

United States Patent

Smith

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[45] Oct. 3, 1972

[54] SHEET STRIPPING APPARATUS

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[73] Assignee: Xerox Corporation, Stamford, Conn.

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[21] Appl. No.: 85,052

[52] U.S. Cl. 355/3, 355/110, 271/51, 271/DIG. 2

[51] Int. Cl. G03g 15/00

[58] Field of Search.....355/17, 85, 104, 107, 108, 355/109, 110, 3; 271/74 PG, DIG. 2, 51

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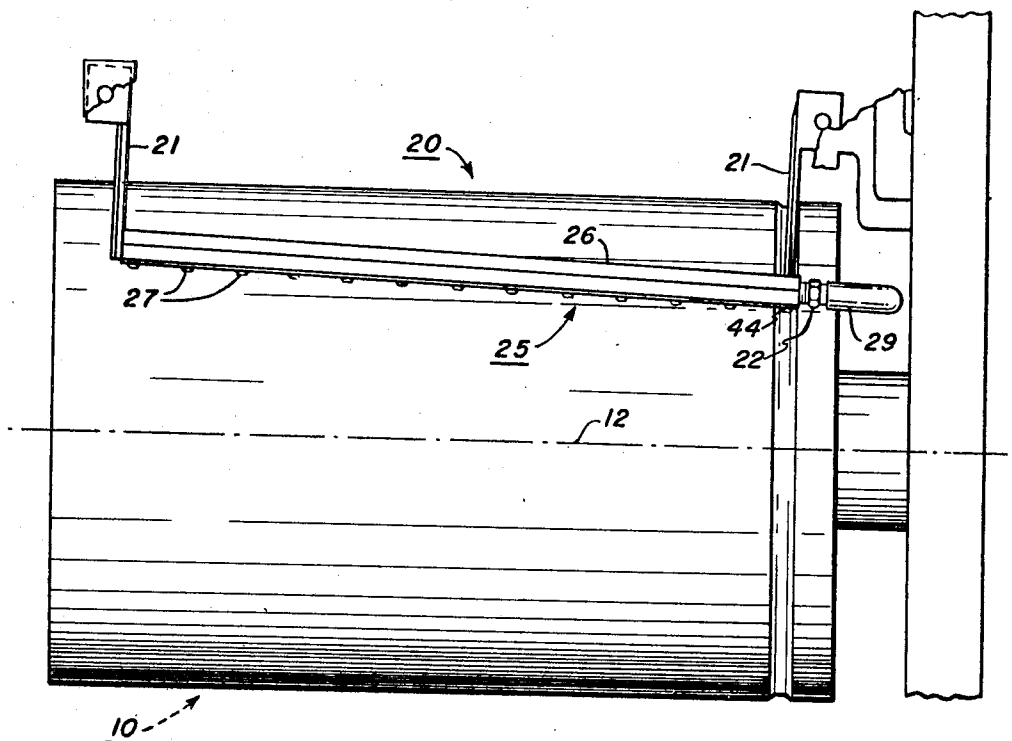
Assistant Examiner—Alan A. Mathews

