Dec. 15, 1970 D. R. STOKES ETAL 3,547,533

MICROFILM REPRODUCTION MACHINE

Filed Nov. 4, 1965 2 Sheets-Sheet 1

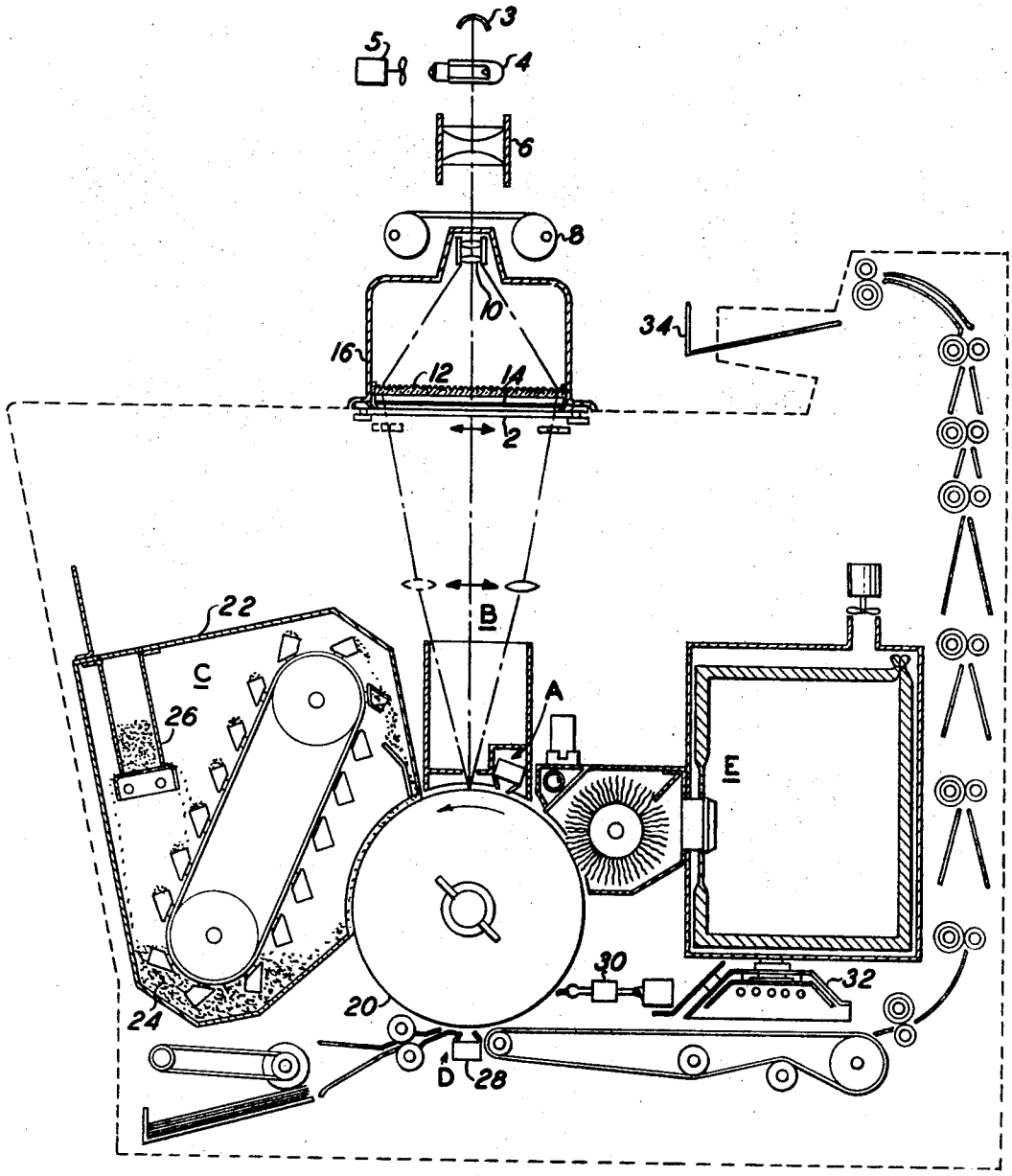

FIG. 1

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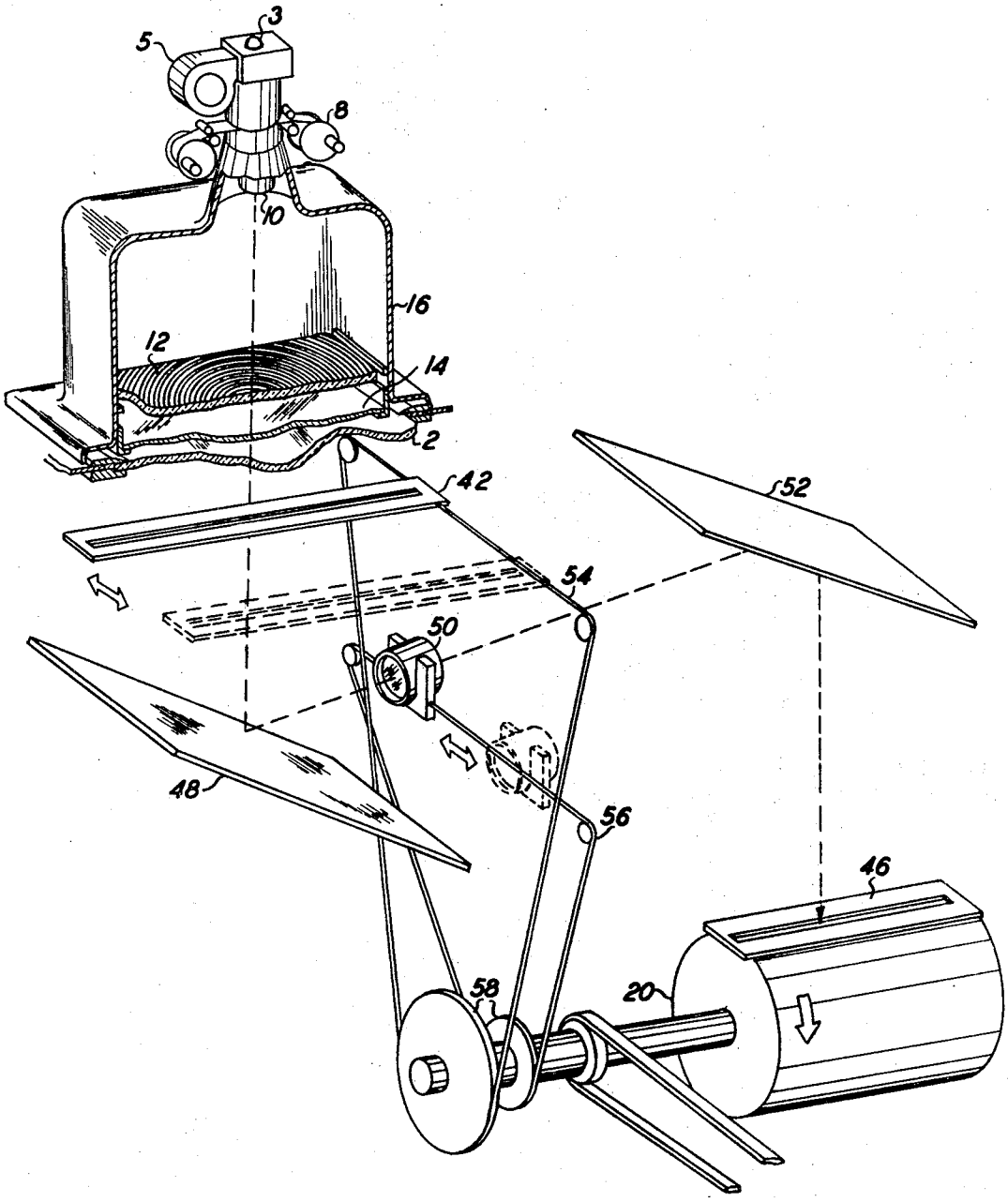

FIG. 2

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MICROFILM REPRODUCTION MACHINE

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9 Claims

ABSTRACT OF THE DISCLOSURE

An electrostatic reproduction machine having a first projector for producing an enlarged image of a microfilm frame upon a Fresnel lens, and a second projection means adapted to project that image on the Fresnel lens as an object and to image it on an electrostatic surface.

This invention relates in general to electrostatographic copying and in particular to improved apparatus for reproducing electrostatographically from microfilm originals. More specifically, the invention relates to an improved xerographic apparatus for causing microfilm, whether in the form of a single frame mounted in a data processing card or in the form of roll film, to be xerographically reproduced on conventional xerographic machines.

