(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 096 450**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **83200851.0**

(22) Date of filing: **10.02.82**

(51) Int. Cl.³: **G 03 G 15/20**

(30) Priority: **24.02.81 IT 6725081**

(43) Date of publication of application:
21.12.83 Bulletin 83/51

(84) Designated Contracting States:
AT DE FR GB

(60) Publication number of the earlier application in accordance with Art. 76 EPC: **0 060 030**

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(54) Electrophotographic copier.

(57) The photocopier uses a magnetic brush unit (32) to develop the image on a photoconductive drum (26). The developed image is transferred to a sheet of paper (39). The photocopier employs a toner fixing system operating cold and under pressure by means of a pair of rollers (56, 58) whose axes are slightly skewed relative to each other. The rollers have different diameters but rotate at the same angular speed in order to create slippage of the upper roller relative to the lower roller for the purpose of obtaining perfectly flat copies in spite of the skew of the rollers.

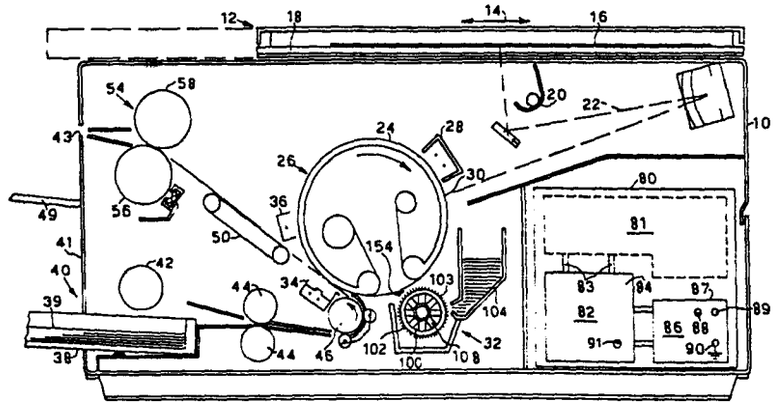


FIG.1

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ELECTROPHOTOGRAPHIC COPIER

This invention relates to an electrophotographic copier comprising means for developing a latent image of an original to be reproduced and formed on a photoconductor element, means for transferring the developed image on to a sheet of paper, and a pair of opposing rollers for the cold-fixing of the image transferred on to the paper sheet, by the action of the pressure between the rollers, and in which the rollers have their axes inclined to each other and at least one roller has a rough surface.

It is known to use rollers pressed one against the other which have their axes inclined at a small angle to each other in order to compensate for the axial deformation due to the applied load. The inclination of the axes leads to deformation of the copying sheets by twisting.

The object of the invention is to provide a copier which obviates this drawback. The invention is characterised in the manner set forth in claim 1 below.

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

Figure 1 is a diagrammatic section through a copier embodying the invention;

Figure 2 is a cross-section through the fixing rollers of Figure 1; and

Figure 3 shows the lubrication device for the rollers of Figure 2 to an enlarged scale.

In Figure 1 a carriage 12 is mounted on the top of copier casing 10 and can move in the two directions 14, to convey an original 16 disposed on a transparent plate 18 fixed to the carriage 12. The original 16 is illuminated by a lamp 20 in order to reflect the image to be reproduced along an optical path 22 on to a photoconductor 24 wrapped round a rotatable drum 26. The drum 26 rotates in a clockwise direction in order to move the photoconductor 24 successively into an electrostatic charge station 28 fed by a negative voltage of the order of -7000 V, into an exposure zone 30, into a development zone 32, into a transfer

station 34 fed by a negative voltage of about -7300 V, and into an erasure station 36 fed by an alternating voltage of about 3500 Vac. During a second revolution of the drum 26, the residual toner remaining on the photoconductor 24 is removed in the station 32.

A drawer 38 containing copying sheets 39 is removably fitted into an aperture 40 situated in the left hand side 41 of the copier. The sheets 39 are fed one at a time by a sheet feeding roller 42 which feeds them by way of rollers 44, 46 to the transfer station 34. The sheets 39 are then conveyed by a belt conveyor 50 to a cold fixing station 54 constituted by two pressure rollers 56, 58. The sheets are fed from the fixing station 54 through an aperture 43 to a tray 49 fixed to the left hand side 41 of the copying machine.

The development station 32 comprises a magnetic brush 100 formed from a rotatable sleeve 102 of non-magnetic material such as stainless steel, on which there is formed a uniform layer 103 of toner fed by a hopper 104. Inside the sleeve 102 there can rotate a steel shaft on which permanent magnets 108 are fixed so that they extend axially and project radially from the shaft 106 nearly to the inside surface of the sleeve 102. The shaft 106 is rotated in a clockwise direction in Fig 1 while the sleeve 102 rotates in an anticlockwise direction with a peripheral speed between about 600 and 750 mm/sec.