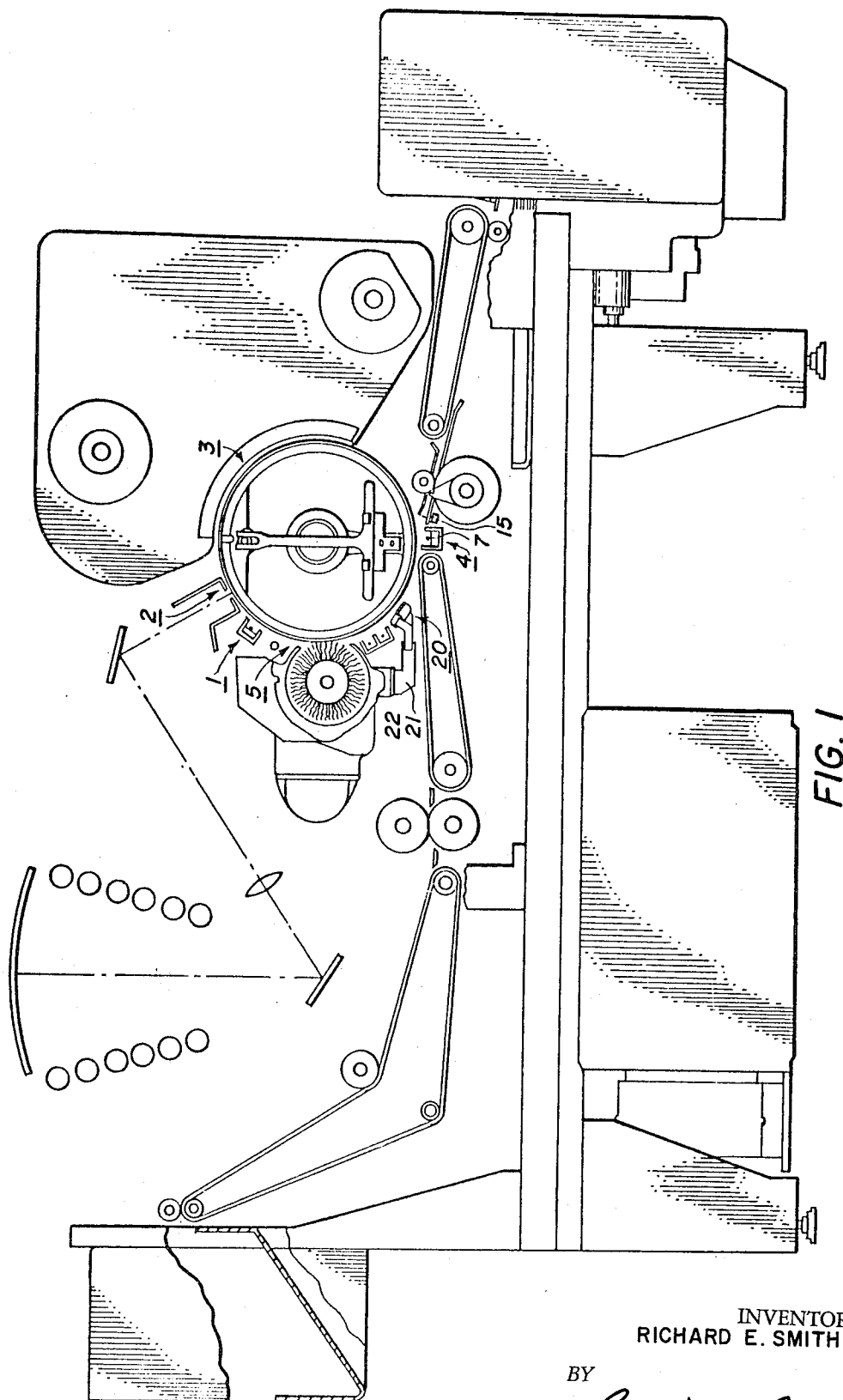
Attorney—James J. Ralabate, John E. Beck and Benjamin B. Sklar

[57] ABSTRACT

Apparatus for separating a copy sheet, supporting a toner image, from a rotating xerographic drum structure wherein the bond between the sheet and the drum is principally electrostatic. The apparatus includes a manifold having a linear array of spaced discharge orifices or nozzles supported in a spaced relationship relative to the surface of the xerographic drum structure. An elongated depression or recess provided in the circumference of the drum structure is disposed opposite one of the nozzles, to thereby provide means for the air discharged from the nozzle to be introduced between the xerographic drum structure and the copy sheet overlying the depression or recess.

