United States Patent

Nelson

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[54] BELT TRANSFER DEVICE

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[52] **U.S. Cl.** **355/3**, 96/1.4, 117/17.5, 118/637, 355/4

[51] **Int. Cl.** **G03g 15/16**

[58] **Field of Search** 355/3, 4, 17; 96/1.4; 117/17.5; 118/637

[56] **References Cited**

UNITED STATES PATENTS

3,318,213	5/1967	Kowalski	118/637 UX
3,328,193	6/1967	Oliphant et al.	118/637 X
3,519,343	7/1970	McNair et al.	355/4
3,520,603	7/1970	Gnage	355/4
3,551,046	12/1970	Gnage	355/4

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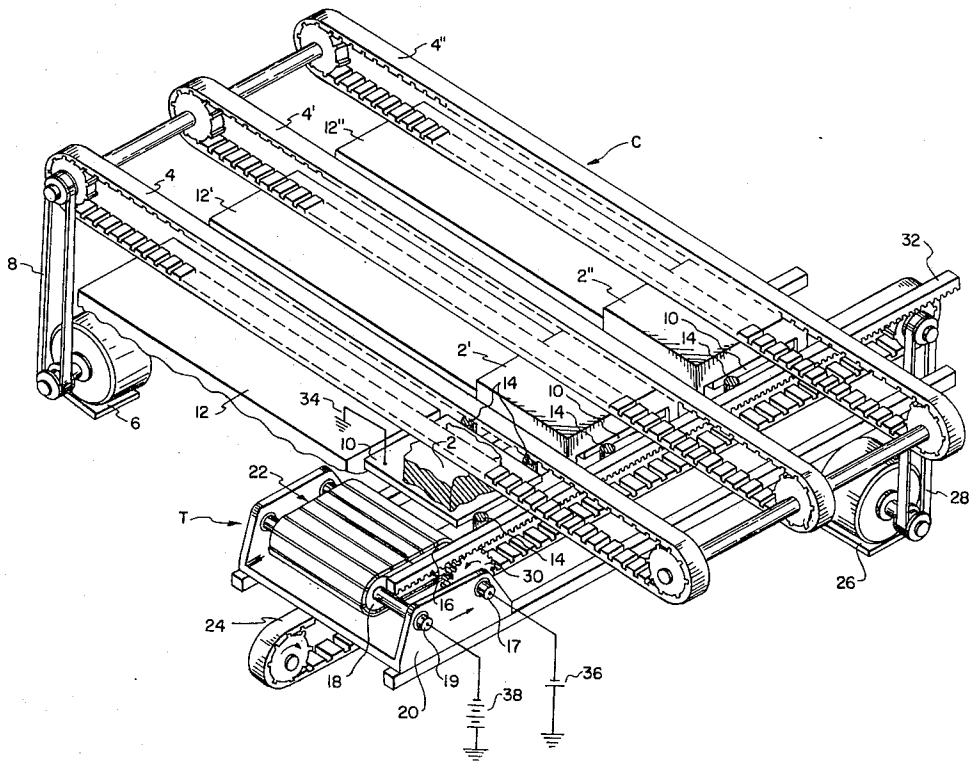
[57] **ABSTRACT**

An electrostatic toner image transfer device is provided in which separate photoconductive elements are brought into registration at a transfer station against registration pins. Transfer of the toner image from the photoconductive element to a receiver sheet is accomplished by means of a transfer device comprising spaced rollers having an endless belt extending therearound which includes alternating conductor and insulative segments and has means for supporting the receiver thereon. A first potential can be applied to one roller to assure intimate contact between the receiver and the photoconductive element and a second and greater potential of the same polarity may be applied to the second roller to cause transfer of the toner image from the photoconductive element to the receiver. As the transfer device is moved through the transfer station the receiver is brought into progressive line contact with the photoconductive element by the first roller followed by the second roller which causes image transfer from the photoconductive element to the receiver and separation of the receiver from the photoconductive element along a progressive line. The segmented belt supports the receiver stationarily against the photoconductive element and successively conducts the potential applied by the respective rollers to the receiver. A plurality of transfer stations can be provided so that a plurality of images can be transferred sequentially to a single receiver, if desired.