Electrostatography encompasses the entire field of forming and utilizing latent electrostatic charge patterns to record and reproduce patterns in viewable form. Xerography employs a photoconductive insulating medium and radiation to form the latent electrostatic images.

In the process of xerography, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the radiation intensity which reaches them and thereby creates an electrostatic latent image on or in the plate coating.

Development of the image is effected with developer material or developers which comprise, in general, a mixture of a suitable pigmented or dyed electroscopic powder, hereinafter referred to as toner, and a granular carrier material, which later functions to carry and to generate triboelectric charges on the toner. In the development of the image, the toner powder is brought into surface contact with the photoconductive coating of the xerographic plate and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic image is usually transferred to a support or transfer material to which it may be fixed by any suitable means.

Since the disclosure of the basic concept of xerography, a variety of machines and devices have been proposed to incorporate such teachings in a manner to form copy xerographically on a commercial basis. For the most part, each of such devices has been specifically designed to the solution of a particular reproduction problem, and for the most part, has been limited to the particular use intended. Thus, for example, machines are presently in wide commercial use for the continuous high-speed enlargement of microfilm in roll form, and for reproducing from opaque originals.

One of the most commercially successful xerographic machines is that disclosed in Mayo Pat. 3,062,109, issued on Nov. 6, 1962. This machine is used for reproducing from opaque originals which are placed on a platen on the top of its desk-like shape. As useful as this machine may be, as evidenced by its commercial acceptance, it

cannot be used to reproduce xerographic copies from microfilm, although many establishments using this machine have occasion to reproduce copies from their microfilm files. The major problem in the development of such an attachment is the production of a suitable image in the plane of the platen of the electrostatic reproducing machine with an adequate quantity of uniform illumination to enable the existing system to produce an acceptable copy.

This apparatus is intended to be used as a microfilm attachment for a standard desk-type electrostatic machine copier, thus providing the capability of producing a hard copy from microfilm as well as from the conventional document copy. There have, of course, been machines for xerographically reproducing from microfilm originals either in rolls or single frame mounted in data processing cards, but these machines were not portable and capable of attachment to other existing xerographic reproducing machines. Although these machines make excellent copies and have achieved substantial commercial success, they all scanned the microfilm original during the exposure step of the xerographic process. This necessitated complicated equipment, automatic devices; programming means and elaborate timing equipment for synchronizing the relative movement of the microfilm original scanning device and the xerographic drum upon which the electrostatic image was to be formed. Such a device may be seen, for example, in Hunt Pat. No. 3,078,770 issued Feb. 6, 1963, and Rutkus Pat. No. 3,137,202 issued June 16, 1964.

It is therefore an object of this invention to improve the electrostatographic reproducing apparatus for microdata image copying.

Another object of this invention is to make portable apparatus for use in existing xerographic reproducing machines for reproducing microfilm onto single sheet transfer copies.

A further object is to xerographically reproduce a full frame of microfilm with no movement of the film relative to a fixed optical axis.

Another object of this invention is to employ inexpensive and easily fabricated optical equipment to xeographically reproduce from microfilm originals.

These and other objects of the invention are attained by means of an apparatus for projecting image rays from miniaturized input for visual viewing to a light-receiving means of an electrostatic reproducing apparatus in order to make xerographic copies of the original projected to the platen.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates schematically an embodiment of a microfilm attachment for projecting viewable images on the platen of an electrostatic copying machine in conjunction with a preferred embodiment of the xerographic apparatus adapted for continuous and automatic operation and incorporating an optical scanning mechanism;

FIG. 2 is a schematic perspective view of the microfilm attachment and xerographic reproducing apparatus showing optical axis and scanning features;

Referring now to the drawings wherein like numerals designate like elements, there is shown schematically in FIG. 1 a microfilm electrostatographic copying apparatus in the environment of a xerographic apparatus incorporated into an automatic machine.

The xerographic apparatus comprises a xerographic plate including a photoconductive layer on a conductive backing and formed in the shape of a drum, generally designated by the numeral **20**. The drum is mounted on a shaft journaled on a frame to rotate in the direction in-

dicated by the arrow to cause the drum surface 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, preferably located as indicated by reference character A, at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum.