3 Claims, 7 Drawing Figures





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FIG. 2

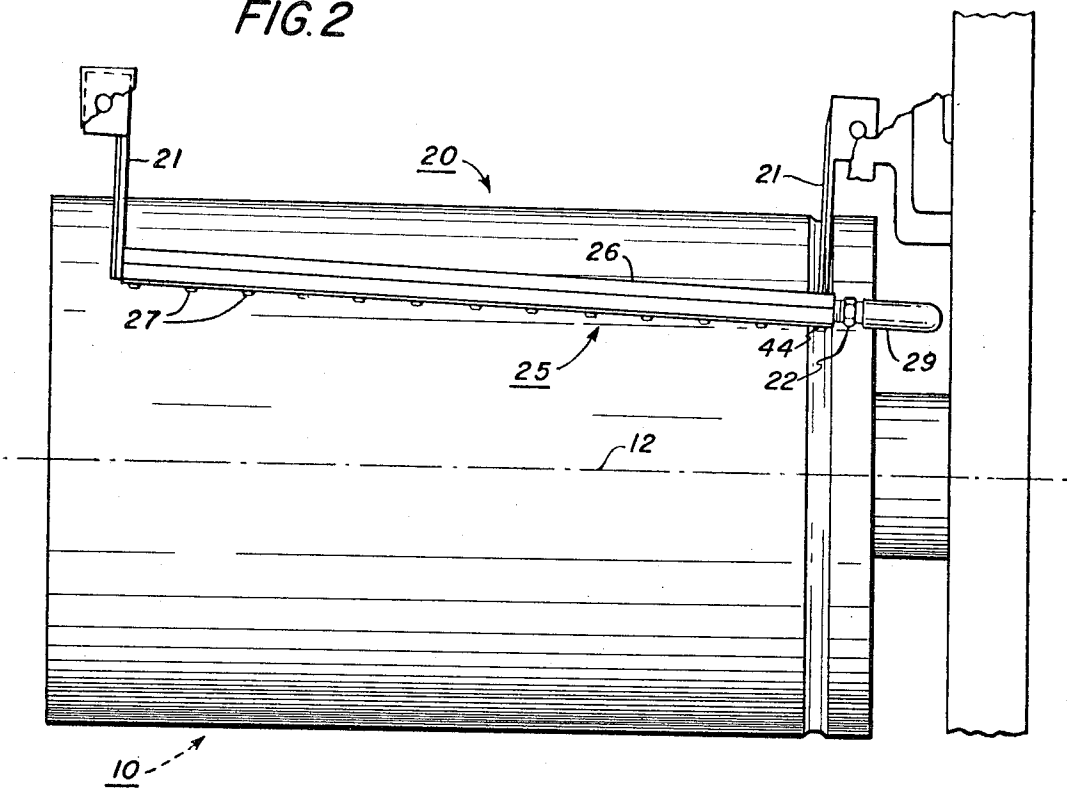


FIG. 5

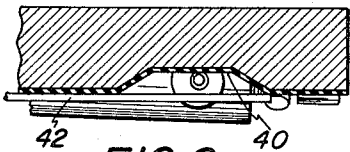
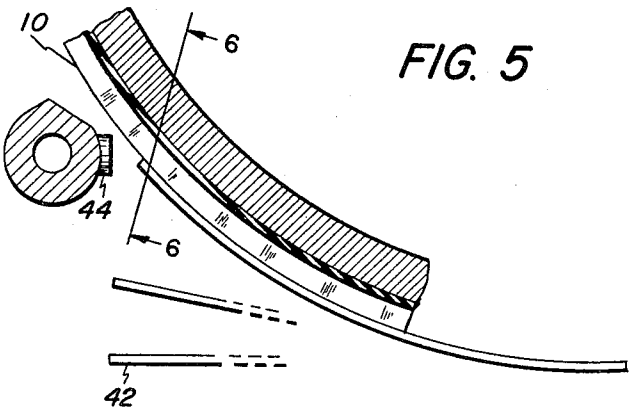


