United States Patent [19]

Thettu

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[54] **TRANSFER APPARATUS**

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[52] **U.S. Cl.** ..... **355/3 R**

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

[58] **Field of Search** ..... 355/3 R, 73, 76; 96/1.4; 117/17.5

[56] **References Cited**

UNITED STATES PATENTS

3,506,259	4/1970	Caldwell et al.	117/17.5 X
3,649,115	3/1972	Hodges	355/3 X
3,687,539	8/1972	Furuichi	355/3 X

FOREIGN PATENTS OR APPLICATIONS

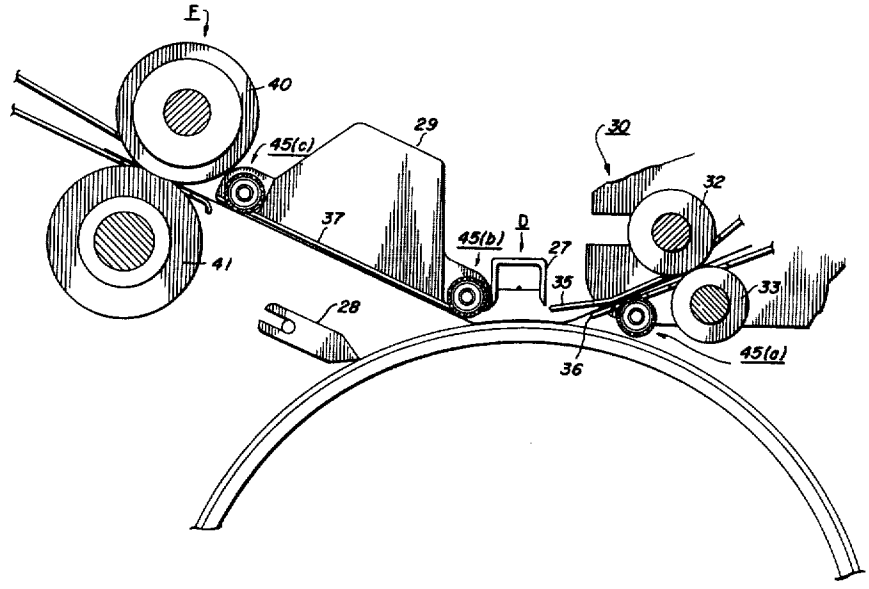
1,522,653	11/1969	Germany	355/3

Primary Examiner—John M. Horan

[57] **ABSTRACT**

Apparatus for preventing externally induced shock waves from being translated by a sheet of final support material into an image transfer region wherein toner images are being transferred from an intermediate surface, such as a photosensitive plate, onto the support material. Dampening rollers are positioned at the entrance and exit to the transfer region capable of contacting the support material so as to uniformly tension the material during the image transfer operation.