Next subsequent thereto in the path of motion of the xerographic drum is exposure station B at which a 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, a latent electrostatic image of copy to be produced is formed.

Adjacent to the exposure station is a developing station C in which there is positioned a developer apparatus including a container **22** having a lower sump portion for accumulating developer material **24**. As toner powder images are formed, additional toner particles must be supplied to the developing material in proportion to the amount of toner deposited on the drum. For this purpose, a toner dispenser, generally designated **26**, is used to replenish toner to the developing material.

Positioned next adjacent to the developing station is the image transfer station D at which the xerographic powder image is electrostatically transferred from the drum surface to a transfer material or support surface. This is accomplished here by the corona transfer device **28**.

Immediately subsequent to transfer is a stripping device, generally designated **30**, for removing the transfer material from the drum surface. After stripping, the powder image may be fused to the transfer material by the fuser **32** and then transported to copy holder **34**.

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

For a more complete and detailed description of the automatic xerographic apparatus, see Mayo et al. Pat. No. 3,062,109, issued Nov. 6, 1962.

At the exposure station B, and more specifically relating to the improvement in microfilm imaging for electrostatographic reproduction, is the microfilm enlarging and imaging apparatus necessary to form a xerographically reproducible image on drum **20** from platen **2**. This is accomplished by means of a projection system adapted to converge the light rays diverging from an enlarging, objective lens **10** to form an enlarged and uniformly lighted image at its focal plane with the rays of light converging therefrom. The light source for this system is a lamp **4** and condenser lens **6** causing light to project through a frame of microfilm held in, for example, microfilm roller **8**, and through objective lens **10** to be enlarged thereby. The resulting image light rays project through a light gathering means such as a Fresnel lens **12** to be imaged on a translucent material **14**, which can be any of a variety of materials, for example, frosted glass, etc., placed approximately at the focal plane of the objective lens system and directly on the platen **2**. The platen defines the object plane of the xerographic reproducing system. The image thereon is protected from extraneous light by light shield and container **16** adapted to position the microfilm projection system such that the image falls substantially over platen **2**. The light source is further directed by reflector **3** and the lamp **4** is cooled by blower **5**.

The container **16** further serves as the housing for the portable microfilm enlarging and imaging apparatus. It is adapted to fixedly contain the Fresnel lens and the translucent material as well as the entire projection system for enlarging and imaging the microfilm. Thus, the entire microfilm projection apparatus is portable and may be easily attached to or detached from an existing xerographic reproducing machine without necessitating any modifications in such machine for accepting this apparatus.

The system, therefore, directs an enlarged image of micro-data obtained from the microfilm original to a translucent material on the platen of the xerographic machine through a light gathering device, such as a Fresnel lens, to insure the converging of the light rays at the exposure station of the xerographic machine. The xerographic machine may then scan the image on its platen to produce a latent electrostatic image on the xerographic drum **20**.

Referring now to FIG. 2, the scanning of the data which is imaged in position on a fixed platen is accomplished by means of a movable lens system which is moved relative to the platen in timed relation to the movement of the xerographic plate or drum. There is provided a light shield **42** having an aperture therein extending across the entire image on the platen. Although this shield may eliminate extraneous light from the scanning lens **50**, it is not an essential element for obtaining acceptable copies. It is included because many commercially successful existing xerographic machines capable of interaction with this portable microfilm unit contain such a shield in conjunction with their own illuminating systems.

A fixed object mirror **48** mounted below the fixed platen reflects the image rays of the data thereon through the lens **50** of the lens system onto an image mirror **52** which in turn reflects the image rays onto the xerographic drum at the slot in a fixed exposure slit plate **46** positioned adjacent to the xerographic drum. This slit **46** prevents extraneous light from reaching the drum and further serves to provide a uniform exposure of the micro-data to be reproduced.

The light shield and the laterally movable lens system are connected by a pair of cables **54** and **56** to the pulleys **58** of the scan control mechanism in such timed relation that the micro-data image appearing at the platen is fully exposed during the scan, through the aperture of the light shield, through the lens, and through the exposure slit to the xerographic plate or drum. For a more detailed and complete description of a preferred embodiment of a xerographic scanning apparatus, see Rutkus et al. Pat. No. 3,062,095 issued Nov. 6, 1962.

