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EUROPEAN PATENT APPLICATION

21 Application number: 80107155.6

51 Int. Cl.³: **G 03 G 15/00**

22 Date of filing: 18.11.80

30 Priority: 03.12.79 US 99800

43 Date of publication of application:
10.06.81 Bulletin 81/23

84 Designated Contracting States:
DE FR GB

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54 **Electrophotographic copier including a belt photoconductor.**

57 An electrophotographic copier includes a belt photoconductor (24) which passes round a drum (32). It is guided from the drum to an exposure position by a vacuum plenum (34) which also serves to tension the belt. Rollers (28) and (30) guide the belt from the plenum to the exposure position and from that position back to the drum. Apart from the exposure station, the processing stations normally positioned adjacent the drum are so positioned.

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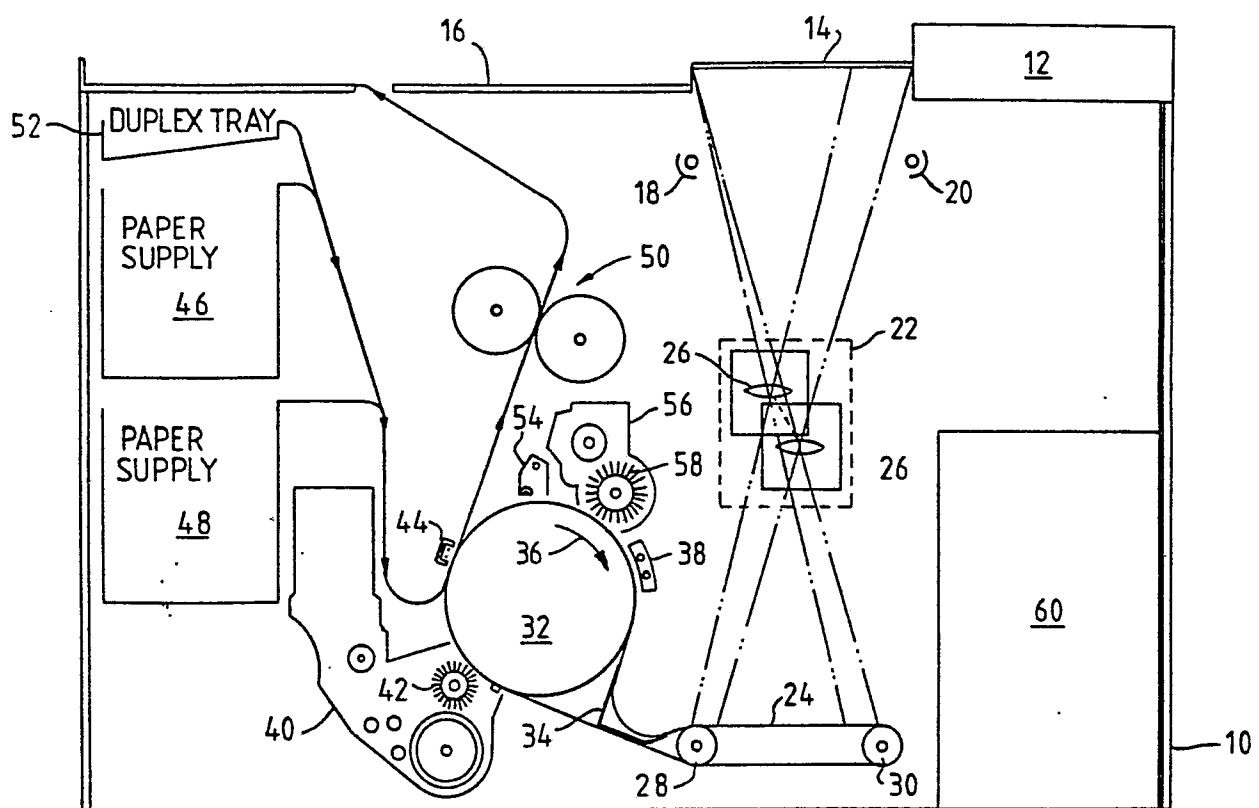


FIG. 1

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ELECTROPHOTOGRAPHIC COPIER INCLUDING A BELT
PHOTOCONDUCTOR

The invention relates to electrophotographic copiers. More particularly, the invention relates to such copiers employing belt photoconductors.