7 Claims, 2 Drawing Figures



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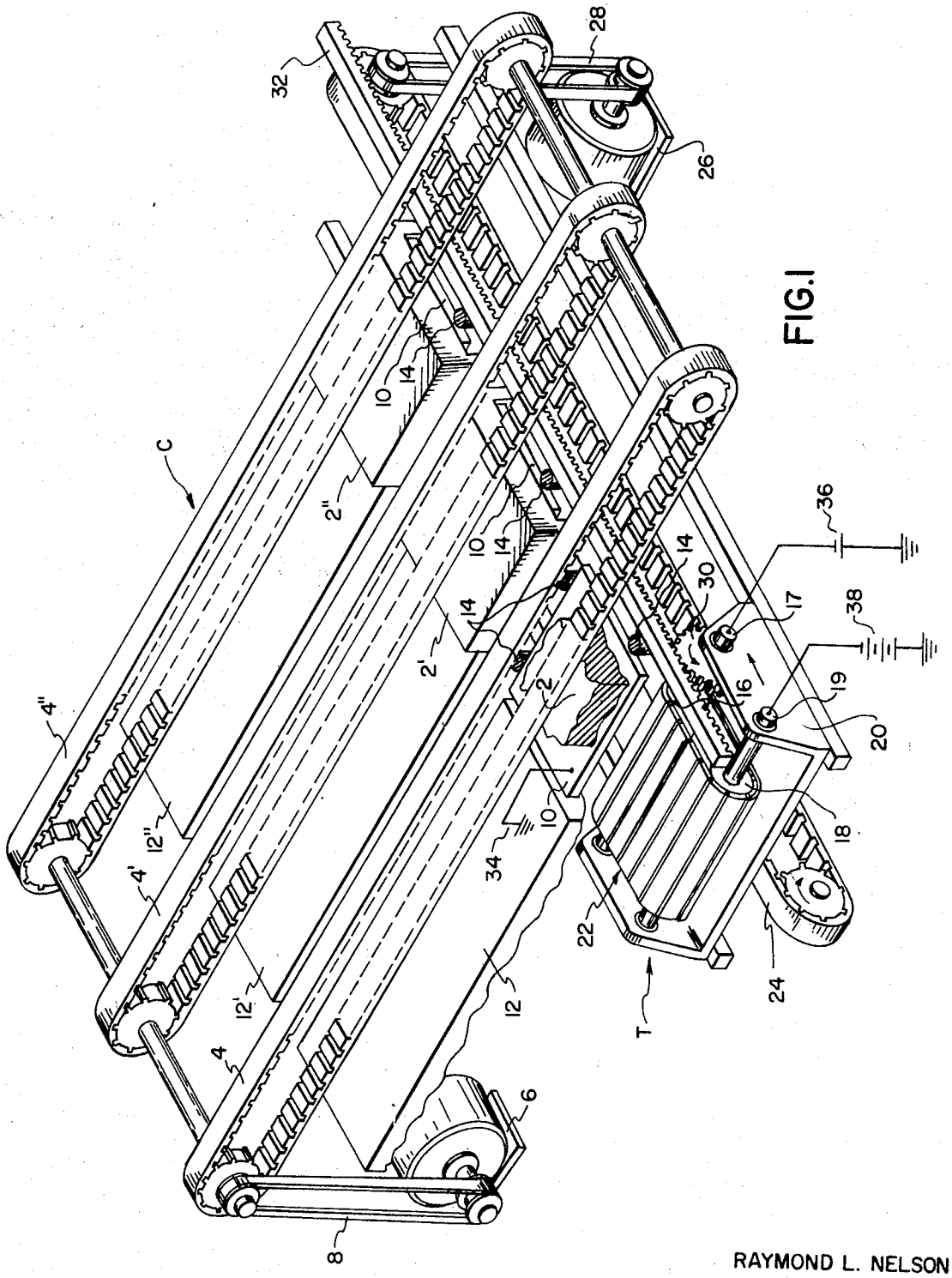

