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(54) IMPROVEMENTS IN AND RELATING TO ELECTROSTATIC COPYING APPARATUS

(71) We, AGFA - GEVAERT AKTIEN-GESELLSCHAFT a body corporate recognised under German Law, of Leverkusen, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to electrostatic copying apparatus.

It is desirable that, in the case of electrostatic copying apparatus having a fixing device for the heat treatment of copying material by means of a heater, and a blower serving for the thermal isolation of the fixing device from heat-sensitive components of the copying apparatus, in particular from the copying drum, damage to the copying material in the fixing device is avoided when faults occur, particularly in the case of failure in the transport of the copying material or failure in the current supply. There is a danger that, should the copying material jam in the fixing device, the copying material will be exposed to the high temperature prevailing in the fixing device for too long a period, and in the most unfavourable case the copying material may catch fire.

The invention provides electrostatic copying apparatus, which comprises an image fixing station having heating means, blower means arranged to hinder over-heating of heat sensitive components of the apparatus, means for monitoring the speed at which copying material is transported through the apparatus, the monitoring means being arranged to produce a control signal when the speed of transport of the copying material falls below a predetermined minimum value, and means for directing air from the blower means into the image fixing station in response to the control signal.

The arrangement offers the advantage that the blower means, which is in any case

present to serve for the thermal isolation of the fixing station from heat-sensitive components of the copying apparatus, is at the same time utilized to cool the interior of the fixing station in the case of faults. By this means, excessive heating of the copying material, and the danger of fire are prevented in simple manner.

According to an advantageous embodiment of the invention, the air directing means comprises a flap that closes an aperture of the fixing station, the flap being held in its initial position by a holding device against the force of a spring acting on the flap and the holding device being associated with a control device that varies its action in accordance with the transport speed of the copying material and causes the flap to be freed when the transport speed falls below a pre-determined value.

Advantageously, the holding devices contain an electro-magnet and the control device associated with the electro-magnet contains a reference stage as well as a generator providing a voltage dependant on the movement of the copying material.

Expediently, the generator contains an operational amplifier including a capacitor in the feedback branch, a controllable semiconductor arranged parallel to the operational amplifier, and a pulse contact device connected to the control electrode of the semiconductor and driven by the copying material. The reference stage is expediently constructed as a threshold stage.

In order to ensure sufficient cooling of the copying material in the fixing station even during a failure in the current supply, the blower contains an inertial mass, preferably a flywheel, that ensures that blower air is provided for a sufficiently long period after the supply voltage has failed.

Electrostatic copying apparatus constructed in accordance with the invention will now be described, by way of example, with

reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of a part of the copying apparatus; and

Fig. 2 shows a circuit arrangement for measuring the transport speed of the copying material.

With reference to the accompanying drawings, and initially to Figure 1, a portion of the copying apparatus which is indicated generally by the reference numeral 1, has a housing 2, which contains a copying drum 3. The copying apparatus 1, includes a fixing device indicated generally by the reference numeral 4, which is provided with a heater 5, a heat reflector 6, and guide bars 7 and 8 for copying paper 9. The housing of the fixing device 4 is provided with apertures 10 and 11.

The copying apparatus 1 is further provided with a blower 12, located in a housing 13. The blower 12 includes a flywheel 14.

In normal use, the aperture 11 of the fixing device 4 is covered by a flap 15 which is held in the position shown in Fig. 1 by the action of an electro-magnet 16 connected to a control device 17. A spring 18 acts on the flap 15, the action of the spring being such as to urge the flap to move into the position shown in chain-dotted lines in Figure 1.

A profiled metal sheet 19, is situated above the aperture 11.

During normal operation of the copying apparatus 1, with the aperture 11 of the fixing device 4 covered by the flap 15, the blower 12, rotating in the direction of the arrow A, produces a stream of cooling air that is directed in the direction of the arrows B to flow between the fixing device 4 and the housing 2. If a fault occurs in the transport of the copying paper 9 in the fixing device 4, the electro-magnet 16 is de-energised by the operation of the control device 17 and the magnetic connection 20, holding the flap 15 over the aperture 11, is broken so that the flap is caused to move by the spring 18 into the position shown by dash dotted lines. With the flap 15 in this raised position, the air flow from the blower 12 is directed through the aperture 11, in the direction of the arrows C, into the fixing device 4. This causes the hot air contained in the fixing device 4 to be discharged through the aperture 10.

