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(54) Electrophotographic printing apparatus.

(57) Electrophotographic printing apparatus where the toner image is transferred to the underside of a paper sheet and where the paper sheet is guided from a transfer station (B) to a fixing unit entrance (A), by a grid plate to which the paper sheet adheres owing to suction means (10), the grid plate forming a guiding surface extending from the transfer station towards the fixing unit entrance, and diverging from the plane defined by the transfer station and the fixing unit entrance of an angle such that the path followed by the paper from the transfer station to the entrance of the fixing unit is slighty greater than their distance, whereby allowance is provided for paper contractions and undersired paper tensioning is prevented.

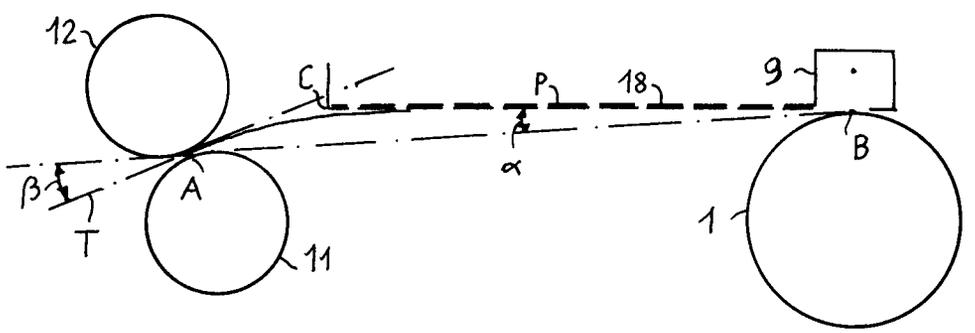

FIG. 2

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The present inventions relates to an electrophotographic printing apparatus, more particularly of the face down type.

Electrophotographic printing apparatuses are known where an image carrier (generally a photosensitive drum), having a toner image formed therein by subjecting the image carrier to a selective radiation exposure followed by a developing operation, is continuously rotated at a peripheral speed equal to the advancement speed of a recording medium, usually paper, which is tangentially brought in contact with the image carrier along a generatrix of the image carrier or contact line.

A corona electrostatic charge generator, usually referred to as scorotron, is located in close proximity to the image carrier at the contact line so that the recording medium crosses the gap between the scorotron and the image carrier.

The effect of the scorotron is to electrostatically charge the recording medium so as to displace the toner from the image carrier and to attract it on the recording medium.

For this reason the scorotron is also named transfer unit and the contact line of the image carrier and the paper, where transfer occurs is named transfer station.

Depending on the location of the transfer station above or below the image carrier, the electrophotographic process is named as face-down or face up process because the toner adheres to the printing medium on the undersurface or the upward surface.

In both cases, after transfer, the recording medium moves along a predetermined path and reaches a fixing station, where by heat and pressure the toner is caused to melt and to permanently adhere to the recording medium.

The face down process offers the advantage of providing an ordered stacking of a plurality of recording medium sheets as they leave the fixing station, without need of turning over devices, or manual rearrangement.

However the face down process requires a carefull handling of the recording medium, along the path between the transfer station and the fixing station.

Along such path the recording medium must be hold in position without contacting the underside surface and without subjecting it to shocks which could cause detaching of the toner from the medium.

A simple way to guide the recording medium is described in EP-A-0292359 where a flat guiding plate defines a rectilinear path between the transfer station and the input of the fixing unit and holds up the paper owing to Coulomb actractive forces.

The arrangement is however effective only at the extent the advancement speed imposed to the recording medium is the same at the transfer station and at the fixing unit.

Moreover, the arrangement makes impossible to take into account the dimensional changes occurring in the recording medium due to the heating operation performed at the fixing station. It has been found that contrarily to any expectation, a contraction, rather than a dilatation occurs in proximity of the fixing station, the contraction being related in unpredictable way to the moisture content of the medium and to its thickness.