FIG. 1

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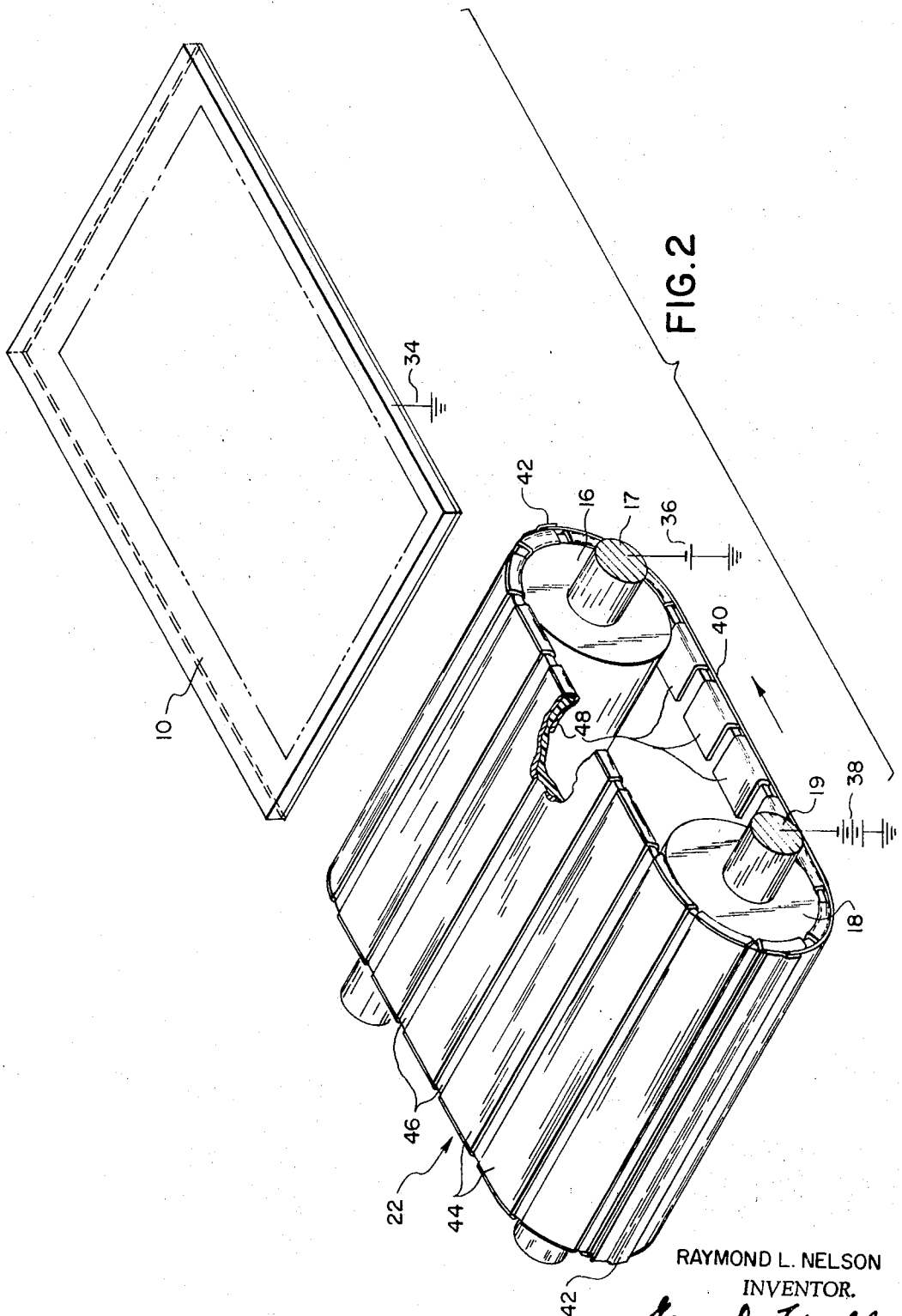

FIG. 2

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BELT TRANSFER DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

The apparatus of this invention may be utilized in the device disclosed in commonly assigned U.S. Pat. application, Ser. No. 741,359 to John S. Pollock, filed July 1, 1968 and entitled "-Printing Apparatus."