With reference to Fig. 2, an electric motor 21 is linked to a drive cylinder 25 via a belt drive connection 22, 23, 24. Above the drive roller 25 is positioned a shaft 26, provided with rollers 27 and 28 which lie against the drive roller 25. The path of the copying paper 9 passes between the drive roller 25 and the rollers 27 and 28, material passing beneath the rollers 27 and 28 being urged by the weight of these rollers onto

the drive roller 25.

One end of the shaft 26 is provided with a rotatable pulse contact disc 29 having alternate conductive and non-conductive zones, 30 and 31 respectively, arranged about its periphery. Two contact springs 32 and 33 are arranged to brush against the periphery of the disc 29 as it rotates.

The switch 32, 33 is connected in series with a resistor 34. This series connection is arranged in parallel with two batteries 35 and 36. A differentiating circuit, comprising a capacitor 37 and a resistor 38, is connected in series with the resistor 34. The differentiating circuit 37, 38 is linked to the control electrode of a field effect transistor 39, the main electrode path of which is arranged in parallel with a capacitor 40. The capacitor 40 is situated in the feedback circuit of an operational amplifier 41. The inverting input of the operational amplifier 41 is connected to the negative pole of the battery 36 via a variable resistance 42.

From the output of the operational amplifier 41, a connection leads to a trigger stage 43, the threshold value of which is determined by the values of two resistors 44 and 45, the resistance 45 being variable. The electro-magnet 16 is connected in the output circuit of the trigger stage 43. The trigger stage 43 is so constructed that the electro-magnet 16 is excited when the input voltage of the trigger stage lies below its threshold voltage, and is deactivated when the input voltage of the trigger stage exceeds its threshold voltage.

When the copying paper 9 is transported in the direction of the arrow D, between the rollers 27 and 28 and the drive roller 25, the shaft 26, and hence the pulse contact disc 29, is turned with a tangential velocity equal to the speed of the copying material. The switch 32, 33 is therefore alternately opened and closed at a frequency dependent on the speed of revolution of the disc 29, and hence changes occur in the voltage across the resistor 34. The voltage fluctuations across the resistor 34 are differentiated by the differentiating circuit 37, 38, so that alternately positive and negative pulses are produced at the control electrode of the field effect transistor 39. Since the control electrode of the field effect transistor 39 is connected to the negative pole of the battery 36 via the resistor 38, it is blocked to current flow, when no pulses are occurring at its control electrode, and negative pulses only serve to strengthen further this blocking action. However when a positive pulse is applied, via the differential element 37, 38, to the control electrode of the field effect

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transistor 39 the transistor becomes unblocked and open to current flow.

Normally, with the field-effect transistor 39 in its blocked state, the capacitor 40 is undergoing charging, and hence a rising ramp voltage appears at the output of the operational amplifier 41. However, when the field effect transistor 39 is unblocked due to a positive pulse occurring at its control electrode, the capacitor rapidly discharges through the field effect transistor and hence the ramp signal is destroyed and the output voltage of the operational amplifier 41 is reset to a datum level. After discharging, the capacitor 40 again undergoes charging, the voltage across it being again a rising ramp signal, until the next pulse occurs at the control electrode of the field-effect transistor 39 to allow the capacitor to discharge again. Hence a saw-tooth voltage occurs at the output of the operational amplifier 41, the maximum values of this voltage lying below the threshold voltage of the trigger stage 43 while the copying material 9 is correctly transported. Therefore while the copying paper 9 is being transported at a desired speed, the electro-magnet 16 is excited and hence the flap 15 is held by the electro-magnet 16 against the action of the spring 18 so as to cover the aperture 11, as shown in Figure 1.