FIG. 6

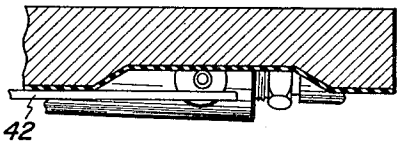
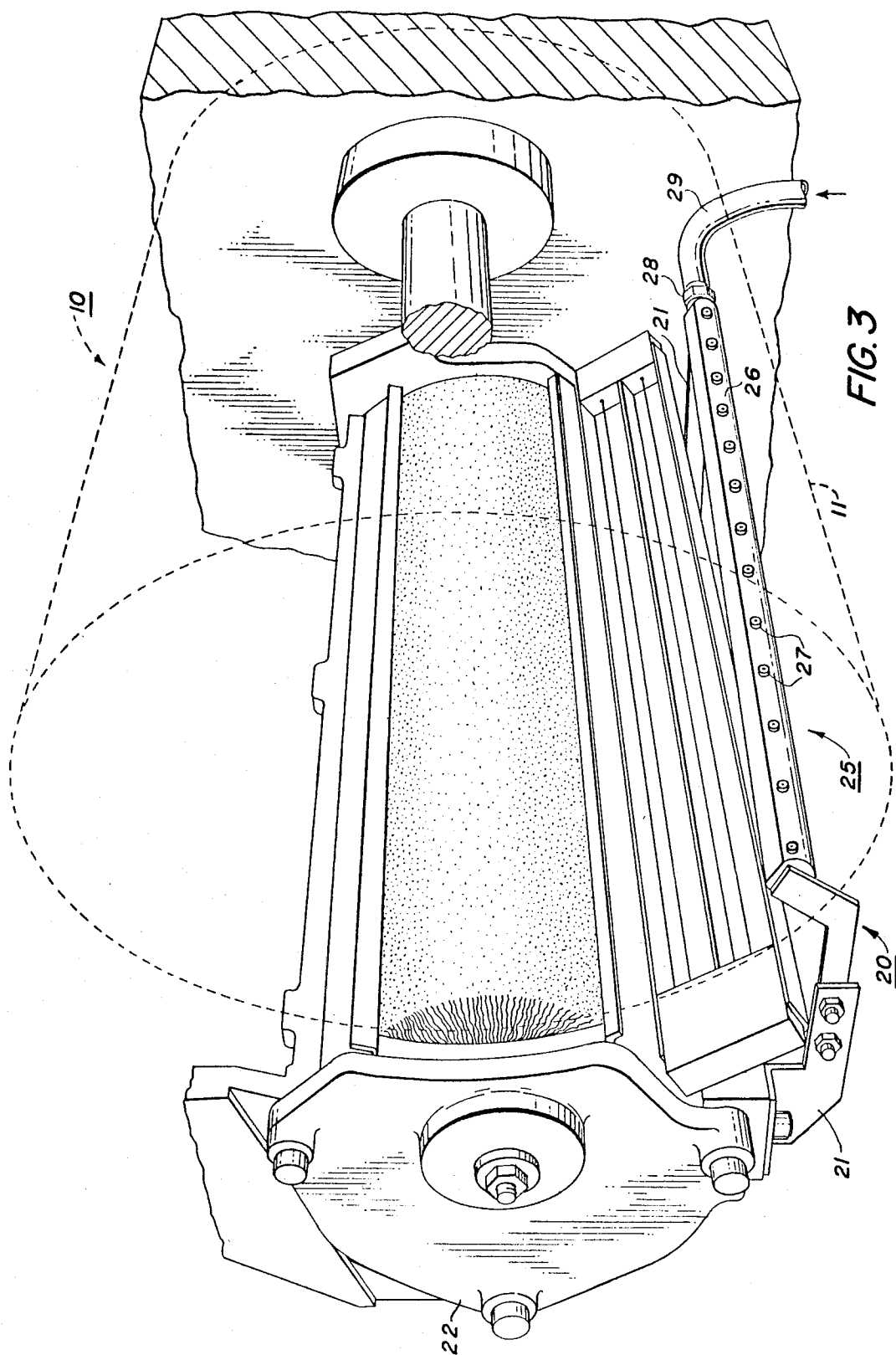