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a transfer device for transfer of an electrostatic toner image from the surface of a photoconductive element to a receiver, and more particularly to such a device for transferring images wherein the receiver is first brought into intimate contact with the photoconductive element by application of a first potential and then is transferred upon application of a second potential.

Description of the Prior Art

In a typical electrophotographic device, a photoconductive element has a substantially uniform electrostatic charge placed thereon which is exposed to a pattern of radiation to form an electrostatic image. This image is then developed by a developing material containing toner particles, having a charge opposite the electrostatic image charge, which are attracted to the electrostatic image to form a toner image. Typically, this toner image may be transferred to a receiver by bringing the photoconductive element into intimate contact with the receiver and applying a potential to the receiver which is opposite that of the electrostatic toner image so that the image is transferred to the receiver.

U.S. Pat. No. 3,328,193 to Oliphant et al. is directed to a transfer device which includes a plurality of opposed rollers to which an increasing potential is applied in the direction of movement of a superimposed copy sheet and master to effect image transfer from the master to the copy sheet.

SUMMARY OF THE INVENTION

In accordance with this invention a transfer device is provided which includes an endless belt having alternating conductive and insulative segments and movable along an endless path around first and second spaced conductive supports. Means is provided on the belt for supporting a receiver across a plurality of the segments. The endless belt is movable along a transfer path past a surface bearing a toner image and is movable along the endless path so that a receiver on the belt is brought into intimate progressive line contact by the first conductive support to which a first potential is applied. Image transfer is obtained by the second conductive support to which a second potential is applied, followed by immediate separation of the receiver from the surface.

More particularly, a transfer device which is movable along a transfer path is provided with first and second spaced rollers having an endless segmented belt extending therearound which belt has alternating conductive and insulative segments and including means for holding a receiver so that upon movement of the transfer device along the transfer path the first roller causes the receiver to be brought into intimate progressive line contact with the photoconductive element and the second roller causes image transfer of the toner image from the photoconductive element to the receiver followed by separation of the receiver from the photoconductive element along a progressive line. The transfer device can be used for multiple image transfer in which the transfer device moves through a plurality of transfer stations to effect image transfer from a plurality of photoconductive elements to form a composite print.

Additional novel features of this invention will become apparent from the description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view showing a carriage mechanism for transporting photoconductive elements to separate transfer stations and a transfer device movable through the transfer stations to effect toner image transfer from each photoconductive element to a receiver on the transfer device; and

FIG. 2 is an enlarged perspective view of a portion of the transfer device of FIG. 1 showing further details of its construction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In an electrophotographic device for making a composite print from separate images, separate photoconductive surfaces are charged and exposed to separate images, such as color separation images, to form corresponding electrostatic images thereon. The photoconductive elements then pass through developing stations which tone the electrostatic images for subsequent transfer to a single receiver in registry to make a composite print.

In accordance with this invention, a carriage transport mechanism C is provided, having a plurality of carriages **2**, **2'** and **2''** attached to timing belts **4**, **4'** and **4''** respectively which are driven, as shown, by a motor **6** through endless belt **8**. Each carriage supports a photoconductive element **10** and is moved across developing stations **12**, **12'** and **12''**, respectively to respective transfer stations where they are brought into engagement with alignment means, such as registration pins **14**. Advantageously, these pins are positioned to space the photoconductive elements with equal distances between the reading edge of adjacent photoconductive elements.