Under the effect of the rotation of the magnetic field of the magnets 108, the toner becomes disposed on the sleeve 102 in the form of a layer 103 of uniform thickness, and slides on the sleeve in an anticlockwise direction with a peripheral speed greater than that of the sleeve 102, namely about 800 mm/sec. The toner layer 103 grazes the photoconductor 24 in the zone 154 of minimum distance between the sleeve 102 and drum 26, in order to develop in the normal manner the latent image formed on the photoconductor 24.

The fixing rollers 56, 58 (Figure 2) are rotatable on two pairs of levers 72, 74 respectively, of which only one pair is shown in the Figure, and are pressed together by spring means 71 acting on one end 73 of the levers 72, 74, which are hinged at their other end on a pin 75. The springs 71 apply to the levers 72, 74 a load which is so determined that the pressure exerted by

the upper roller 58 on the lower 56 is sufficient to fix a toner image deposited on the copying sheet 39 when the copying sheet is made to pass between the two rollers. The rollers 56, 58 are rotated in opposite directions at the same angular speed by means of a pair of equal gear wheels 157, 159.

The lower roller 56 is of hardened steel and has a specurlarly polished rolling surface 56', the upper roller 58 also being of hardened steel but having its surface 58' sandblasted and chromium plated by a procedure known in the art in order to provide copies having a non-reflecting opaque surface.

The two rollers 56, 58 are also so mounted that their axes form a small contained angle of between 30' and 2° in order to compensate for axial deformation due to the high applied load, and to allow uniform distribution of the load along the contact line.

In order to prevent the copying sheet from leaving in a deformed condition due to the inclination of the two rollers, according to the invention the upper roller 58 is constructed with a diameter slightly greater than the diameter of the lower roller so as to create a limited peripheral slippage of the upper roller 58 relative to the lower roller 56. In this manner, the upper fibres of the sheet 39 are stretched to an equal extent over the entire width of the sheet, so that any twist caused by the inclination of the rollers is nullified.

The peripheral slippage S is defined by the equation:

$$S = \Delta\phi / \phi_i$$

where $\Delta\phi$ is the difference between the diameters of the two rollers and ϕ_i is the diameter of the lower roller 56. Optimum values of S lie between 0.001 and 0.003. The best flatness of the sheets is obtained where S = 0.0013, and with normal paper having a substance of between 60 and 80 g/m^2.

According to a further characteristic of the invention, the lower roller 56 (Figures 2 and 3) is lubricated with a small quantity of silicone oil, which is transferred by contact to the upper roller 58 during their rotation, during these stages which precede the arrival of a copying sheet to be fixed. The purpose of lubricating the fixing roller 58 is, as is known, to

to prevent adhesion between it and the toner particles, which would soil the copying sheets during their fixing during the subsequent revolutions of the roller 58.

The roller 56 is lubricated by means of a strip of felt 160 (Figure 3) on which is wound a heavy fabric 162, for example a pile fabric provided on one face with a dense layer of fibres 168 such as velvet, so as to form a substantially cylindrical element 160, 162 removably inserted into an appropriate seat 164 supported by a cross member 165 and having a slot 166 facing the roller 56 over its entire length. The portion 167 of velvet fabric 162 included in the slot 166 extends outwardly such that its hairs 168 touch the roller 56.

The felt 160 is soaked with a predetermined quantity of silicone oil, which is then transferred to the roller 56 by capillarity through the fabric 162 by means of the fibres 168 of the velvet 162. The quantity of oil transferred from the lubricating element 160 to the roller 56 can be varied by choosing different lengths of hairs 168. From tests carrier out, it has been found that by varying the pile length from about 3 mm to about 6 mm, a corresponding average oil consumption is obtained which varies from about 4 g to about 7 g for every 10,000 copies made.

Because of the uniform distribution of the velvet pile fibres, the oil is transferred to the cylinder 56 in a constant manner over the entire length of the roller without any precise positioning of the element 160 relative to the roller 56 being required. In addition, by using a pile fabric of the velvet type rather than other lubricating elements formed either from felt alone or from felt enclosed in a non-pile fabric, there is no oil accumulation at the contact strip between the element 160 and roller 56 during the non-working periods of the machine.

The machine is supplied electrically by means of a power unit disposed on a single printed circuit board 80 (Figure 1) comprising all the supply circuits of the voltages required for the copier operation. More specifically, the board 80 is disposed vertically, and comprises a stabilised low voltage D.C. supply circuit 81 of known type, and not described in detail. The board 80 also comprises the high voltage generating circuits used in the charge station 28, transfer station 34 and erasure station 36.

