

[54] **PHOTOCOPYING MACHINE**

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117/17.5

[56] **References Cited**

UNITED STATES PATENTS

2,986,442 5/1961 Broding 355/16 X

3,432,231	3/1969	Gardner.....	355/16 X
3,600,082	8/1971	Knechtel.....	355/16 X
3,630,615	12/1971	Reynard.....	355/16 X
3,687,539	8/1972	Furuichi.....	118/637 X
3,697,160	10/1972	Clark.....	355/16 X
3,700,323	10/1972	Guyette et al.	355/16

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[57]

ABSTRACT

A dry transfer process photocopying machine comprising a generally horizontal, transparent rest for support of original documents to be copied, and a continuous belt having a photoconductive outer surface which is transported repeatedly over a vertical path and exposed on the vertically aligned portion thereof to images of the documents to be copied, said images being developed and transferred to copy paper to be supplied from a copy paper reserver and subsequently fixed thereon by a heating means.

2 Claims, 3 Drawing Figures

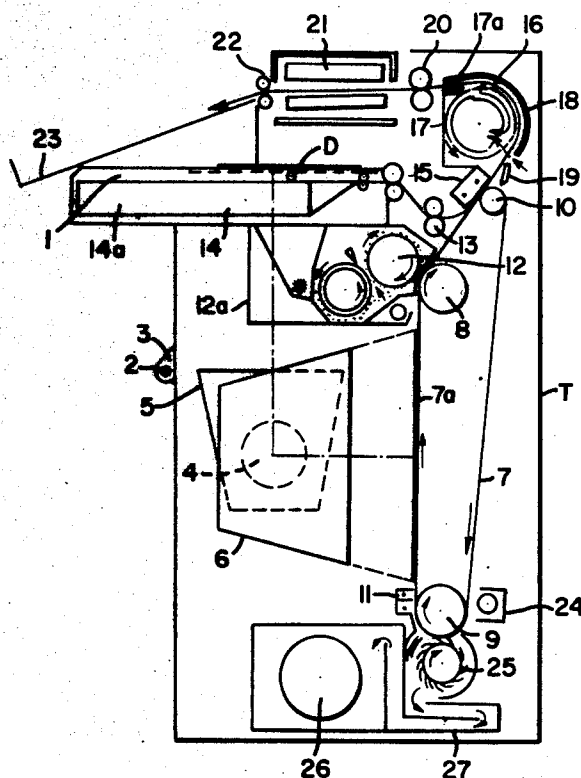
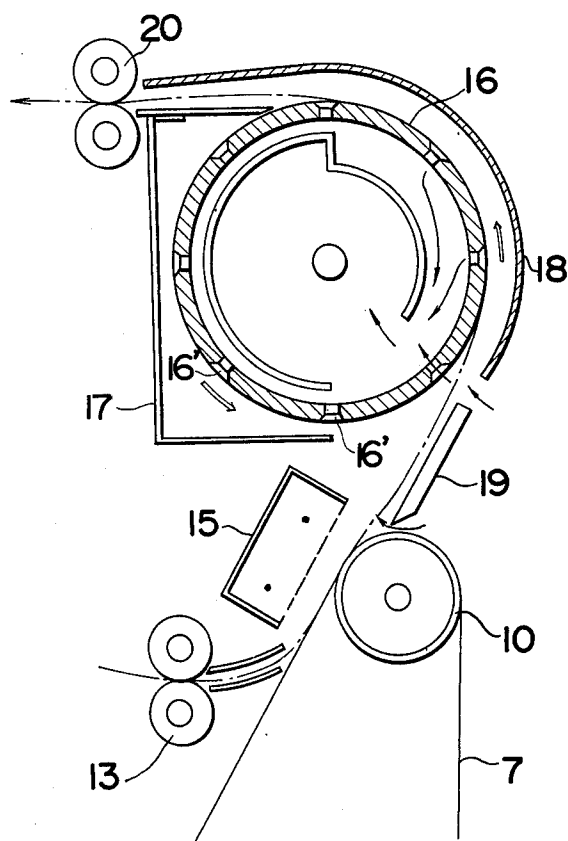


FIG. 3



PHOTOCOPYING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a dry transfer type photocopying machine, and more particularly to an improved photocopying machine comprising a generally horizontal, transparent rest for support of original documents to be copied, copy paper reserve, sensitization, image development transfer, and cleaning means, past which a continuous belt having a photoconductive outer surface is transported repeatedly, the belt being transferred to copy paper and subsequently fixed thereon by a heating means.