The transfer device T includes first and second spaced rollers **16** and **18** rotatably mounted in a generally U-shaped frame or carriage **20**. An endless, segmented belt **22** extends around the rollers. Frame **20** is illustrated as being attached to a timing belt **24** driven by a motor **26** through an endless belt **28**, as shown. The rollers are caused to rotate in a counterclockwise direction, as viewed in FIG. **1**, as the transfer device is driven across the transfer station by means of a gear **30** on roller shaft **17** which engages a rack **32** and is sized so that endless, segmented belt **22** makes one revolution from the position where it engages the first photoconductive element until the position where it engages the second photoconductive element as it moves along a transfer path past the transfer stations. Conveniently, each photoconductive element is connected to ground, as by a lead **34**, whereas roller **16** is connected to a first potential **36** and roller **18** is connected to a second, but greater, potential **38** of the same polarity.

As best seen in FIG. **2**, a receiver sheet **40** is attached to segmented belt **22**, as by resilient clips **42** which engage opposite ends of the sheet. Alternatively, the receiver can be electrostatically tacked to the segmented belt by means, not shown. Conveniently, the segmented belt includes relatively wide conductive segments **44** interconnected by relatively narrow segments **46**. The belt can be made from a web of mylar which has a nickel coating on one side which coating is removed along narrow lines, such as one-sixteenth inch wide across the mylar belt and spaced approximately one-half inch apart. Thus, the bare mylar strips form insulative segments **46** whereas the nickel-coated portions form the conductive segments **44**. A conductive lacquer can be applied as a layer on the edges and underside of the belt as strips **48** to provide a conductive path between each segment and the respective rollers. The size and spacing of the segments can be varied provided that they are not so wide as to reach from one roller to the other and preferably the insulating segments are narrow in comparison to the conductive segments and there are at least two segments on each side of the belt between the rollers. The receiver **40** must be sufficiently conductive that it electrically bridges the space between conductive segments of the belt but not so conductive that a significant current passes through it when it is covering parts of both rollers at the same time. By way of example, a potential in the range of −100 volts to −200 volts applied to the first roller and a potential on the order of −1,000 volts applied to the second roller has been found to be satisfactory.

As transfer device T moves along the transfer path past the photoconductive elements, the rollers revolve so that the receiver is brought into progressive line contact with the upper surface of segmented belt **22** and is held stationary with respect to each photoconductive surface while in contact therewith. Thus, receiver **40** is first brought into contact with a photoconductive element **10** by roller **16** moving along the transfer path past the photoconductive element bearing a toner image. It remains in contact with the photoconductive element until roller **18** moves therepast, at which time image transfer takes place and receiver **40** is pulled away from photoconductive element **10** along a progressive line. The significant feature of this sequence is that as the paper is first brought into contact with photoconductive element **10**, the potential between the receiver **40** and the photoconductive element is chosen so that the charged marking particles will not be repelled from the photoconductive element onto the receiver but is strong enough to bring the receiver and photoconductive element into intimate contact. However, as roller **18** passes underneath receiver **40**, the potential between the paper and the photoconductive element **10** is of sufficient potential to cause a transfer of toner particles from the photoconductive element **10** to receiver **40** to effect transfer of the toner image.

From the foregoing, the advantages of this invention are readily apparent. A transfer device has been provided which supports a receiver sheet by means of a segmented endless belt so that it is brought into intimate progressive line contact with successive photoconductive elements by a first roller to which a potential is applied, prior to image transfer which is subsequently effected by a second roller to which a second and greater potential is applied after which separation of the receiver from the photoconductive elements is effected along a progessive line.

The invention has been described in detail with reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. A transfer device movable along a transfer path for transferring a toner image from a surface to a receiver, said device comprising:

a first conductive endless belt support;

a second conductive endless belt support spaced from said first support, said first and second supports being mounted for movement along said transfer path;

a movable endless belt extendable around said first and second supports and having alternating conductive and insulative segments extending thereacross and engageable with said supports;

means for holding the receiver on said segmented belt so that the receiver is extendable across a plurality of said segments;

means for moving said endless belt along said transfer path past said surface and for moving said endless belt along said endless path to bring the receiver into progressive line contact with said surface to effect transfer of said toner image from said surface to the receiver and to separate the receiver from said surface along a progressive line after transfer;

means for applying a first potential to said first support for bringing the receiver into intimate progressive line contact with said surface as said transfer device is moved thereacross; and

means for applying a second potential to said second support for effecting image transfer of said toner image from said surface to the receiver upon movement of said second support past said surface.