If, however, the speed of transport of the copying material 9, or the speed of rotation of the drive roller 25 falls below a predetermined minimum speed, the value of the rising ramp voltage at the output of the amplifier 41 rises to a value which exceeds the threshold value voltage of the trigger stage 43. The electro-magnet 16 is consequently de-energized and the flap 15 is allowed to move into the position into which it is urged by the spring 18, that is to say, into the position shown in Fig. 1 by dash-dotted lines. Thus the cooling air current flowing from the blower 12 is directed in the direction of the arrow C through the aperture 11 to cool the fixing device 4, and, of even more importance, to cool the copying paper 9.

Should the electro-magnet 16 be without current for any other reason, for example, due to failure of the supply voltage, and flap 15 will again be pivoted into the position shown in Fig. 1 by dash-dotted lines to allow air from the blower 12 to enter the fixing device 4. Should the fault be due to failure of the supply voltage, the blower 12 will also be deprived of current but due to the action of the flywheel 14, the rotational motion causing the cooling air flow will continue for a time after the power supply has been cut off.

WHAT WE CLAIM IS:—

1. Electrostatic copying apparatus, which

comprises an image fixing station having heating means, blower means arranged to hinder over-heating of heat sensitive components of the apparatus, means for monitoring the speed at which copying material is transported through the apparatus, the monitoring means being arranged to produce a control signal when the speed of transport of the copying material falls below a predetermined minimum value, and means for directing air from the blower means into the image fixing station in response to the control signal.

2. Apparatus as claimed in claim 1, wherein, in normal use, the blower means tends to thermally isolate heat-sensitive components of the apparatus from the fixing station.

3. Apparatus as claimed in claim 2, which includes a copying drum and the said heat-sensitive components include the copying drum.

4. Apparatus as claimed in any one of claims 1 to 3, wherein the means for directing air from the blower means into the image fixing station comprises flap means and resilient means tending to urge the flap means into a position in which air from the blower means is deflected into the fixing station, and wherein there is provided holding means, which during normal operation of the apparatus hold the flap means against the action of the resilient means in such a position that the fixing station is isolated from the blower means.

5. Electrostatic copying apparatus as claimed in claim 4, wherein the holding device comprises an electromagnet which is deactivated in response to the control signal so as to allow the flap means to move under the action of the resilient means.

6. Electrostatic copying apparatus as claimed in any one of claims 1 to 5, wherein there is provided means for monitoring the speed at which copying material is transported through the apparatus, and arranged to produce the control signal when the speed of the copying material falls below a predetermined minimum value, and wherein the monitoring means comprises means for transmitting a series of pulses the width of which is dependent on the speed at which the material is conveyed, means for generating a ramp signal during each pulse and for resetting the ramp signal to a datum level between the pulses, means for comparing the value of the ramp signal with a reference value and means for generating a control signal when the value of the ramp signal reaches the reference value.

7. Electrostatic copying apparatus as claimed in claim 6, wherein the means for generating a ramp signal comprises a capacitor and means for applying a current to charge the capacitor.

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transistor 39 the transistor becomes unblocked and open to current flow.

Normally, with the field-effect transistor 39 in its blocked state, the capacitor 40 is undergoing charging, and hence a rising ramp voltage appears at the output of the operational amplifier 41. However, when the field effect transistor 39 is unblocked due to a positive pulse occurring at its control electrode, the capacitor rapidly discharges through the field effect transistor and hence the ramp signal is destroyed and the output voltage of the operational amplifier 41 is reset to a datum level. After discharging, the capacitor 40 again undergoes charging, the voltage across it being again a rising ramp signal, until the next pulse occurs at the control electrode of the field-effect transistor 39 to allow the capacitor to discharge again. Hence a saw-tooth voltage occurs at the output of the operational amplifier 41, the maximum values of this voltage lying below the threshold voltage of the trigger stage 43 while the copying material 9 is correctly transported. Therefore while the copying paper 9 is being transported at a desired speed, the electro-magnet 16 is excited and hence the flap 15 is held by the electro-magnet 16 against the action of the spring 18 so as to cover the aperture 11, as shown in Figure 1.