The electrophotographic copying process which is used primarily for reproducing copies of original documents is well known in the prior art. Although there are several variations, the basic process requires a photconductive element. This element is initially charged by a corona device. After charging, the element passes to an imaging station at which it is selectively discharged in accordance with the informational contents of an original document to form a latent image of the original document. The latent image is developed with toner and the toned image is then transferred to copy paper. The image is then fused into the paper to form a permanent copy of the original. The photoconductor element is then cleaned and the process repeated.

At the imaging station, the prior art devices use either flash illumination or a scanning arrangement using a moving line of light to illuminate the original document. Flash illumination has the advantage that a complete image of the document is directed on to the document. If the illumination period is short, then the photoconductor can be exposed whilst travelling relatively rapidly, so that the time taken to produce each copy is short. With scanning systems, only one section of the document is illuminated at a time and the photoconductor speed has to be limited to the speed of the scanning arrangement. In addition, each scan cycle requires a flyback time to allow the scanning mechanism to return to its home position after a complete scan. Thus, the scanning systems are inherently slower than flash systems.

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Prior art electrophotographic copiers may be divided into two classes, belt type electrophotographic copiers and drum type electrophotographic copiers.

U.S. Patent 4,089,516 shows an example of the drum type prior art electrophotographic copier. The copier includes a cylindrical drum with a length of photosensitive material wrapped about its surface. The drum is journaled for rotation about a shaft which is mounted to the frame of the copier. A plurality of processing stations (including charging, imaging, developing, transferring and cleaning) are positioned around the periphery of the cylindrical drum. In order to copy an original document, the document is placed on the document platen. A narrow footprint of light is generated by the illumination system. The footprint of light scans the document and the light rays reflecting from the document are focused through the optical path of the system to form a latent image onto the photosensitive material. The latent image is developed and transferred to a support media. The image on the support media is fused by a heat source to form a permanent copy.

This type of prior art electrophotographic copier has several advantages, for example, compactness of the machine. Generally less space is required to package the copier since the processing stations are arranged in a circular configuration. Also, cleaning and stripping the transfer media from the photosensitive element is done more efficiently since the photosensitive element has a continuous curvature. However, in this type of system flash illumination cannot be used to discharge the photosensitive material. The reason is that the photosensitive material is curved and only a portion of the photosensitive material can be discharged at any instant of time. As a result, the throughput of this type of electrophotographic copier is usually relatively low.

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U. S. Patent 3,661,452 exemplifies a belt type prior art electrophotographic copier. In this type of copier, an endless photosensitive belt is supported for travel, in an endless generally triangular path, by a plurality of rollers. At least one of the rollers is biased, by mechanical means such as a spring, to create tension in the belt. A plurality of conventional processing stations are positioned in proximity within the orbit of the photosensitive belt. The processing station includes a flash illumination system for exposing the photosensitive belt on a first flat run. The exposed photosensitive belt is developed by a development station which is positioned relative to a second flat run of the belt. At least one of the rollers has a sufficiently wide diameter to curve the belt at a point between the flash illumination system and the development station. Image transfer from the belt to a supporting media, such as paper, occurs at the curved section of the belt.

Although the above-described belt type electrophotographic copier is an improvement to the prior art in that it incorporates one feature (namely, image transfer at a curved surface) from the prior art drum type copier, it has a few drawbacks. For example, the optical path includes a plurality of mirrors which reflect light emitting from the document glass onto the photosensitive belt. As the light rays are reflected from mirror to mirror, some of the light intensity is lost. Unless the light rays which strike the photosensitive belt are of a certain intensity, the belt is not properly discharged and the copy quality tends to be poor. The mirrors which are used to reflect the light rays often require optical alignment. Optical alignment is often difficult to achieve and expensive. A large number of the belt type copiers use toner for developing a latent image on the photosensitive belt. The toner tends to contaminate the mirror and adversely



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affects their light reflecting characteristics. Finally, it is often difficult to replace photosensitive belt in the above described type of copier. The difficulty stems from the fact that the mechanical biasing means which tension the belt has to be adjusted before the belt can be removed.