2. A transfer device movable along a transfer path for transferring a toner image from a photoconductive element onto a receiver supported by said transfer device, said device comprising:

a transfer carriage movable along said transfer path;

a first roller rotatably mounted on said carriage;

a second roller spaced from said first roller and rotatably mounted on said transfer carriage;

an endless belt extendable around said first and second rollers and having alternating conductive and insulative segments extending thereacross, said conductive segments being engageable with said rollers and said belt being movable along an endless path;

means for attaching the receiver to said segmented belt so that the receiver is extendable across a plurality of said segments;

means for moving said transfer carriage along said transfer path past said photoconductive element and for moving said endless belt along said endless path to bring the receiver into progressive line contact with said photoconductive element to effect transfer of said toner image from said photoconductive element to the receiver and to separate the receiver from said photoconductive element along a progressive line after transfer;

means for applying a first potential to said first roller for bringing the receiver into intimate progressive line contact with said photoconductive element as said transfer device is moved thereacross; and

means for applying a second potential to said second roller for effecting image transfer of said toner image from said photoconductive element to the receiver upon movement of said second roller past said photoconductive element.

3. A transfer device as claimed in claim **2**, wherein:

said conductive segments are wider than said insulative segments.

4. A transfer device, as claimed in claim **2**, wherein said belt includes:

an endless web of insulative material having an outer surface which includes said insulative segments and having an inner surface;

a plurality of spaced conductive segments across said outer surface of said web to form said conductive segments; and

a plurality of conductive strips in contact respectively with said conductive segments and extending across said inner surface of said web to make electrical contact with said rollers.

5. A transfer device, as claimed in claim **2**, wherein said moving means includes:

a shaft extending from one of said rollers;

a pinion connected to said shaft;

a rack extending along said transfer path and engageable by said pinion; and

a drive means connected to said carriage to move said carriage along said transfer path to cause said pinion to rotate said one roller and said endless belt due to engagement of said pinion with said rack.

6. An electrophotographic device for effecting transfer of a toner image from at least one photoconductive element onto a receiver movable along a transfer path, said device comprising:

a first transfer station along said transfer path;

means for moving a first photoconductive element having a first toner image into said first transfer station;

means at said first transfer station for aligning said photoconductive element;

a transfer carriage movable along said transfer path;

a first roller rotatably mounted on said carriage;

a second roller spaced from said first roller and rotatably mounted on said transfer carriage;

an endless belt extendable around said first and second rollers and formed of alternating conductive and insulative segments extending thereacross, said conductive segments being engageable with said rollers and said belt being movable along an endless path;

means for attaching the receiver to said segmented belt so that the receiver is extendable across a plurality of said segments;

means for moving said transfer carriage along said transfer path past said first photoconductive element and for mov-

ing said endless belt along said endless path to bring the receiver into progressive line contact with said first photoconductive element to effect transfer of said first toner image from said first photoconductive element to the receiver and to separate the receiver from said photoconductive element along a progressive line after transfer;

means for applying a first potential to said first roller for bringing the receiver into intimate progressive line contact with said first photoconductive element as said transfer device is moved thereacross; and

means for applying a second potential to said second roller for effecting image transfer of said first toner image from said first photoconductive element to the receiver upon movement of said second roller past said first photoconductive element.

7. An electrophotographic device, as claimed in claim 6, further including:

a second transfer station along said transfer path;

second means for moving a second photoconductive element having a second toner image into said second transfer station to effect transfer of said second image to said receiver to form a composite image upon movement of said transfer device along said transfer path past said second transfer station.

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