined by the ribs 2a and 2b and which heat the areas of the copy support located above them in a very uniform and careful manner.

The heating plate 2 carries suction channels 2c and 2d running the length of, and bounded on the inside by, the transverse ribs 2a joined by means of bores 14 to the suction duct 3. As may be seen in Figure 2, the suction channels 2c and 2d are closed off at their ends by bars 2e running parallel to the direction A, so that a vacuum is able to develop in these channels joined to the suction duct 3 as soon as they are covered at the top by a copy support. If the width of the heating plate 2 approximately equals the width of the copy support, it is thus ensured that the copy support is drawn towards ribs 2a and 2b immediately in front of and behind the sections enclosed by them and by this means is in optimum contact with the air cushions enclosed by these ribs throughout its passage through the fixing device.

Before a copy support moving in the direction A reaches the actual heating zone, it passes over a pre-heating zone which is provided with longitudinal ribs 2f. By these ribs, direct contact of the copy support with the heating plate 2 is prevented in this preheating zone as well. Owing to the absence of a further transverse rib at the upstream edge 2g of the heating plate 2, and to the sloping upstream ends of the ribs 2f, the leading edge of a copy support enters the fixing device very easily. For the same reason the suction channels 2c and 2d have a saw-tooth shaped cross-section, as shown in Figures 1 and 2, the sides of the transverse ribs which face the incoming edge of a sheet being raked at a more acute angle to the direction of movement of the sheet than the opposite side of the ribs.

Referring now to Figure 3, the second form of device is the same as that shown in Figures 1 and 2, except that the transverse ribs 2a are connected by longitudinal ribs 2h which are symmetrically angled away from the centre of the heating plate 2 by an angle α with respect to the direction of movement A of the copy support. Thus, firstly, it is not always the same places on the sheet that come into contact with the heated ribs 2h in the actual heating zone during the passage of the sheet, which could lead to a visible mark on the sheet running in the longitudinal direction of the sheet, and secondly, the snow-

plough-like arrangement of the ribs 2h exerts forces laterally outwards, in the direction of the arrows B in Figure 3, on the sheet as it passes through, which causes a smoothing action to take place.

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CLAIMS

1. A fixing device for electrophotographic copying apparatus for fusing a toner image to the upper side of a sheet-like copy support, having a plate, which in use is heated for heating the underside of the copy support, the upper side of the heating plate being divided by longitudinal and transverse ribs into individual sections that are separate from one another, each of which in use encloses a cushion of air, the ribs serving to space the copy support away from the heating plate, the top portions of the ribs being such that the copy support is contacted by the ribs only over very narrow areas.
2. A fixing device as claimed in claim 1, wherein some of the longitudinal ribs are angled with respect to the normal direction of movement of the copy support.
3. A fixing device as claimed in claim 2, wherein the angled longitudinal ribs are angled outwardly with respect to the normal direction of movement of the copy support.
4. A fixing device as claimed in any one of claims 1 to 3, wherein there are provided suction nozzles that in use are connected to a source of reduced pressure and open out through the surface of the heating plate to enable copy supports to be held in contact with the ribs.
5. A fixing device as claimed in claim 4, wherein the suction nozzles open into one or more suction ducts that are adjacent to each section defined by ribs and extend across the entire heating plate transversely to the normal direction of movement of the copy support.
6. A fixing device as claimed in claim 5, wherein the upstream sides, as defined with respect to the normal direction of movement of copy supports, of the transverse ribs are raked back from the vertical.
7. A fixing device as claimed in any one of claims 4 to 6, wherein a suction air channel of which the upper closure is formed by the heating plate penetrated by the suction nozzles is provided.
8. A fixing device as claimed in any one of claims 1 to 7 wherein in a manner known *per se*, at least one thermostatically controlled heating element extends transversely to the direction of transport through the heating plate.
9. A fixing device as claimed in any one of claims 1 to 8, wherein in a manner known *per se*, a heat radiator is mounted above the heating plate.
10. A fixing device as claimed in any one of claims 1 to 9, wherein the portion of the heating plate over which a copy support first passes in normal operation of the device is a pre-heating zone provided only with longitudinal ribs which are so shaped as to guide an approaching copy support onto the heating plate.
11. A toner fixing device substantially as hereinbefore described with reference to, and as

the heating plate 2 to be maintained permanently at a predetermined temperature, for example of 100 to 130°C, when the electrophotographic copying apparatus in which it is installed is in a state of readiness

5 for use.

As may be seen in Figure 2, the heating plate 2 carries on its upper side two ribs 2a which are transverse to the direction A and a plurality of ribs 2b which are longitudinal to the direction A which

10 divide the portion of the heating plate that is between the ribs 2a, above the heating element 13 and below the heat radiator 11 and 12 into rectangular, recessed sections. The ribs 2a and 2b have rounded top edges so that they have only very

15 narrow areas of contact with the copy support 5 transported across them. The copy support 5 thus comes into contact essentially only with the cushions of heated air that have developed in the sections defined by the ribs 2a and 2b and which

20 heat the areas of the copy support located above them in a very uniform and careful manner.