It is, therefore, the main objective of the present invention to provide an improved electrophotographic copier incorporating advantageous features of both the belt type and the drum-type electrophotographic copier.

According to the invention, there is provided an electrophotographic copier including a belt photoconductor movable through a closed path past a charging station, an imaging station, a developing station and a transfer station, characterised in that said path is defined by a rotatable drum over the majority of the circumference of which the belt passes, a planar exposure platen positioned adjacent the drum and guide means directing the belt from the drum on to the platen and from the platen back on to the drum, said exposure station being arranged to direct an image of an original document on to a section of the belt passing over the platen, and the remaining ones of said stations being positioned about the drum periphery.

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

FIG. 1 shows a schematic view of an electrophotographic copier embodying the present invention;

FIG. 2 is a side view of the photoconductor path in the FIG. 1 copier;

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FIG. 3 is an isometric view of the photoconductor path of FIG. 2;

FIG. 4 is an isometric view of a vacuum chamber shown in FIGS. 1 and 2; and

FIG. 5 shows a cross-section of the vacuum chamber of FIG. 4.

FIG. 1 shows an electrophotographic copier including a frame 10. A recirculating automatic document feed (RADF) 12 is positioned at the top right hand corner of the frame. The RADF is a conventional device. In operation, a plurality of original documents are placed in the RADF and the RADF feeds documents sequentially from a deposited stack onto the document glass 14. After the desired number of copies are made from an original document placed on the document glass, a feed mechanism (not shown) feeds the document from the document glass onto the original document tray 16. From the original document tray, the document is retrieved by an operator.

The document glass 14 is fabricated from a transparent material such as glass or clear plastic. Illumination means 18 and 20 are positioned below the document glass. When an original document is positioned on the glass and illumination means 18 and 20 are activated, the document glass and the documents thereon are illuminated. In the preferred embodiment of the invention, the illumination means 18 and 20 are flash lamps. A focusing assembly 22 is positioned directly below the document glass and in optical alignment thereto. As is used in this application, the term optical alignment means that light emanating from the document glass is focused directly through the focusing assembly 22 onto the photoconductor belt 24. Focusing assembly 22 includes lens 26. In FIG. 1 the focusing lens is shown in two positions. In the topmost position, the electrophotographic machine is operating

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in the so-called nonreduction mode. In the nonreduction mode a copy is reproduced on a one to one basis. This means that the size of the copy is the same size as the original document. When the focusing lens 26 is positioned in the bottom or lower position, the machine is operating in the so-called reduction mode. In the reduction mode a copy is reproduced at a smaller size than the original document.

It is worthwhile noting that lamps 18 and 20, together with focusing assembly 22, form the imaging station for the electrophotographic copier. The function of the imaging station is to produce a latent image of an original document, positioned on document glass 14, on the photoconductor belt 24. The photoconductor belt 24 is configured into a curved run and a flat run, with imaging occurring at the flat run of the photoconductor belt. The flat run of the photoconductor is defined by idler rollers 28 and 30 respectively. The idler rollers are mounted, in spaced relationship, on frame 10 and as the photoconductor belt is transported past the imaging station, the idler rollers are freely rotated therewith. The curved run of the belt is defined by a photoconductor drum 32. The drum is journaled for rotation on the frame 10. A vacuum chamber 34 forms a concave bend in the photoconductor. The concave bend allows a smooth transition between the curved run and the flat run of the photoconductor belt. In addition, by using the vacuum column instead of a mechanical member to bend the photoconductor belt, there is no physical contact between the bending means and the outer surface of the photoconductor belt. As will be explained subsequently, the vacuum chamber also operates as a means for tensioning the photoconductor belt and prevents the same from slipping as it is transported in its curvilinear and linear path.