The consequence is that the recording medium may be subjected between the fixing unit and the transfer station, to a pull having a non uniform distribution resulting in permanent wrinkling of the medium leaving the fixing unit.

This disadvantage is overcome by the face down electrophotographic printing apparatus of the present invention where guiding means are provided between the transfer station and the fixing unit, which guides the medium along a path having a length some how greater then the straight distance between transfer station and fixing unit, thus providing a buffer which prevents any stretching of the recording medium and at the same time assures efficient and continuous guiding.

The guiding means of the invention comprises a grid plate providing a path some how divergent from a straight line connecting the transfer station and the entrance of the fixing unit and suction means which cause the medium to adhere to the grid at a variable extent, depending on the effective length of the medium portion interposed between the transfer station and the fixing unit, thus preventing any undesired pull increase.

Moreover the guiding means of the invention may be provided with ozone abating filters, thus combining two advantageous effects in a unitary arrangement.

The features and the advantages of the invention will appear more clearly from the following description of a preferred form of embodiment and from the enclosed drawings where:

- Figure 1 shows in schematic side view the structure of an electrophotographic printing apparatus in accordance with the present invention.
- Figure 2 shows in enlarged section view a detail of the apparatus of fig. 1.
- Figure 3 shows in enlarged section view a variant of the detail shown in fig. 2.

The apparatus comprises a photocondutive drum 1 rotating in the direction of the arrow 2, a corona charger 3, with charges in uniform way the surface of the photoconductive drum, a scanning light beam generator 4, electronic control circuits 5,

a developing unit 6 a paper feeding device 7, paper driving rollers 8, a corona discharger 9, a suction box 10, a fixing unit consisting in a rotating heating drum 11 and a pressure roller 12, discharging rollers 13, a cleaning blade 14 and a waste toner collector tank 15.

The apparatus is powered by a power supply 16 and the moving elements are driven by suitable motors not shown.

As known the operation of the apparatus is as follows.

The photoconductive drum, uniformily charged by corotron 3 is selectively discharged by a modulated scanning light beam generated by unit 4 in the course of the photosensitive drum revolution. Toner is selectively applied on the exposed or unexposed areas of the photosensitive drum, depending on the used (positive or negative) process, by the developing unit 6.

The developing unit 6 is basically a toner container having a rotating developing drum 61 which brings a controlled amount of toner in proximity of the photoconductive drum surface where it is selectively attracted and adhere thereto forming a toner image.

The rotation of drum 1 brings the toner image to a transfer station formed by the corona discharger 9 facing the surface of drum 1 along a predetermined generatrix or transfer line.

A recording medium usually a peper sheet, is pulled from a hopper 17 by the paper feeding roll 7, suitably driven, and fed along a feeding path where it is pinched by driving rollers 8 and further fed along an horizontal path at a speed equal to the peripheral speed of drum 1.

The paper sheet contacts the surface of drum 1 at the transfer line, were the action of the transfer unit 9 causes the toner to adhere to the underside surface of the paper.

Then the paper continue to move along the horizontal path, detaching from the drum 1 surface.

The suction box 10, having a suction grid plate 18 extending along the horizontal path to be followed by the paper, exerts a pull on the paper, preventing its falling downward, owing to the paper intrinsecal weight.

The combined driving effect of rollers 8 and the holding action of the suction box, compel the paper to move along a nearly horizontal path and to reach the fixing unit where it is pinched between the heating drum 11 and the pressure roller 12 which further drive it to subsequent driving rollers 13 for discharging in a tray 19.

The contact line between the pressure roller 12 and the heating drum may be considered as the entrance of the fixing unit for the paper sheet.

According to the present invention, the grid plate 18 which drives the paper sheet towards the entrance of the fixing unit is not in the same plane defined by the transfer line and the entrance of the fixing unit but slightly divergent therefrom, from the transfer line towards the fixing unit entrance.

The arrangement is more clearly shown in the enlarged section view of Figure 2, where points A,B represents the entrance and transfer line respectively.