A step-up transformer 82 with a step-up ratio of 1:100 is fed with an alternating voltage of the order of 24 Vac taken from the power unit 81 at two tracks 83. The transformer 82 is embedded in a block 84 of epoxy resin of the type suitable for high voltage and having a dielectric constant of not less than 15,000 V/mm, and a specific electrical volume resistivity of the order of 1.10^{14} ohm. cm. The transformer 82 is of the known type, and is suitable for the high voltages concerned.

Two tracks 85, suitably spaced apart to prevent high voltage discharge, emerge from the transformer 82 to supply a voltage quadrupler circuit 86 of known type formed from a network of diodes and capacitors and embedded in an epoxy resin block 87 of the same type as stated heretofore. The high voltages required by the copier are available at two terminals 88, 89 fixed directly to the resin block 87, a third terminal 90 representing the earth of the high voltage power unit. An alternating voltage of about 3,500 Vac for supplying the erasure station 36 taken from a terminal 91 directly fixed to the block 84.

CLAIMS

1. An electrophotographic copier comprising means (32) for developing a latent image of an original to be reproduced and formed on a photoconductor element (24, 26), means (34) for transferring the developed image on to a sheet of paper (39), and a pair of opposing rollers (56, 58) for the cold-fixing of the image transferred on to the paper sheet, by the action of the pressure between the rollers, and in which the rollers have their axes inclined to each other and at least one roller has a rough surface, characterised in that the roller (58) with the rough surface has a peripheral speed greater than the opposing roller (56) of the pair, so that any deformation of the sheet caused by the inclination of the rollers is nullified.

2. A copier as claimed in claim 1, characterised in that the rollers (56, 58) rotate at the same angular speed in opposite directions and the rough roller (58) has a greater diameter than the opposing roller (56).

3. A copier as claimed in claim 1 or 2, characterised in that the rough roller (58) slips on the opposing roller (56) with a slippage ratio of between 0.001 and 0.003.

4. A copier as claimed in any of claims 1 to 3, characterised in that the said opposing roller (56) is lubricated with silicone oil by means of a lubricating element formed from a spongy member (160) enclosed within a fabric (162) provided with pile fibres (168) on its outer face, so that the oil is transferred, by contact, to the rough roller (58) in order to prevent toner particles adhering to the surface thereof.

5. A copier as claimed in claim 4, characterised in that the fabric (162) is a velvet having a layer of pile fibres of length from 1 mm to 10 mm.