FIG. 7



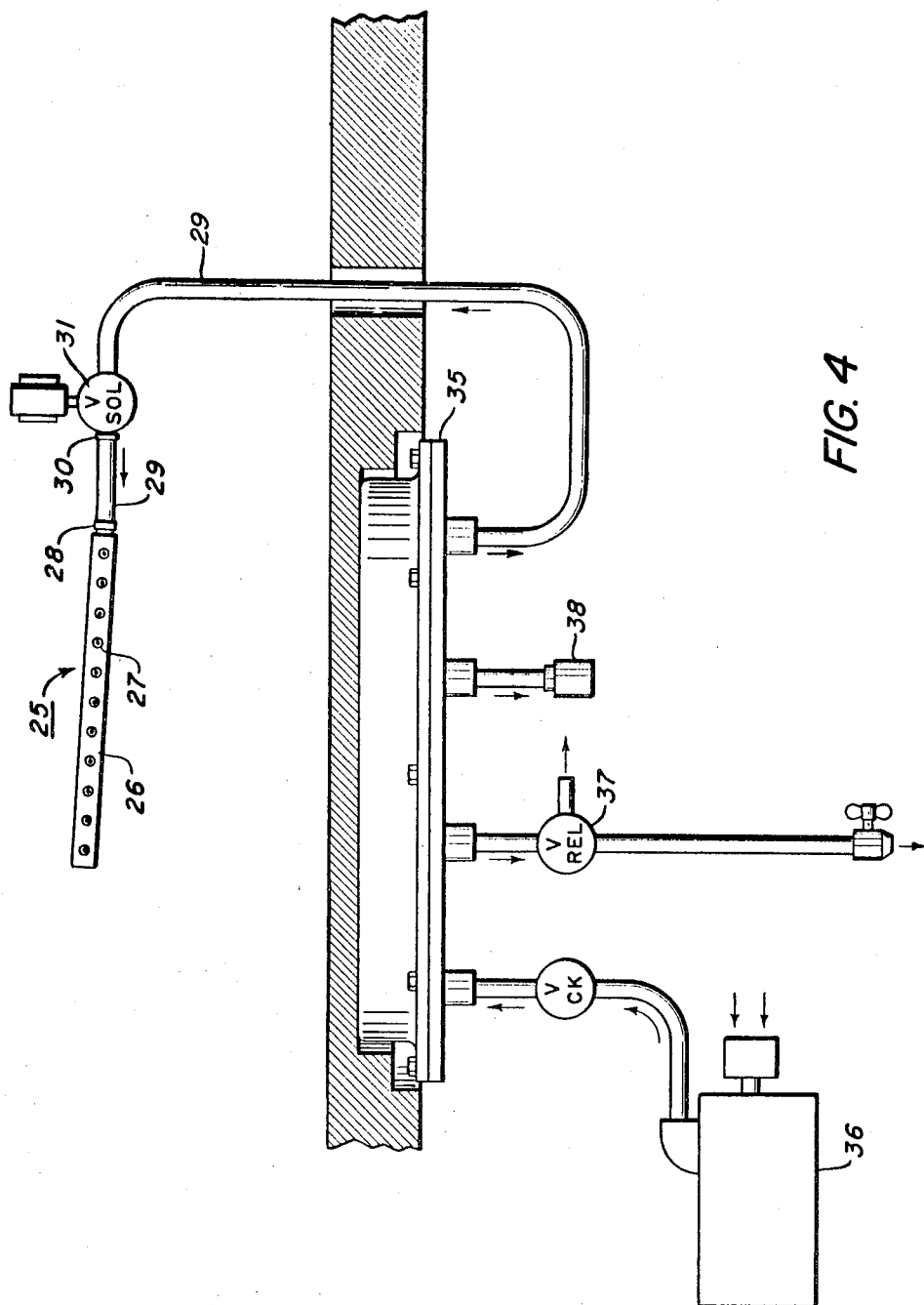


FIG. 4

SHEET STRIPPING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates, in general, to sheet stripping apparatus and, more particularly, to a sheet stripping mechanism for removing sheets of transfer material from a xerographic plate.

More specifically, this invention relates to an improved sheet stripping apparatus utilizing jets of compressed aeriform fluid to strip a sheet of transfer material from a xerographic plate or similar device.

In the process of xerography, for example, as disclosed in Carlson U.S. Pat. No. 2,297,691, a xerographic plate comprising a layer of photoconductive material on a conductive backing is given a uniform electrostatic charge over its surface and then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate in accordance with the light intensity reaching it thereby creating an electrostatic latent image on or in the plate.

Development of the image is effected by developers which comprise, in general, a mixture of suitable pigmented or dyed resin based powder, hereinafter referred to as toner, and a granular carrier material which functions to carry and to generate triboelectric charges on the toner. More specifically, the function of the carrier material is to provide mechanical control of the toner, or to carry the toner to an image surface and, simultaneously, provide almost homogeneity of charge polarity. In the development of the image, the toner powder is brought into surface contact with the photoconductive coating and is held thereon electrostatically in a pattern corresponding to the latent electrostatic image. Thereafter, the developed xerographic image is usually transferred to a transfer or support material or record medium to which it may be fixed by any suitable means, for example, the application of heat.

In the mixture of toner particles and carrier material, the toner particles, which are many times smaller than the carrier particles, adhere to and coat the surface of the carrier particles due to the electrostatic attraction between them. During development, as the toner coated carrier particles roll or tumble over the xerographic plate carrying an electrostatic image of opposite polarity to the charge on the toner, toner particles are pulled away from the carrier by the latent electrostatic image and deposited on the plate to form a developed toner image.