The grid plate 18 is arranged according to a plane P tangent to drum 1 in B and the entrance A is located below such plane so that the grid plate 18 diverges from the plane AB of a small angle α, preferably in the order of 3-5°.

The grid plate 18 extends towards the pressure roller 12 up to an edge shown as point C near to the surface of the pressure roller 11 and no further, to avoid interference with the pressure roller.

A paper sheet moving from the transfer station to the entrance of the fixing unit, follows the grid plate 18 up to point C, then the leading edge of the paper sheet moving forward, interfere with the pressure roller 12, which smoothly bends downward the edge and brings it to the entrance of the fixing unit, with a direction substantially tangent in A to the heating drum.

To this purpose the pressure roller 12 and the heating drum 11 are preferably arranged with their center axis defining a tangent plane T, common to both and containing point A, diverging from plane AB of an angle no lesser than and preferably comprised between α and 2α.

The portion of the paper sheet comprised between A and B has clearly a length equal or greater than AC + CB, hence greater than AB.

Therefore if a contraction of the paper occurs at the fixing station, virtually resulting in an increase of the speed at which the paper is pulled by the fixing unit, as to the speed at which the paper is pulled by driving rollers 8, the paper may partially and gradually detach from the grid plate and the difference in driving speed is compensated by a corresponding shorting of the paper portion comprised between A and B, without paper tensioning.

Since the distance AB is usually in the order of 5-10 cm and the paper path is greater than AC + CB and by the more, greater than the arc subtended by chord AB, and tangent in B to drum 1, it can be easily verified by geometrical considerations that the path followed by the paper sheet, for an angle α of 3° or more, exceeds the length of the chord AB by more that 0,5 mm. and largely suffices to compensate for contraction of paper sheets occurring in practice, the paper sheets having a length in the order of 30-35 cm.

In figure 1 and 2 the grid plate 18 has been shown as having a flat surface.

It is however clear that the same results described with reference to fig. 1 and 2 may be

obtained with a grid plate slighty concave as shown in fig. 3, the concavity being generically cylindrical with axis perpendicular to the path.

According to a further aspect of the invention and reconsidering Fig. 1 the suction box 10, containing a suction fan 30, is provided at the outlet with an active carbon filter 31.

In fact the corona charger 3 and the scorotron 9, due to the high biasing voltage, acting on the atmospheric oxigen, develops a certain amount of ozone.

The suction unit, in addition to holding the paper sheet when present, provides a suction action for the air present in the apparatus, mostly the one surrounding the photosensitive drum 1, and performs an efficient abating function for the developed ozone.

Claims

1. Electrophotographic printing apparatus having an image carrier, a transfer unit located at a location above said image carrier to transfer a toner image formed on said carrier to an underside surface of a recording medium moving along a predetermined path interposing between the image carrier and the transfer unit, the location of said transfer unit defining a transfer station along said path at a line transverse to said path
a fixing unit along said path, downstream of said transfer station said fixing unit having an entrance and an exit for entering said moving recording medium therein, fixing of the toner image onto said medium, and releasing said medium from said exit,
a medium guiding means located along and above said path between said transfer station and said fixing unit,
characterized in that said medium guiding means comprises a suction box having an outlet and an inlet suction grid with a guiding surface for said medium, located along said path between said transfer station and said fixing unit, and suction means in said box,
said guiding surface diverging from the transfer station towards said fixing unit from a plane defined by said transverse line and said fixing unit entrance by an angle α, so that the length of said path, between said transferse line and said fixing unit entrance, exceeds by at least 0,5 mm the distance between said transverse line and said fixing unit.

2. Electrophotographic printing apparatus as in claim 1 where the guiding surface of said inlet grid has a cylindrical concavity with axis perpendicular to said path.

3. Electrophotographic printing apparatus as in claim 1 where said suction box has a carbon filter at said outlet.

4. Electrophotographic printing apparatus as in claim 1 where said fixing unit comprises a heating drum and a pressure roller, contacting each other at said entrance, in a tangent plane diverging from the plane defined by said transverse line and said fixing unit entrance by no less than said angle α.