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Still referring to FIG. 1, the drum 32 is cylindrical in shape and is of sufficient diameter so that a plurality of processing stations can be positioned around the periphery. The drum diameter may be, for example, approximately 280 m.m. The drum is rotated in a clockwise direction shown by arrow 36. The drum is driven by a drive mechanism including a motor (not shown). As the drum is rotated, it transports the photoconductor belt to pass within the vicinity of a plurality of processing stations. The first processing station which the photoconductor accesses is the charging station 38. At charging station 38, a conventional charge corona deposits an even charge on the surface of the photoconductor belt. The charge photoconductor belt is transported through the vacuum chamber 34 onto the flat area defined by idler rollers 28 and 30, respectively. The imaging station then exposes the photoconductor belt to an image of a document positioned at the document glass 14 to form a latent image on the photoconductor. The latent image is next transported to the developer station 40. The developer station 40 is positioned about the orbit of the photoconductor drum 32. The developer station is a conventional magnetic brush developer station using a two component developer mix and will not be described in detail. Positioned upstream from the developer station 40 is a transfer station 44. The transfer station 44 includes a transfer corona. In order to transfer the toned image which now resides on the surface of the photoconductor, a sheet of paper is fed from the duplex tray or paper supply trays 46 or 48, respectively. The sheet of paper moves along the paper path (shown by the arrows) between the transfer corona and the photoconductor drum 32. At this point the corona deposits a charge onto the paper. The charge on the paper is of opposite polarity to the toned image on the photoconductor. As a result of the electric field between the paper and the photoconductor surface, the toned image is transferred from the photoconductor onto the transfer paper. The paper is then transported into fuser assembly 50. In the fuser assembly, the toner is fused preferably by some heating means, into the paper. The copy sheet is then transferred into exit tray 52.

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Positioned downstream from the transfer station 44 is a preclean lamp 54. After the image is transferred from the photoconductor surface, the preclean lamp illuminates the photoconductor. The illumination tends to neutralize the polarity of residual toner on the belt. The neutralized toner is then cleaned by the cleaning station 56 which is positioned downstream from the preclean lamp 54. The cleaning station 56 is fitted with brush 58. The brush scrubs the surface of the photoconductor and removes the residual toner. The electronics and power supplies which are necessary to operate the electrophotographic copier, are packaged and mounted in a compartment 60.

By configuring the photoconductor so that imaging occurs on a flat run of the photoconductor which is positioned straight down from the imaging station, the need for a plurality of mirrors which reflect light from the document platen is obviated.

FIGS. 2 and 3 show a side and isometric view of the photoconductor path respectively. Elements in FIGS. 2 and 3 which are common to FIG. 1 will be identified with the same numeral. The curved section of the photoconductor path is defined by drum 32. As was stated earlier, a plurality of conventional electrophotographic processing stations are positioned about the periphery of the drum. The stations have already been identified and will not be repeated at this point. A vacuum chamber 34 is positioned such that the inner surface of one of the sides of the vacuum chamber is in tangential alignment to the surface of the drum. As the photoconductor exits the periphery of the drum, it enters the vacuum chamber. When negative pressure is applied to the vacuum chamber, the photoconductor is held firmly against the surface of the cylindrical drum and the surface of a platen 62. Idler roller 28 is positioned between the exit side of the vacuum chamber and guides the photoconductor onto the platen. In the preferred configuration, the inner walls of another side of the vacuum

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chamber is in tangential alignment to the curved surface of roll 28. Idler roller 30 guides the photoconductor belt as it exits from the platen. A projection 76 extends from the inside surface of end wall 76 of the vacuum column a similar projection being mounted on end wall 78 (FIG. 4). The projections prevent the photoconductor belt from escaping out of the vacuum column particularly when the pressure to said vacuum column is turned off.

FIGS. 4 and 5 show an isometric and a cross-sectional view, respectively, of the vacuum chamber 34. The vacuum chamber is an elongated chamber with a length, L, which is substantially the same as the width of the photoconductor. In the electrophotographic copier configuration of FIG. 1, the vacuum chamber is positioned so that its length is running transversely to the direction of motion of the photoconductor. By way of example, in FIG. 4 the photoconductor would be moving in a direction shown by arrow 68. The vacuum chamber includes an air plenum 70 with a photoconductor support trough or chamber 72 attached thereto. A conduit hose 74 is attached to a vacuum supply source (not shown) and supplies a vacuum in the air plenum. The photoconductor trough or chamber includes end members 76 and 78 respectively. Elongated members 80, 82 and 84 are arranged at an angle with respect to each other as shown in FIG. 4. In addition to giving structural support or rigidity to the photoconductor trough, the end members are the means for guiding the photoconductor laterally. As the photoconductor belt exits the cylindrical surface of photoconductor drum 32 (FIG. 1) and is transported through the vacuum chamber onto the imaging platen, the photoconductor belt tends to move in a direction traverse to the direction of normal belt motion. The presence of end members 76 and 78, respectively, guide the edges of the photoconductor to eliminate the traverse motion. In order to interconnect the photoconductor trough with the vacuum air