The heating plate 2 carries suction channels 2c and 2d running the length of, and bounded on the inside by, the transverse ribs 2a joined by means of bores

25 14 to the suction duct 3. As may be seen in Figure 2, the suction channels 2c and 2d are closed off at their ends by bars 2e running parallel to the direction A, so that a vacuum is able to develop in these channels joined to the suction duct 3 as soon as they are

30 covered at the top by a copy support. If the width of the heating plate 2 approximately equals the width of the copy support, it is thus ensured that the copy support is drawn towards ribs 2a and 2b immediately in front of and behind the sections enclosed by

35 them and by this means is in optimum contact with the air cushions enclosed by these ribs throughout its passage through the fixing device:

Before a copy support moving in the direction A reaches the actual heating zone, it passes over a

40 pre-heating zone which is provided with longitudinal ribs 2f. By these ribs, direct contact of the copy support with the heating plate 2 is prevented in this preheating zone as well. Owing to the absence of a further transverse rib at the upstream edge 2g of the

45 heating plate 2, and to the sloping upstream ends of the ribs 2f, the leading edge of a copy support enters the fixing device very easily. For the same reason the suction channels 2c and 2d have a saw-tooth shaped cross-section, as shown in Figures 1 and 2, the sides

50 of the transverse ribs which face the incoming edge of a sheet being raked at a more acute angle to the direction of movement of the sheet than the opposite side of the ribs.

Referring now to Figure 3, the second form of

55 device is the same as that shown in Figures 1 and 2, except that the transverse ribs 2a are connected by longitudinal ribs 2h which are symmetrically angled away from the centre of the heating plate 2 by an angle α with respect to the direction of movement A

60 of the copy support. Thus, firstly, it is not always the same places on the sheet that come into contact with the heated ribs 2h in the actual heating zone during the passage of the sheet, which could lead to a visible mark on the sheet running in the longitudinal

65 direction of the sheet. and secondly, the snow-

plough-like arrangement of the ribs 2h exerts forces laterally outwards, in the direction of the arrows B in Figure 3, on the sheet as it passes through, which causes a smoothing action to take place.

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CLAIMS

1. A fixing device for electrophotographic copying apparatus for fusing a toner image to the upper side of a sheet-like copy support, having a plate, which in use is heated for heating the underside of the copy support, the upper side of the heating plate being divided by longitudinal and transverse ribs into individual sections that are

75 separate from one another, each of which in use encloses a cushion of air, the ribs serving to space the copy support away from the heating plate, the top portions of the ribs being such that the copy support is contacted by the ribs only over very

80 narrow areas.

2. A fixing device as claimed in claim 1, wherein some of the longitudinal ribs are angled with respect to the normal direction of movement of the copy support.

3. A fixing device as claimed in claim 2, wherein the angled longitudinal ribs are angled outwardly with respect to the normal direction of movement of the copy support.

4. A fixing device as claimed in any one of claims 1 to 3, wherein there are provided suction nozzles that in use are connected to a source of reduced pressure and open out through the surface of the heating plate to enable copy supports to be held in contact with the ribs.

5. A fixing device as claimed in claim 4, wherein the suction nozzles open into one or more suction ducts that are adjacent to each section defined by ribs and extend across the entire heating plate transversely to the normal direction of movement of the copy support.

6. A fixing device as claimed in claim 5, wherein the upstream sides, as defined with respect to the normal direction of movement of copy supports, of the transverse ribs are raked back from the vertical.

7. A fixing device as claimed in any one of claims 4 to 6, wherein a suction air channel of which the upper closure is formed by the heating plate penetrated by the suction nozzles is provided.

8. A fixing device as claimed in any one of claims 1 to 7 wherein in a manner known *per se*, at least one thermostatically controlled heating element extends transversely to the direction of transport through the heating plate.

9. A fixing device as claimed in any one of claims 1 to 8, wherein in a manner known *per se*, a heat radiator is mounted above the heating plate.

10. A fixing device as claimed in any one of claims 1 to 9, wherein the portion of the heating plate over which a copy support first passes in normal operation of the device is a pre-heating zone provided only with longitudinal ribs which are so shaped as to guide an approaching copy support onto the heating plate.

11. A toner fixing device substantially as hereinbefore described with reference to, and as

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shown in, Figures 1 and 2 of the accompanying drawings.

12. A toner fixing device as claimed in claim 11, modified substantially as hereinbefore described with reference to, and as shown in, Figure 3 of the accompanying drawings.

13. Electrostatic copying apparatus including a toner fixing device as claimed in any one of claims 1 to 12.

- 10 14. Apparatus as claimed in claim 13, wherein a transport device for the copy support, including a moving belt and a supply of reduced pressure to the underside of the belt, is provided.

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