The system, as shown in FIG. 2, for xerographically reproducing the image formed on translucent material **14** approximately at the focal point of platen **2** is shown as folded since that is the most convenient manner of including it in an automatic xerographic machine such as that which was schematically shown in FIG. 1. As was shown in FIG. 1, the image rays leaving the first projection system at objective lens **10** diverge, causing an enlargement of the image of the microfilm. However, the light rays striking the translucent material on which the image is formed are converging rays such that the light rays are substantially directed to the xerographic scanning lens **50** through exposure plate **42**. This is caused by the Fresnel lens, or a suitable field lens. Without such a lens, the light rays forming the image on the translucent material at the platen would continue through in the diverging manner that they leave the objective lens. Much of these light rays are unuseable to the xerographic reproducing system viewing the image formed on its objective plane since only that portion of the light rays passing through the xerographic scanning lens **50** will dissipate the charge on the drum forming a latent electrostatic pattern comparable to the image on platen **2**. Lamp **4** produces light of sufficient intensity to accomplish the production of the latent image.

From the foregoing, it will be apparent that the platen is in the image plane of the projection system projecting

the microfilm image and further serves as the object plane for the projection system of the xerographic reproducing apparatus.

The Fresnel lens is placed a slight distance above the focal plane of the xerographic reproducing system so that the gratings of the lens are not reproduced as lines on the xerographic copy. This distance, however, is such that there is sufficient imaging at the xerographic drum so as to permit production of copies having acceptable resolution.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth; and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

What is claimed is:

1. A reproducing apparatus for electrostatographically reproducing a microfilm object, such apparatus having an electrostatographic surface adapted for receiving image rays of the microfilm object and processing apparatus for reproducing copies therefrom, comprising

first projection means for projecting diverging image rays of the microfilm object,

an image receiving member partially approximately at the focal plane of said first projection means and arranged to receive enlarged microfilm images from said first projection means, said image receiving member including a Fresnel lens positioned slightly out of the focal plane of said first projection means, and

second projection means adapted to direct the enlarged image on said receiving member simultaneously, as the same is produced, to the electrostatographic surface at a large magnification compared to the microfilm object and thereby effect the reproduction of enlarged copies of the microfilm images by the processing system.

2. The apparatus of claim 1, said image receiving member comprising a Fresnel lens spaced from the focal plane of the first projection means and a translucent material approximately at the focal plane of said second projection means.

3. The apparatus of claim 1, said second projection system adapted to scan the enlarged micro-data image on said image receiving member and to project the enlarged micro-data image rays thereon to the electrostatographic surface and thereby effect the reproduction of enlarged copies of the micro-data images by the processing system.

4. The apparatus of claim 1, said first projection means including a lamp means and an enlarging lens system and having means associated therewith for supporting microfilm for projection of images therein, and adapted to present an illuminated, enlarged representation of each microfilm image; said second projection means adapted

to scan the image on said image receiving member and to project said image rays thereon to the electrostatographic surface and thereby effect the reproduction of enlarged copies of the images by the processing apparatus.

5. The apparatus of claim 1 wherein said first projection means and said image receiving member have further associated therewith a light shielding housing adapted to maintain said first projection means and said receiving member and adapted to removably position said member approximately at the focal plane of said first projection means.

6. A reproducing apparatus including

a platen to which an object is applied during copying thereof,

a photosensitive surface,

first projection means adapted to project the light rays from an object positionable at said platen to the photosensitive surface,

processing means adapted to be active upon the exposed photosensitive surface to form copies thereon of the object at the platen,

an image receiving member applicable to the platen and including a Fresnel lens,

second projection means adapted to present image light rays at the removable image receiving member,

a light shielding housing removably positionable on the platen and enclosing and securing said image receiving means and said second projection means in a spaced apart relation to each other with at least a portion of the former approximately in the image plane of the latter.

7. The apparatus of claim 6 wherein said light shielding housing is adapted to maintain said second projection means and said receiving member in a spaced apart relationship, said housing including spacer means attached thereto near said receiving member to maintain said Fresnel lens positioned slightly spaced from the focal plane of said second projection means.

8. The apparatus of claim 6 wherein the object is positionable on the same surface of said platen as is said image receiving member.

9. The apparatus of claim 6 wherein said first projection means is adapted to scan the platen.

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