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plenum, a plurality of holes 86 are positioned in side member 80. Whenever a source of negative vacuum is connected to air plenum 70 via conduit 74 and the tape is positioned so that its width is running parallel to the length (L) of the vacuum chamber, a bight of the photoconductor belt is pulled into the trough and, as a result, creates the reverse bend which allows the smooth transition from the curved run to a flat run and also tensions the photoconductor about the drum and the platen and idler rollers. In order to remove the photoconductor belt, the negative pressure is dropped and the belt is then free to be removed.

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CLAIMS

1. An electrophotographic copier including a belt photoconductor (24) movable through a closed path past a charging station (38), an imaging station (14, 26), a developing station (40) and a transfer station (44), characterised in that said path is defined by a rotatable drum (32) over the majority of the circumference of which the belt passes, a planar exposure platen (62) positioned adjacent the drum and guide means (28, 30, 34) directing the belt from the drum on to the platen and from the platen back on to the drum, said exposure station being arranged to direct an image of an original document on to a section of the belt passing over the platen, and the remaining ones of said stations being positioned about the drum periphery.
2. A copier as claimed in claim 1, further characterised in that said guide means includes means (34) for creating a concave bend in the photoconductor belt as it passes between the drum and the platen.
3. A copier as claimed in claim 2, further characterised in that said means for creating comprises a vacuum plenum of trough-like configuration to receive, bend and tension the belt.
4. A copier as claimed in claim 2 or claim 3, characterised in that said guide means includes a first roller (28) positioned between the means for creating and the platen to guide the belt therebetween.
5. A copier as claimed in claim 4, further characterised in that said guide means includes a second roller (30) positioned adjacent the end of the platen opposite the first roller and about which the photoconductor belt is wrapped for return to the drum.

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6. A copier as claimed in claim 5, further characterised in that said first roller and means for creating are configured and positioned further to guide the photoconductor belt from the second roller back to the drum.

7. A copier as claimed in any of the previous claims including a document platen for supporting original documents to be exposed for copying, and an optical system for directing light reflected from an original document on the platen to a section of the photoconductor on the exposure platen, further characterised in that said exposure platen is positioned in a plane parallel to that of the document platen whereby the optical axis of the optical system is rectilinear.

8. A copier as claimed in any of the previous claims, further characterised in that the imaging station includes means for flash illuminating an original document.