If, however, the speed of transport of the copying material 9, or the speed of rotation of the drive roller 25 falls below a predetermined minimum speed, the value of the rising ramp voltage at the output of the amplifier 41 rises to a value which exceeds the threshold value voltage of the trigger stage 43. The electro-magnet 16 is consequently de-energized and the flap 15 is allowed to move into the position into which it is urged by the spring 18, that is to say, into the position shown in Fig. 1 by dash-dotted lines. Thus the cooling air current flowing from the blower 12 is directed in the direction of the arrow C through the aperture 11 to cool the fixing device 4, and, of even more importance, to cool the copying paper 9.

Should the electro-magnet 16 be without current for any other reason, for example, due to failure of the supply voltage, and flap 15 will again be pivoted into the position shown in Fig. 1 by dash-dotted lines to allow air from the blower 12 to enter the fixing device 4. Should the fault be due to failure of the supply voltage, the blower 12 will also be deprived of current but due to the action of the flywheel 14, the rotational motion causing the cooling air flow will continue for a time after the power supply has been cut off.

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2. Apparatus as claimed in claim 1, wherein, in normal use, the blower means tends to thermally isolate heat-sensitive components of the apparatus from the fixing station.

3. Apparatus as claimed in claim 2, which includes a copying drum and the said heat-sensitive components include the copying drum.

4. Apparatus as claimed in any one of claims 1 to 3, wherein the means for directing air from the blower means into the image fixing station comprises flap means and resilient means tending to urge the flap means into a position in which air from the blower means is deflected into the fixing station, and wherein there is provided holding means, which during normal operation of the apparatus hold the flap means against the action of the resilient means in such a position that the fixing station is isolated from the blower means.

5. Electrostatic copying apparatus as claimed in claim 4, wherein the holding device comprises an electromagnet which is deactivated in response to the control signal so as to allow the flap means to move under the action of the resilient means.

6. Electrostatic copying apparatus as claimed in any one of claims 1 to 5, wherein there is provided means for monitoring the speed at which copying material is transported through the apparatus, and arranged to produce the control signal when the speed of the copying material falls below a predetermined minimum value, and wherein the monitoring means comprises means for transmitting a series of pulses the width of which is dependent on the speed at which the material is conveyed, means for generating a ramp signal during each pulse and for resetting the ramp signal to a datum level between the pulses, means for comparing the value of the ramp signal with a reference value and means for generating a control signal when the value of the ramp signal reaches the reference value.

7. Electrostatic copying apparatus as claimed in claim 6, wherein the means for generating a ramp signal comprises a capacitor and means for applying a current to charge the capacitor.



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8. Electrostatic copying apparatus as claimed in claim 7, wherein the means for generating a ramp signal also comprises an inverting, directly coupled amplifier, the capacitor being connected from the output to the input of the amplifier and the current being applied to the input of the amplifier.
9. Electrostatic copying apparatus as claimed in claim 8, wherein a steady voltage is applied to the non-inverting input of the amplifier, the inverting input being connected to a zero voltage level through a resistor.
10. Electrostatic copying apparatus as claimed in any one of claims 6 to 9, wherein the pulse transmitting means is arranged in the control circuit of a semiconductor device which is arranged in parallel with the capacitor.
11. Electrostatic copying apparatus as claimed in claim 10, wherein the semiconductor device is a field effect transistor connected to the pulse transmitter via a differentiating circuit.
12. Electrostatic copying apparatus as claimed in any one of claims 6 to 11, which comprises rotatable means arranged to be frictionally driven by the material being transported, the pulse transmitting means being responsive to the speed at which the rotatable means is so driven.
13. Electrostatic copying apparatus as claimed in claim 12, wherein the pulse transmitting means comprises a pulse disc arranged to rotate with the rotatable means, and pulse contacts which co-operate with the disc to alternately make and break an electrical connection between the contacts as the disc rotates.
14. Electrostatic copying apparatus as claimed in any one of claims 1 to 13, wherein the blower means comprises rotatable means.
15. Electrostatic copying apparatus as claimed in claim 14, wherein the blower means further comprises a flywheel.
16. Electrostatic copying apparatus as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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