Conventionally there are known two main methods of obtaining copies of original documents by the dry transfer process. In one method, successive portions of an original document to be copied are illuminated through a slit, shutter, or similar means, which is moved parallel to the document, which is generally horizontal, and images of these successive portions are directed by suitable optical means onto successive portions of a photosensitive material, the speeds of the photosensitive material, optical means, and the slit being in definite ratios. In the other method, there is instantaneous exposure of a photosensitive material, through suitable optical means, to the entirety of an original document. The present invention relates to a machine employing the latter method of photocopying.

Instantaneous exposure photocopying machines make it possible to effect exposures comparatively rapidly, at various magnifications, and have the advantage that considerably fewer moving parts are required, which simplifies problems of construction. However, a problem conventionally associated with instantaneous exposure photocopying machines is that it has not been possible to provide a compact machine requiring little floor space, and convenient for operators. In principle, constructional elements employed in this type of photocopying machine are a document rest, two fixed mirrors, lens, and a moveable copying material on which the latent image of a document may be formed, for subsequent transfer to copy paper, and arrangement of these elements to provide a compact machine presents certain problems. A particular problem is that of the disposition of the moveable photocopying material, which may be horizontal or vertical, as opposed to the document which is conveniently always horizontal. Disposing the photocopying material horizontally results in a very long machine, requiring an excessive amount of floor space. On the other hand, in conventional machines in which copying material is disposed vertically, construction is rendered more complex, and in particular there is the disadvantage that the path over which copy paper must travel is long, and it is generally necessary to wait a long time to obtain a first copy of a document.

SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to provide an improved photocopying machine.

It is another object of the invention to provide a photocopying machine which is compact.

It is a further object of the invention to provide a photocopying machine wherein time per copy is reduced.

It is a still further object of the invention to provide a photocopying machine wherein heat dispersion is optimum.

In accomplishing these and other objects, there is provided, according to the present invention, an instantaneous exposure photocopying machine wherein a photosensitive material is disposed on a path which comprises a vertical section and a sloping section, and adjacent to which necessary sensitization or other means are provided. Exposure to an image of a document to be copied is effected on a vertically aligned portion of the photosensitive material, which portion is then transported upwards to the sloping section, where it is brought into contact with copy paper, and is subsequently moved around a small diameter pulley, and downwards. The copy paper, to which a required image has been transferred, peels of the photosensitive material at the vicinity of the small diameter pulley, due to the stiffness of the copy paper, and is attracted and temporarily attached to a rotatory drum comprising a plurality of holes through which air is drawn to provide a suction force, which holds the copy paper on the drum. From the drum, the copy paper is transferred to a fixing section provided in the upper portion of the photocopying machine, and thence to an outlet tray.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention may be had from the following full description thereof, when read in reference to the attached drawings, in which;

FIG. 1 is a schematic cross-sectional view of a photocopying machine according to one embodiment of the present invention,

FIG. 2 is a front view showing optical paths in the machine of FIG. 1, and

FIG. 3 is a cross-sectional view, on an enlarged scale, of a drum employed in the machine of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1, the general function of the photocopying machine T shown is that a document to be copied is placed on a horizontal document support 1, which is provided in an upper forward portion of the photocopying machine T. An image of the document is directed through a lens 4 and fixed mirrors 5, 6 onto a vertical portion 7a of a photosensitive belt 7 which is provided in rear portion of the machine T, to form an electrostatic image on the belt portion 7a. The belt portion 7a is then transported upwards on to a rearwardly sloping section of the belt path, where the image of the document is transferred onto a sheet of charged copy paper 14, which is supplied from a reserve 14a provided in an upper front portion of the photocopying machine T to directly face to the belt upper portion at a fixed position different than the document support 1. The belt portion 7a is subsequently transported downwards, while the copy paper 14 is moved out of contact with the belt 7, and onto a drum 16, which directs the copy paper 14 upwards and then forwards, to supply the copy paper 14 to a fixing section 21 which is provided in an uppermost part of the photocopying machine T, and from which the copy paper 14 is subsequently supplied onto a tray 23 located at the uppermost front portion of the machine T.