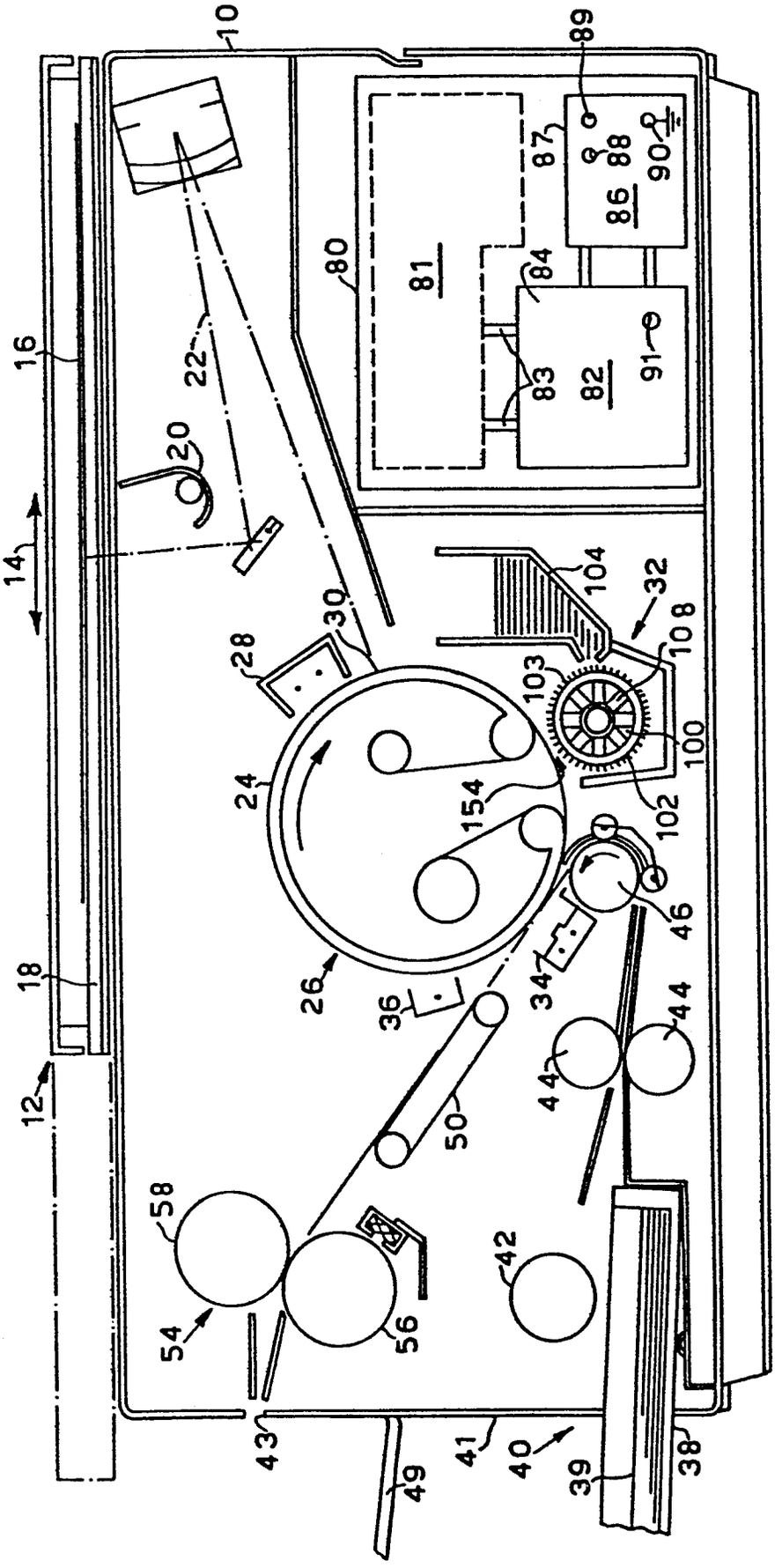

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FIG.1

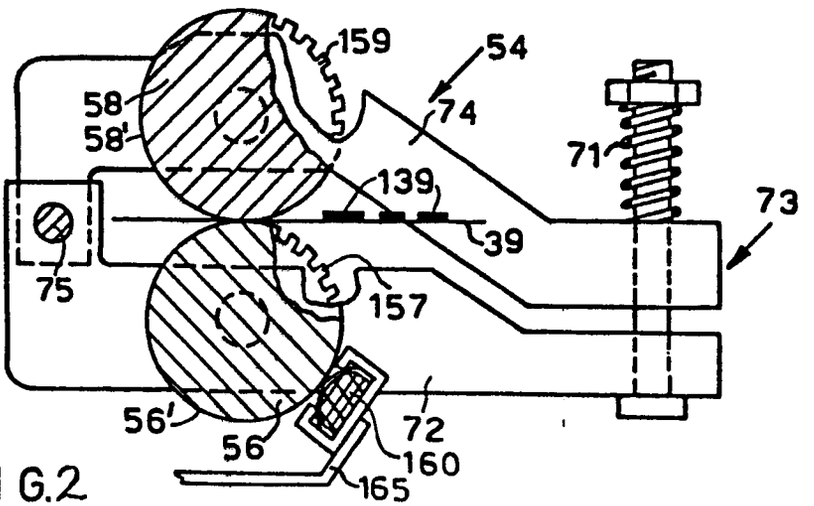

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FIG.2

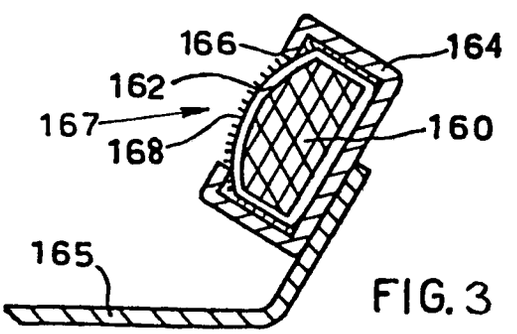

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FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

0096450
Application number

EP 83 20 0851

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	FR-A-2 198 180 (ADDRESSOGRAPH MULTIGRAPH CORPORATION) * Page 1, lines 24-27; page 3, line 22 - page 4, line 26; figures 1,2 *	1,2,4, 5	G 03 G 15/20
P,A	WO-A-8 101 060 (MINNESOTA MINING AND MANUFACTURING CO.) * Page 3, lines 18-33; page 6, line 21 - page 7, line 17 *	1,2	
A	US-A-4 200 389 (T. MATSUI et al.) * Abstract; figures 2,4 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
G 03 G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12-09-1983	GALANTI M.

CATEGORY OF CITED DOCUMENTS

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