Because of the electrostatic charges placed on the support material or record medium the support material electrostatically adheres to the xerographic plate. Mechanical strip fingers commonly used in the printing art cannot be successfully used as a means for stripping the support material from a xerographic plate. Since mechanical strip fingers, in order to strip a sheet of support material from a xerographic plate, must be inserted between the support material and the plate, they will inadvertently graze and mark the photoconductive surface if such surface is exposed. Also during this process, as the support material is peeled from the xerographic plate by the strip fingers, the surface of the support material or record medium carrying the transferred images will slide on the strip fingers. The xerographic image at this time is held on the support materi-

al by electrostatic forces only, the image areas brushing against the surface of the strip fingers would, therefore, be disfigured.

To overcome the problems with mechanical stripping devices, a sheet stripping apparatus, forming the subject matter of U. S. Pat. No. 3,062,536, issued in the name of J. Rutkus, Jr., et al., was developed. Prior art sheet stripping apparatus of the type disclosed in Rutkus et al. utilizes a plurality of aeriform fluid emitting nozzles disposed adjacent the xerographic drum, the emission of fluid therefrom being directed toward the surface of the xerographic drum adjacent the leading edge of the copy sheet which is electrostatically attached to the drum subsequent to image transfer thereto. In constructions of the foregoing type, it has been discovered that in certain instances the copy sheet is so firmly attached to the xerographic drum by virtue of the electrostatic forces that the jets of aeriform fluid do not effect release of the leading edge of the copy sheet.

Accordingly, it is the general object of this invention to provide a new and improved sheet stripping apparatus for use in an automatic xerographic reproducing machine.

It is a more particular object of this invention to provide an improved sheet stripping method of the type utilizing aeriform fluid emission.

Another object of this invention is to provide improved sheet stripping apparatus utilizing compressed aeriform fluid in conjunction with a depression or recessed area provided in the xerographic drum which permits introduction of the fluid between the paper and the drum thereby applying a force against the surface of the record medium in a direction so as to effect removal thereof.

Further objects and advantages of the present invention will become more apparent from the following description of the preferred embodiment of the invention when considered in conjunction with the accompanying drawings forming a part hereof.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of an automatic xerographic reproducing machine utilizing the invention;

FIG. 2 is a bottom plan view of an area of the machine of FIG. 1, illustrating a sheet stripping system forming a part thereof;

FIG. 3 is a perspective view of a part of the machine of FIG. 1, illustrating an aeriform fluid discharge device forming a part of the stripping system of the invention;

FIG. 4 is a schematic illustration of an aeriform fluid discharge manifold and controls therefor;

FIG. 5 is a schematic illustration of the relative positions of the inboard discharge orifice and the drum structure;

FIG. 6 is a cross-sectional view taken on the line VI—VI of FIG. 5; and

FIG. 7 is a view similar to FIG. 6 of a modification thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring to the drawings, especially FIG. 1, there is shown an embodiment of the subject invention in a

suitable environment such as an automatic xerographic reproducing machine having a xerographic plate including a photoconductive layer or light-receiving surface on a conductive backing and formed in the shape of a drum structure, which is mounted on a shaft journaled in a frame to rotate in a direction indicated by the arrow to cause the surface thereof sequentially to pass a plurality of xerographic processing stations.

For the purpose of the present disclosure, the several xerographic processing stations in the path of movement of the drum surface may be described functionally as follows:

A charging station 1, at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum structure;

An exposure station 2, at which the light or radiation pattern of copy to be reproduced is projected onto the drum surface to dissipate the drum charge in the exposed areas thereof thereby forming a latent electrostatic image of the copy to be reproduced;

A developing station 3, at which xerographic developing material, including toner particles having an electrostatic charge opposite to that of the electrostatic latent image, are cascaded over the drum surface, whereby the toner particles adhere to the electrostatic latent image to form a xerographic powder image in the configuration of the copy being produced;

A transfer station 4, at which the xerographic powder image is electrostatically transferred from the drum surface to a record medium; and

A drum cleaning and discharge station 5, at which the drum surface is brushed to remove residual toner particles remaining thereon after image transfer, and at which the drum surface is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

It is believed that the foregoing description is sufficient for purposes of this application to show the general operation of xerographic reproducing apparatus utilizing a sheet stripper mechanism constructed in accordance with the invention.