In greater detail, the document support 1 is made of glass or other suitable transparent and is positioned horizontally at a suitable height at the upper front por-

tion of the photocopying machine T. At a front portion of the machine T below the document rest 1, there is provided a lamp 2 for momentary illumination of the whole of a document D on the rest 1. The lamp 2 may be, for example, a xenon flash lamp, and is partially enclosed in a reflector 3 which ensures that light emitted by the lamp 2 is directed efficiently onto the document D. When the document D is illuminated, an image thereof is directed by fixed mirrors 5, 6 and a fixed lens 4 onto a portion of the photosensitive belt 7. The mirror 5 is located in a generally central portion of the machine T, below the document support 1, and, as indicated most clearly in FIG. 2, is inclined at an angle of 45° to the support 1. Light reflected from a document D on the support 1 is directed by the mirror 5 through the lens 4 onto the mirror 6 (FIG. 2). The mirror 6 is in a generally vertical alignment and is suitably inclined with respect to the mirror 5 and lens 4, for instance, at an angle of 45° to direct image rays therefrom in a horizontal plane, towards the rear of the machine T, and onto the surface of the abovementioned belt 7.

The belt 7 is a continuous belt having a photosensitive outer coating, is provided in a rear portion of the photocopying machine T, and is driven by pulleys 5, 9 and 10, which are rotated by suitable means (not shown). The pulleys 8, 9 are generally equal in diameter, the pulley 9 is rotatably mounted in a lower rear portion of the machine T. The pulley 8 is rotatably mounted in an upper rear portion of the machine T, directly above the pulley 9, the most forward points of the outer peripheries of the pulleys 8, 9 lying on the same vertical line, whereby that portion of the belt 7 between the pulleys 8, 9 is vertical. The pulley 10 is considerably smaller in diameter than the pulleys 8, 9, and is provided above and rearwards of the pulley 8, whereby that portion of the belt 7 between the pulleys 8, 10 slopes upwards and rearwards. From the pulley 10, the belt 7 is led to the pulley 9. The belt 7 is driven upwards from the pulley 9 to the pulley 8, to the pulley 10, and downwards to the pulley 9.

On the forward side of the belt 7, in the vicinity of the pulley 9, there is provided a corona discharge unit 11 for sensitization of those portions of the belt 7 passing this location. The polarity of the charge imposed by the corona discharge unit 11 on the surface of the belt 7 depends on the type of surface. For a surface comprising aluminum sputtered on polyester film and coated with resin containing zinc oxide, for example, the charge is made negative. After passing the location of the corona discharge unit 11 and being sensitized thereby, a particular portion 7a of the belt 7 is carried on to the vertical stretch between the pulleys 8, 9, and is there exposed to an image of a document D, directed from the document support 1 by the mirrors 5, 6, and lens 4, whereby an electrostatic image is formed on the belt portion 7a.

After exposure, the belt portion 7a is brought to a development unit 12, which is provided forward of and adjacent to the pulley 8, and comprises a brush for direction of toner particles oppositely charged to the electrostatic image onto the belt portion 7a. The belt portion 7a is next carried onto the sloping section between the pulleys 8, 10, and is there brought into contact with a sheet of copy paper 14, which is supplied by rollers, or sets of rollers 13, and other suitable guide means from the reserve 14a. The copy paper reserve 14a is provided in an upper front part of the machine T, below the level of the document support 1 at a certain