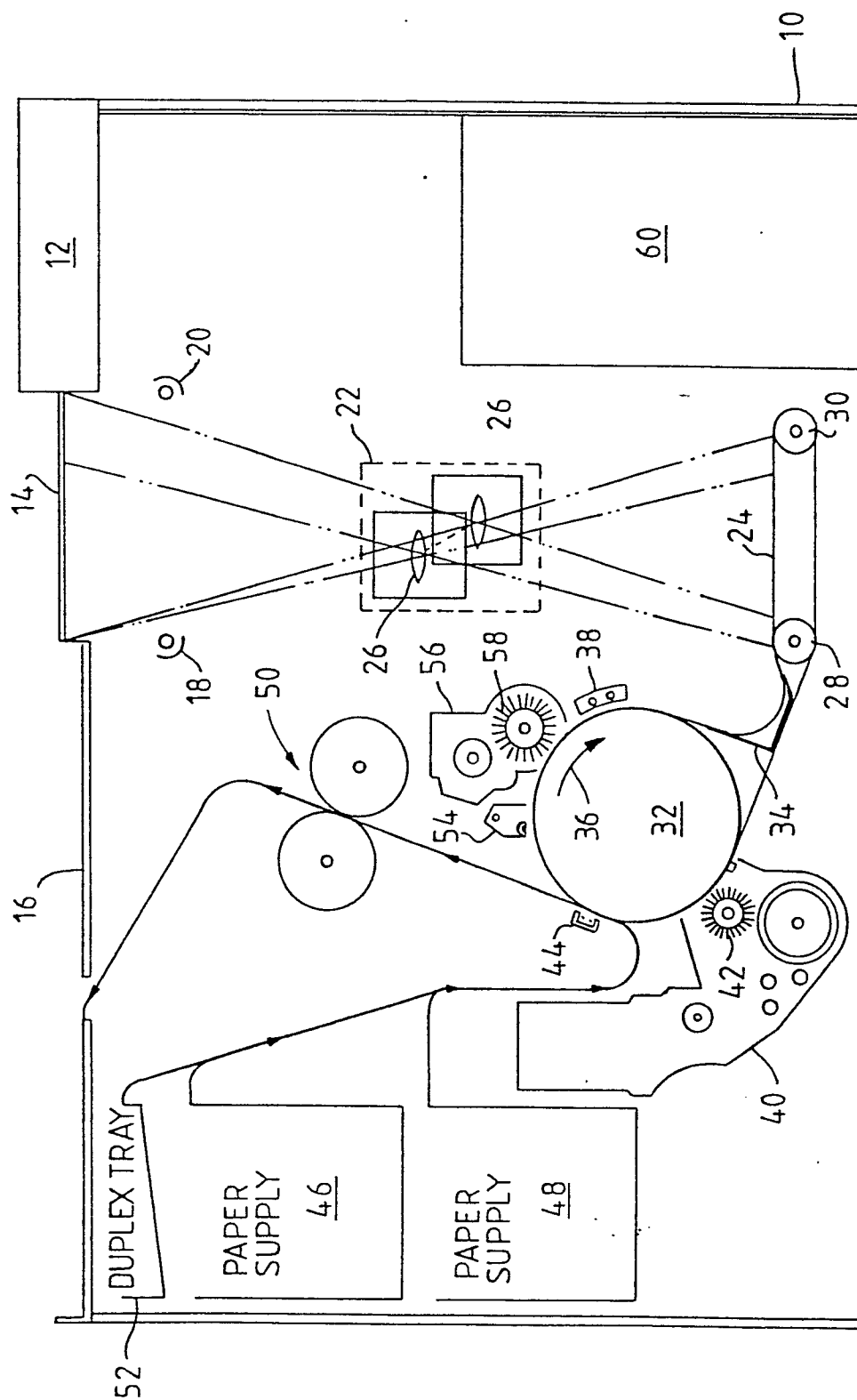


FIG. 1

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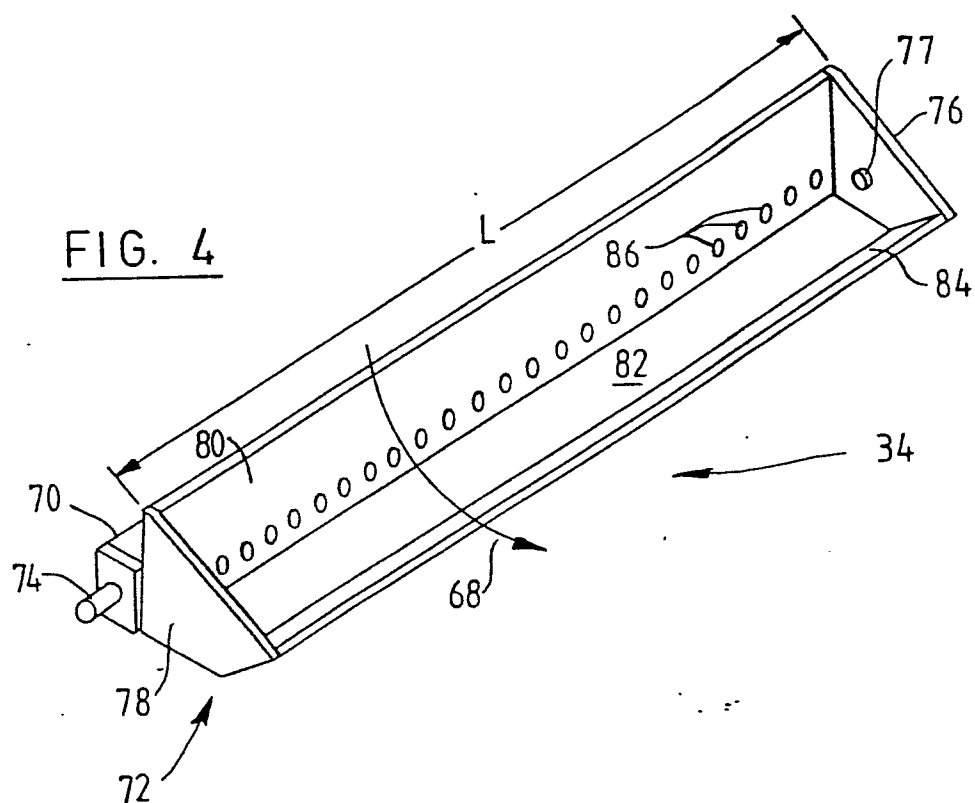
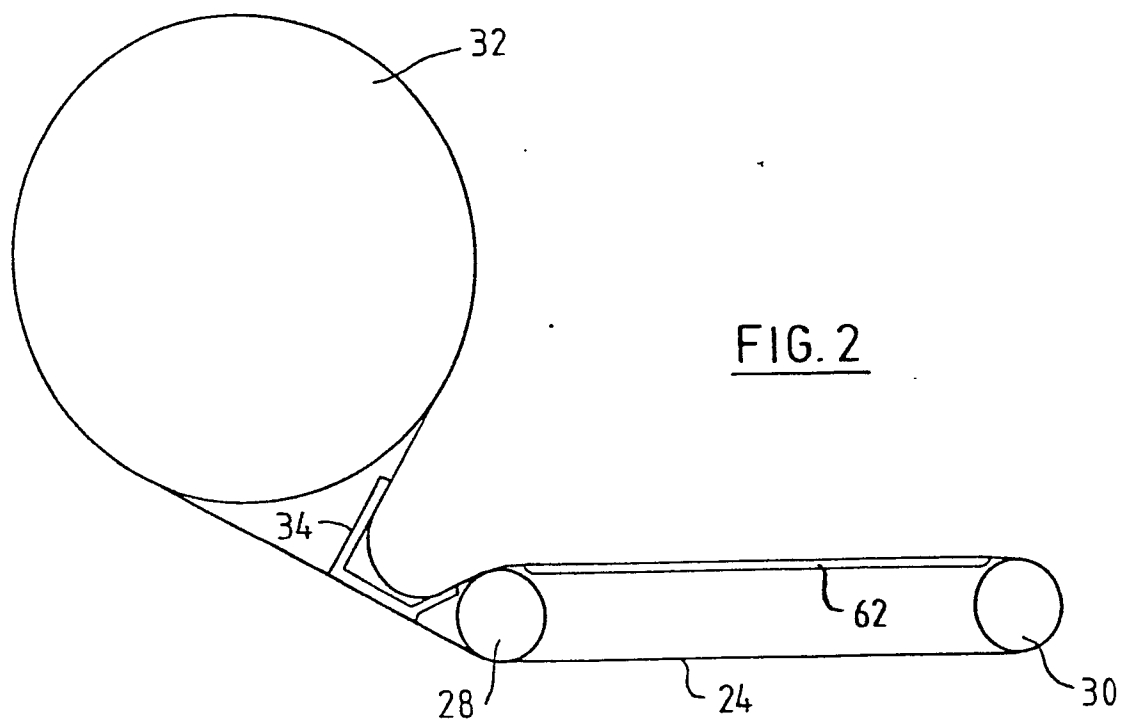
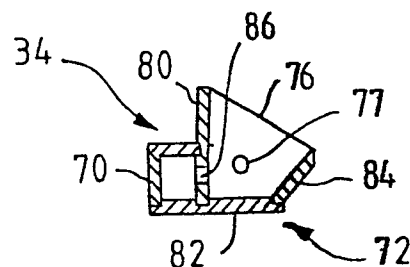
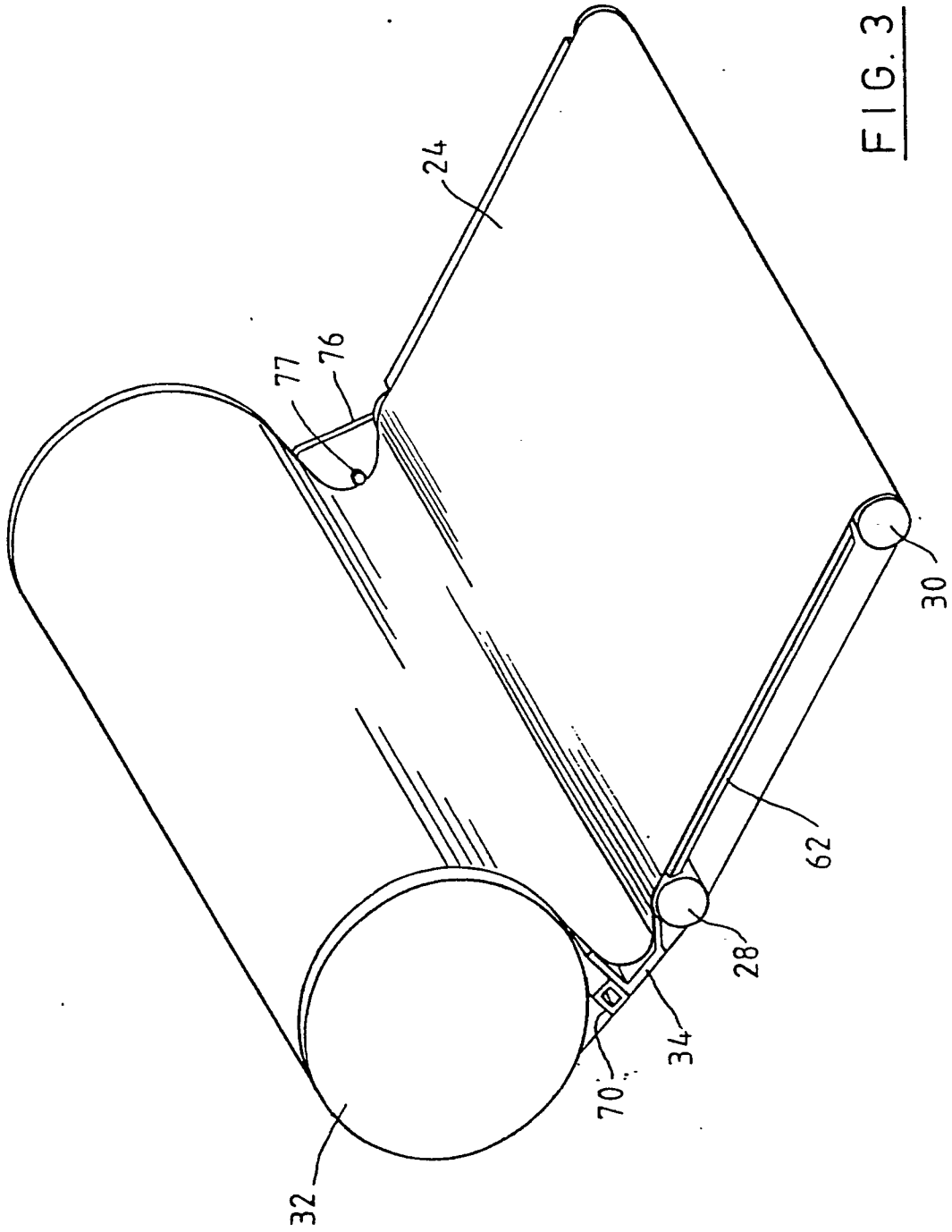


FIG. 5



FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

0029953

Application number

EP 80 10 7155.6

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
D	<u>US - A - 4 089 516</u> (D.F. COLGLAZIER et al.) --	1	G 03 G 15/00
D	<u>US - A - 3 661 452</u> (E.D. HEWES et al.) ----		
X	<u>US - A - 4 013 359</u> (R.C. DUBOIS et al.) --		
X	<u>DE - A - 2 138 981</u> (IBM) --		TECHNICAL FIELDS SEARCHED (Int. Cl.3)
X	<u>DE - A - 2 154 809</u> (IBM) ---		G 03 G 15/00
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
X The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search Berlin		Date of completion of the search 26-02-1981	Examiner HOPPE