At the image transfer station 4, the powder images previously formed on the xerographic drum structure are electrostatically transferred to a record medium, the electrostatic charge being applied to the record medium by means of a corona transfer device 7. The electrostatic charge applied to the record medium during the transfer process is sufficient to cause the record medium to adhere to the drum structure even after the material has passed out of the corona emission area. It will, therefore, be apparent that there must be provided some means for breaking the bond between the support material and the xerographic drum structure without degradation of the powder images and the drum structure. To this end, there is provided a sheet stripping apparatus generally indicated 20.

One form of a sheet stripping mechanism, constructed in accordance with the present invention, is specifically illustrated in FIGS. 2, 3, and 4 and employs a manifold 25 having multiple outlets or orifices 27 directed against the surface 11 of the xerographic drum structure 10 so that the jets of compressed aeriform fluid from the orifices are directed against the leading edge of a record medium to blow the edge of the medium off the drum, the remainder thereof then peeling off

the drum due to its own weight. The manifold may be supplied with compressed aeriform fluid by means of any suitable source of compressed aeriform fluid, desirably at substantially constant pressure.

Specifically in the embodiment disclosed, there is provided a discharge manifold 25 positioned adjacent to the light sensitive surface 11 of the drum structure 10 and at an angle to the drum's axis of rotation 12 by means of brackets 21 which may be secured to a structural element of the machine, as for example, the drum cleaning device 22. Multiple parallel spaced outlet orifices 27 secured to the manifold 25 are positioned so that streams of compressed aeriform fluid emerging from the orifices are directed to stroke the surface of the xerographic drum structure at an angle between the normal and the tangent to the drum's surface. The manifold 25 consists of a tube 26 closed at one end and counterbored at the intake end to receive a tube coupling 28 press fitted into place. Each orifice passes through the wall of tube 26 so that each is in communication with the interior thereof.

Compressed aeriform fluid is delivered to the manifold by means of a flexible tube 29 connected at one end to the manifold tube coupling 28 and at its other end to a male hose connector 30 threaded into a solenoid valve 31 of any suitable commercial type. The solenoid valve 31 is activated whenever a sheet or piece of record medium is forwarded to the xerographic drum structure closing a limit switch 15 (FIG. 1). The valve is held open to allow the compressed aeriform fluid to be directed against the drum and leading edge of the support material for a sufficient time to allow the material to be removed from the drum structure without effecting the toner powder image electrostatically transferred to the support material, preferably for 3° of rotation of the drum structure.

Constant pressure compressed aeriform fluid is supplied to the manifold 25 through the solenoid valve 31 by means of an accumulator tank 35 and a compressor 36 as shown schematically in FIG. 4. The compressor 36 operates to keep the accumulator tank 35 at a constant pressure, preferably about 13 psi by means of a pressure relief valve 37. A pressure switch 38 operates the compressor 36 whenever the accumulator tank pressure drops below a predetermined minimum and then interrupts operation when the pressure is again suitable. In the embodiment shown, when the solenoid is actuated, the valve opens for about 0.036 seconds, which is equivalent to 3° of rotation of the drum structure, discharging the aeriform fluid at substantially a constant pressure, thereafter reclosing allowing the accumulator tank to again be brought up to the original pressure.

At the transfer station 4, the toner powder image is substantially removed from the drum surface onto the support material by means of a corona transfer device 7 that is located at or immediately after the line of contact between the support material and the rotating drum structure. In operation, the electrostatic field created by the corona transfer device is effective to tack the support material electrostatically to the drum surface, whereby the support material moves with the drum structure while in contact therewith. Simultaneously, with the tacking action, the electrostatic field is effective to transfer the toner particles comprising the

xerographic powder image from the drum structure surface and cause them to adhere electrostatically to the surface of the support material.

It will be appreciated that this type of stripping mechanism depends upon the discharged fluid getting between the drum structure and the powder image support material, consequently, when the force of attraction between the support material and the drum structure, along the leading edge of the support material, is greater than the force of the discharged fluid, improper stripping occurs. In practice the puffer first breaks the inboard lead edge of the copy paper from the drum surface and strips the sheet across the drum to the outboard edge. The critical part of the stripping operation then is the initial separation of the inboard lead edge of the copy sheet from the drum. In accordance with the present invention the drum structure is, therefore, provided with a recess or depression 40 over which the support material or record medium 42 is disposed (see FIGS. 5 and 6).