position in which one end of sheets of copy paper 14 is placed so as to face the upper portion of the belt. While in contact, the belt portion 7a and the copy paper 14 receive a charge applied by a corona discharge unit 15, which is located adjacent to and facing the upper portion of the belt sloping section between the pulleys 8, 10, whereby an image of the document D is transferred onto the copy paper 14. The voltage applied by the discharge unit 15 preferably has an AC component, and may be, for example, AC, or half-wave rectified AC. After arriving at the location of the pulley 10, the belt portion 7a is transported downwards past a lamp 24 which is provided adjacent to and to the rear of the pulley 9, and which erases the charge, and hence the electrostatic image on the belt portion 7a. The belt portion is next brought into contact with a rotatable cleaning brush 25, which is provided in a housing below the pulley 9, and which removes remnant toner particles from the belt portion 7a. Toner particles removed by the brush 25 are drawn into a suitable reception means by a fan 26, which is provided with a filter, and is located in a housing which is forward of the brush 25 housing and connected thereto by suitable ducts 27. After being cleaned, the belt portion 7a is again brought to the location of the corona discharged unit 11, where it may be sensitized again, and repeat the abovedescribed circuit, which circuit is, of course, followed by other portions also of the belt 7.

With reference now to the sheet of paper 14, on to which an image of the document D is transferred at the location of the discharge unit 15, when the belt portion 7a begins to be carried around the small diameter pulley 10, the leading end of the paper 14 peels away from the belt 7, due to the stiffness of the paper 14 and to the existence of a belt-bending portion of small radius on the pulley 10. As the belt portion 7a continues to be carried around the pulley 10, the paper continues to peel away from the belt 7, and to be advanced in a generally straight line upwards and rearwards (due to contact of the rear portion of the paper 14 with the belt 7). When the paper 14 is thus advanced it is moved past a guide block 19, and, then, is brought into contact with the abovementioned drum 16, thereby to cause the paper to peel perfectly away from the belt 7.

The drum 16 is rotatably supported and partially enclosed in a frame 17 provided in a top rear portion of the photocopying machine T, above the discharge unit 15 and the small diameter pulley 10. The shortest distance between the outer periphery of the drum 16 and that of the pulley 10 is less than the length of the sheet of paper 14, whereby the front end of the paper 14 may come into contact with the outer periphery of the drum 16 before the rear end thereof moves out of contact with the belt 7. Parallel to the top and rear portions of the drum 16, there is provided a guide board 18. Both the guide board 18 and block 19 are made of material having good dielectric qualities, whereas the drum 16 is made of an electrically conductive material. The drum 16 comprises a hollow inner portion into which air, moved by means of a known compressor or the like (not shown), may pass by flowing through a plurality of openings 16', formed in the outer periphery of the drum 16 at equal intervals so as to suck and hold the paper on the outer periphery of the drum 16. The drum 16 is a rotated counter to the belt 7 by a conventional known means such as a motor, and at a speed such that the peripheral speed thereof is equal to the speed of the belt 7. As indicated by the arrows in FIG. 1, when the

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drum 16 is rotated counterclockwise in the drawing, air between the pulley 10 and the lower end of the board 18 moves upwards into a channel between the board 18 and drum 16, and then downwards between the drum 16 and frame 17, while at the same time air is drawn into the openings formed in the outer periphery of the drum 16, thus constituting a suction force by which paper 14 may be held to the drum 16. This suction force is aided by electrically grounding the drum 16, which thus attracts the paper 14, which has been charged by the corona discharge unit 15. In contrast to this, the board 18 and block 19 being non-conductive, there is no risk of the paper 14 being attracted thereto or smudged thereby. Thus, when the front end of the paper 14 comes into contact with the drum 16, the paper 14 is held against the drum 16, and as the drum 16 and belt 7 continue to rotate counter to one another, the paper is peeled of the belt 7, curves onto and is held to the outer periphery of the drum 16, the image-carrying portion of the paper 14 being outwards with respect to the drum 16. The openings of the drum 16 through which air is drawn may be formed evenly over the periphery of the drum 16, or, if less suction force is required, may be spaced so as to provide suction force at opposite ends only of a sheet of copy paper. Rotation of the drum 16 is synchronized with that of the belt 7, to ensure that sheets of copy paper always come into contact with the same portions of the drum 16.