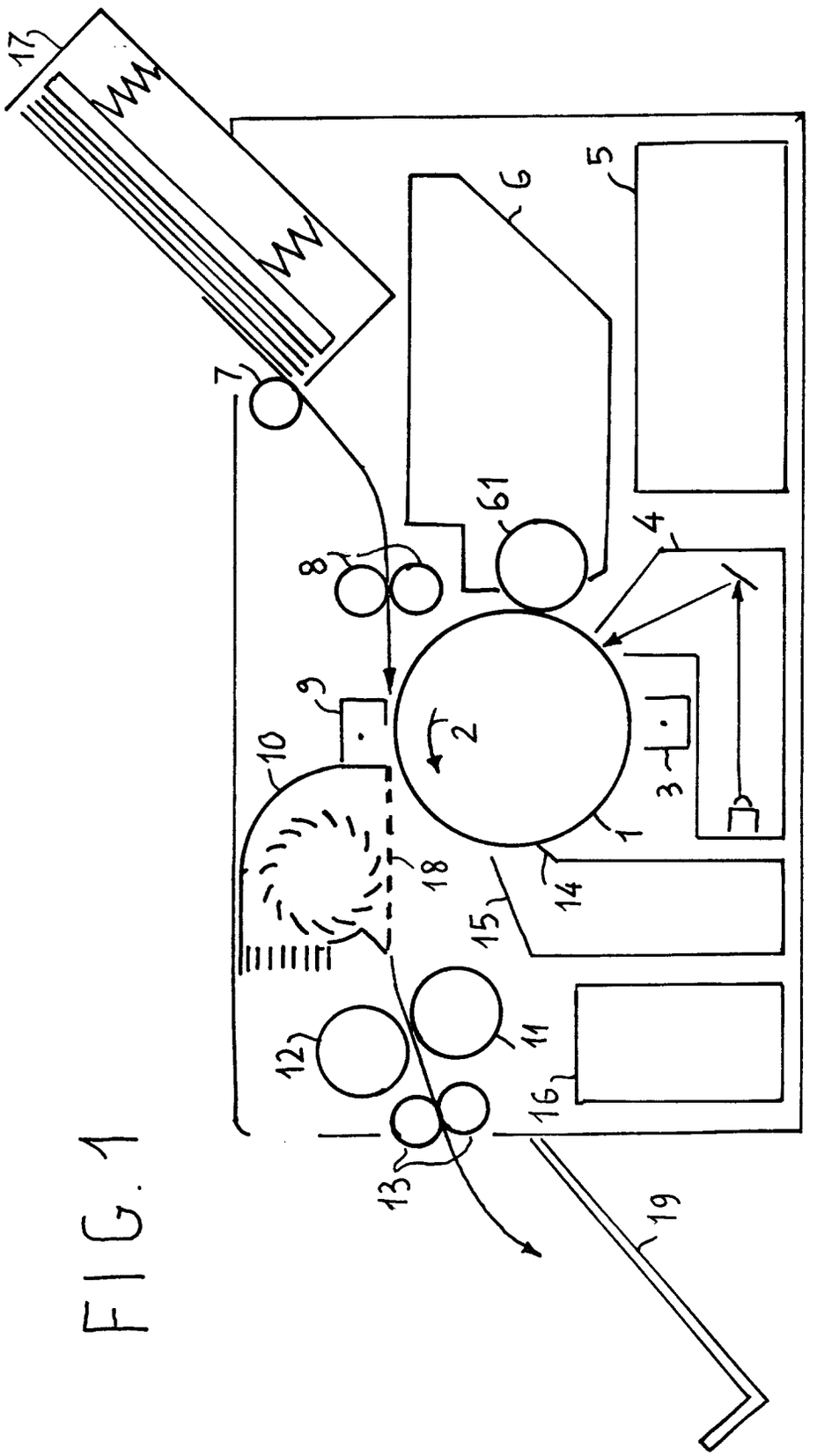


FIG. 1

FIG. 2

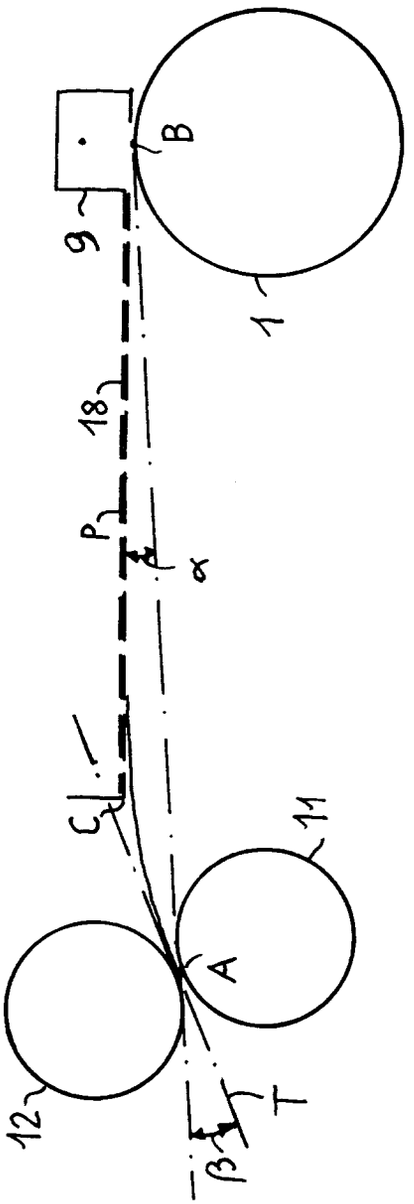
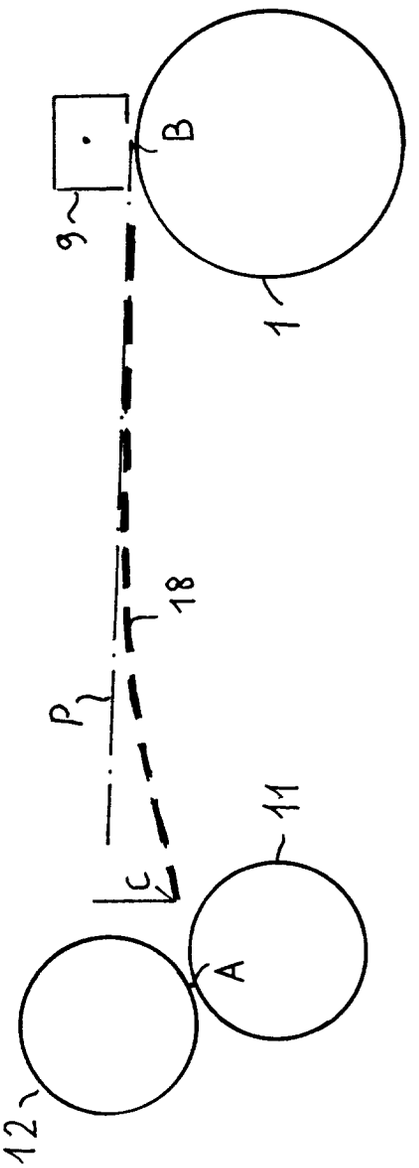


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 92 83 0385

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.5)
X	US-A-4 992 835 (MATSUZAKA) * figures 1,4 *	1,2	G03G15/00 G03G15/16 G03G15/20
X	US-A-4 017 065 (POEHLEIN) * figures 1,4 *	1	
D,A	EP-A-0 292 359 (FUJITSU) * figures 4,7 *	1	
A	US-A-3 578 859 (STILLINGS) * figure 2 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 214 (P-304)(1651) 29 September 1984 & JP-A-59 095 562 (MINOLTA CAMERA) 1 June 1984 * abstract *	1	
A	DE-A-4 032 290 (MINOLTA CAMERA) * figures 1,2 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	08 MARCH 1993	HOPPE H.

CATEGORY OF CITED DOCUMENTS

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