The recess or depression 40 extends circumferentially about the drum structure and is aligned with the inboard orifice 44 and spaced therefrom approximately 0.188 inches. A recess or depression of approximately 0.50 inches wide by 0.06 inches deep provides satisfactory results where the drum structure accommodates an $8\frac{1}{2} \times 11$ inch record medium and the 11 inch dimension is perpendicular to the longitudinal dimension of the recess or depression. The foregoing arrangement results in a 0.06 inch gap between the support material and the bottom of the recess or depression. It will be seen, that the foregoing configuration will cause the fluid discharged from the orifice 44 to be directed to the drum side of the record medium via the recess or depression, thereby forcing the edge thereof downwardly from the drum structure. The recess or depression is preferably provided in the drum structure 10 by first forming the recess in the conductive base member 14 which is then overcoated with the light-sensitive surface 11.

While in the embodiment of FIG. 6, the record medium overlaps the entire transverse dimension of the recess or depression 40, other variations are possible without departing from the scope of the present invention. For example, as shown in FIG. 7, the support material does not extend over the entire width of the depression or recess. In this embodiment, the overhanging portion of the support material is prevented from sagging into the groove by its own beam strength which is increased by the fact that the material is curved around the drum structure.

It will now be seen that there has been provided a new and improved sheet stripping apparatus wherein a recess or depression is provided in a xerographic drum structure sub-adjacent the support material or copy sheet for effecting introduction of fluid between the drum structure and the copy sheet. The depression or recess is coextensive with the circumference of the drum structure to facilitate installation of the drum structure which would otherwise have to be aligned in a predetermined position if the depression were not continuous.

It will be understood that various changes in the details, materials and arrangement of parts which have been herein described and illustrated in order to ex-

plain the nature of the invention may be made by those skilled in the art without departing from the spirit and scope of the invention. However, while the invention has been described with reference to the structure disclosed herein, it is not intended that the invention be limited to the details as set forth. It is intended that this application cover such modifications or changes as may come within the scope of the following claims. For example, the orientation of the manifold 25 could be parallel to the axis of the drum structure and protuberances could be provided in lieu of the depression or recess, in order to provide the spacing between the record medium and the drum structure.

What is claimed is:

1. In a reproducing system including a xerographic drum structure capable of having a powder image formed thereon which can be subsequently transferred to a record medium brought into contact with the drum structure, the powder image and the record medium being maintained on the xerographic drum structure by electrostatic forces, the improvement comprising:

a depression in said xerographic drum structure, said depression being co-extensive with the circumference of said xerographic drum structure adjacent one end thereof, and

means for intermittently discharging aeriform fluid, said discharge means being disposed adjacent said xerographic drum structure such that discharge aeriform fluid is directed into said depression whereby aeriform fluid is interposed between the record medium and the xerographic drum structure.

2. Xerographic apparatus including a rotatable drum structure, said apparatus comprising:

means for transferring a powder image from said rotatable drum structure to a record medium by bringing the record medium into contact with the rotatable drum structure;

a source of compressed aeriform fluid;

a discharge manifold having a linear array of discharge orifices operatively connected to said source;

cyclically operative means to discharge said compressed aeriform fluid through said discharge manifold; mounting means connected to said discharge manifold to permit said manifold to be mounted adjacent to said xerographic drum whereby jets of compressed aeriform fluid may be directed by said discharge orifices against said xerographic drum in advance of the leading edge of said record medium which is electrostatically held to the drum as a result of transferring the image;

a recess coextensive with the circumference of said drum structure adjacent one end thereof, said recess providing a space between said record medium and said rotatable drum structure, said space permitting introduction of aeriform fluid discharged from said manifold between said record medium and said rotatable drum structure; and

timing means connected to said cyclically operative means to limit the duration of the jets of compressed aeriform fluid from said discharge orifices so that the particles forming the powder image

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electrostatically adhering to said xerographic drum structure and to said record medium are not disturbed.

3. Apparatus according to claim 2 wherein said mounting means connected to said discharge manifold to permit said manifold to be mounted adjacent said xerographic drum permits mounting of said manifold in

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a non-parallel orientation with respect to the axis of rotation of said xerographic drum structure to sequentially, along the longitudinal axis of the drum structure, separate the leading edge of the record medium therefrom.

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