The paper 14 is carried upwards and then forwards by the drum 16, and the leading edge thereof is brought into contact with a wedge portion 17a, which is provided at the upper edge of the frame 17, projects towards the drum 16, and separates the paper 14 from the drum 16. With rear end of the paper 14 still adhering to the outer periphery of the drum 16, the paper 14 is pushed forwards in a generally straight line, away from the drum 16, and is brought into contact with a pair of rolls 20, which are provided forward of and generally level with the top of the drum 16. The paper 14 is drawn forwards by the rolls 20, and guided into the abovementioned infra-red heating compartment 21, which heats the paper 14 to fix the toner particles constituting the image thereon. After the image has been fixed, the paper 14 is withdrawn from the compartment 21 by rolls 22, and supplied thereby onto the output tray 23, which is provided at an uppermost forward position of the photocopying machine T, above the level of the document rest 1.

As is clear from the description and drawings of the preferred embodiment, there is provided, according to the present invention, a dry transfer process photocopying machine comprising a generally horizontal, transparent rest 1 for support of original documents D to be copied, a continuous belt 7 having a photoconductive outer surface which is transported repeatedly over a path consisting of a vertical portion, along which said belt is transported upwards and exposed to images of the documents to be copied, said images exposed on the belt being developed and transferred to copy paper to be supplied from a copy paper reserve 14a provided below the rest, a sloping portion above and continuous to said vertical portion, and a curved portion having a small radius of curvature and being continuous to said sloping portion, a large diameter rotatable drum 16 located above and adjacent to said belt path curved portion, and forming a plurality of portions through which air may be drawn upon rotation of said drum, whereby

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the copy paper to which an image has been transferred from said belt may be attracted to and temporarily held on the outer periphery of said drum, with the image surface thereof outwards with respect to said drum, said drum transporting said copy paper to a heating means 21 for fixing said image on the copy paper, and first and second guide means 19, 18 made of dielectric material, said first guide means being located between said belt path curved portion and said drum, and said second guide means being located generally parallel to a portion of the outer periphery of said drum, whereby air may pass between said first guide means and said belt and between said first and said second guide means, to said drum. It is to be noted that, with the above arrangement, a major advantage of a photocopying machine of the present invention is that the distance over which a sheet of copy paper travels from an image transfer section to an output tray is extremely short, and the time it is necessary to wait for a completed photo copy of an original document is correspondingly shortened. Other advantages of the invention are that clean disposal of excess toner particles is ensured since the toner removal brush and associated means are provided in a lowermost part of the machine, and also that, since heating means for fixing images on copy paper is provided at the uppermost portion of the machine, dissipation of heat is optimum.

Although the present invention has been fully described by way of the preferred embodiment thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the true scope of the present invention, they should be construed as included therein.

What is claimed is:

1. In a dry transfer process photocopying machine including generally horizontal, transparent support means for support of original documents to be copied, copy paper reserve means for storing a supply of copy sheets, charging means, full frame instantaneous exposure means, image developing means, image transfer means, cleaning means and a photosensitive member in the form of a belt, said photosensitive member being exposed to an image of an original document by said exposure means subsequent to uniform application of charges by said charging means and developed by said developing means prior to transfer of said image onto a sheet of copy paper fed from said reserve means, and said copy paper being subsequently fixed by a fixing means, the improvements which comprise:

means for supporting and rotating said photosensitive member and including a plurality of rollers, said photosensitive member being supported vertically with respect to said transparent support means and one of said rollers having a small radius of curvature defining an uppermost portion of said vertically supported photosensitive member;

said developing means being located below said roller of small radius but adjacent another of said rollers supporting the photosensitive member;

said image transfer means being located adjacent said small radius roller for transferring a developed image onto a sheet of copy paper fed from said reserve means and through a feeding means located adjacent but between said developing and transfer means;

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a first guide means of dielectric material located immediately above said small radius roller;
a rotatable drum of conductive material located above said uppermost portion of the photosensitive member and leading to a suction means, said rotatable drum formed with plurality of portions through which air may be drawn and rotated synchronously with said photosensitive member; and
a second guide means separate from said first guide means and located generally parallel to a portion of the outer periphery of said drum and made of dielectric material;

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whereby said sheet of copy paper to which an image has been transferred is separated from said photosensitive member by said small radius roller with the aid by said first guide means and guided by said drum to said fixing means.

2. The improvements claimed in claim 1, wherein said exposure means includes a lamp for instantaneously flashing a document supported on said transparent support means, a first mirror provided at a 45° angle with respect to said support means, a lens and a second mirror for projecting an image of said document onto said photosensitive member.

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