1 Claim, 4 Drawing Figures



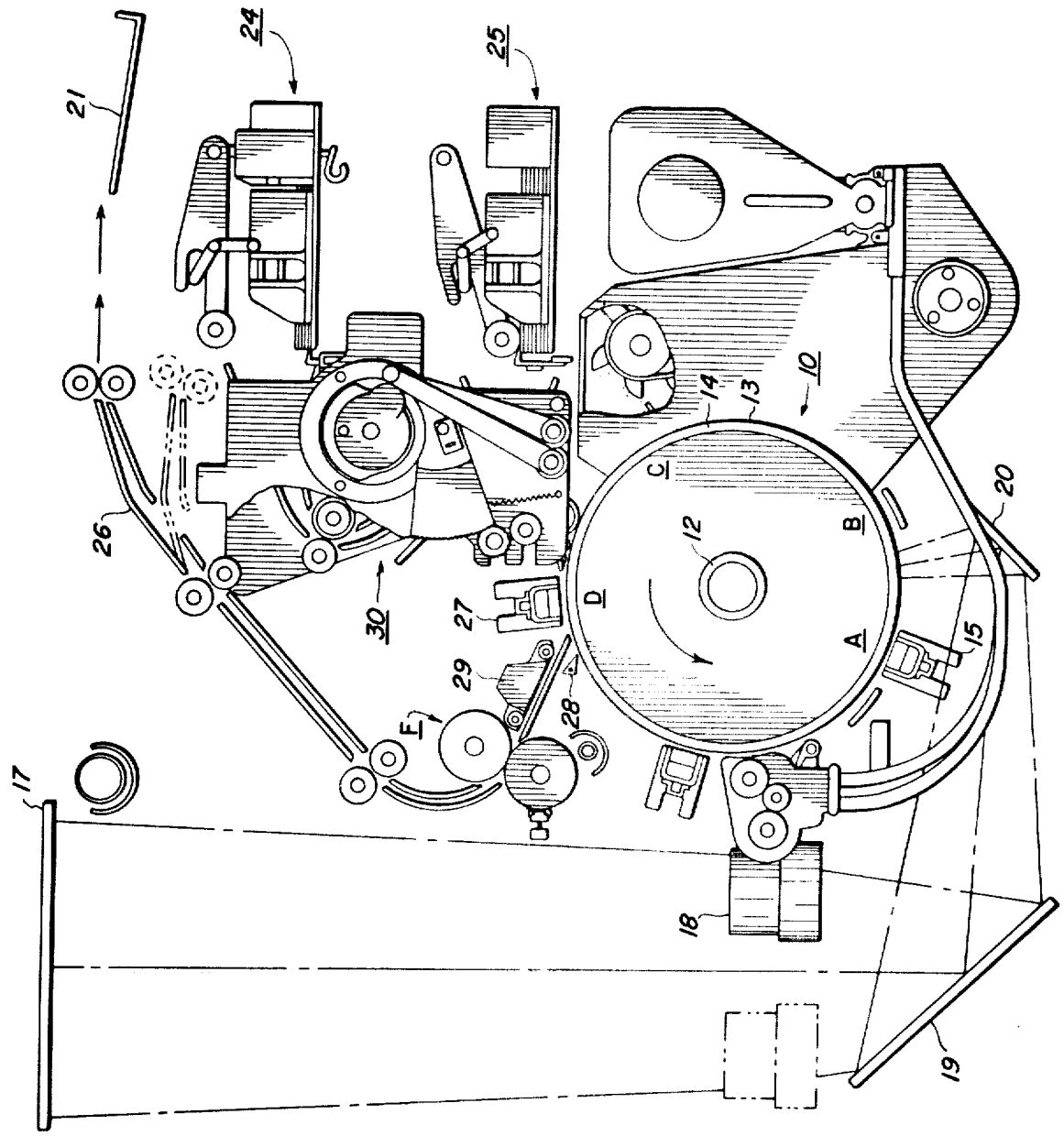


FIG. 1

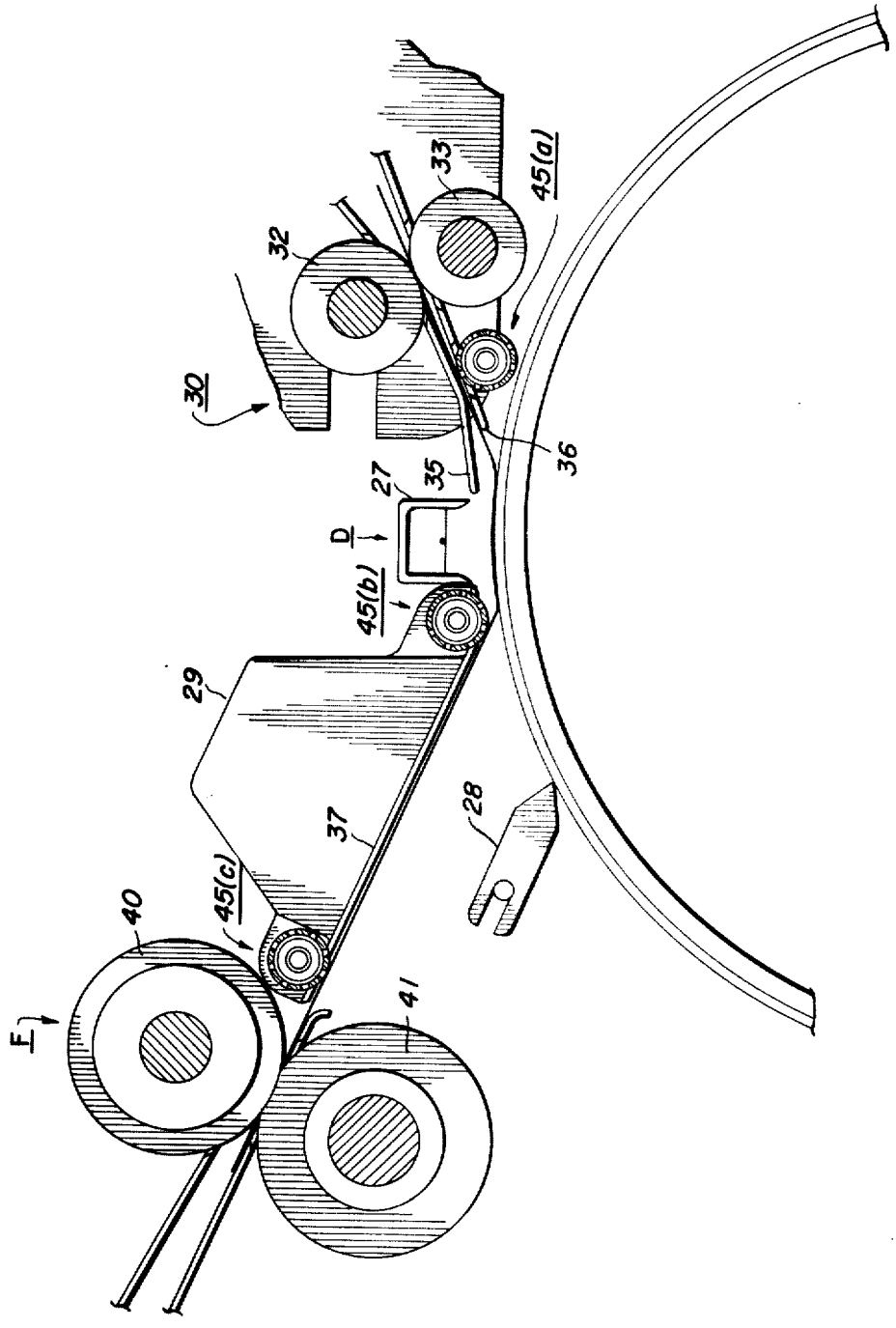


FIG. 2

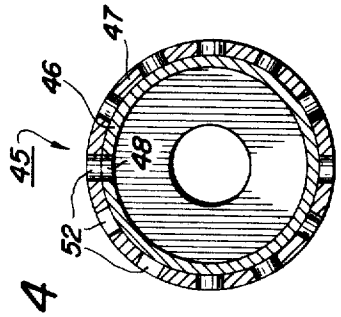


FIG. 4

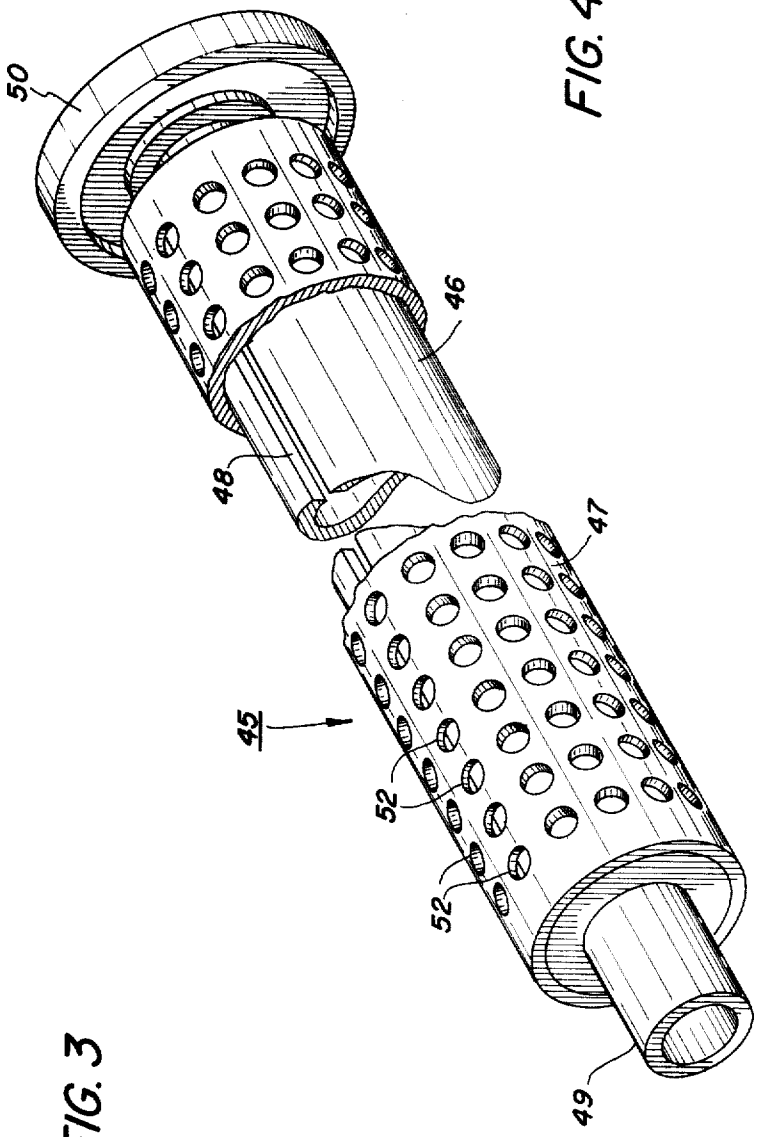


FIG. 3

TRANSFER APPARATUS

This invention relates to apparatus for transferring a toner image from a photosensitive plate surface onto a sheet of final support material.

More specifically, this invention relates to a device for eliminating skips and smears from being created upon a final copy made from an original when produced, as for example, by the reusable xerographic process. It should be apparent, however, that the apparatus of the present invention is not necessarily limited to use in the reusable xerographic process and this invention has wider application in any machine type environment wherein toner images are to be transferred from an intermediate support surface onto a final support sheet, such as paper, Mylar, or the like in image configuration. The term skips and smears, as herein used, relates to any deleterious effect on the fidelity of the created image resulting from the image being transferred from the intermediate support surface to the sheet of final support material.

In the automatic reusable xerographic art, a latent electrostatic image of an original to be copied is conventionally recorded upon the surface of a moving photosensitive member, such as a selenium coated plate, and the image rendered visible by applying charged toner particles to the plate surface. The visible toner image is then transferred from the plate onto a sheet of final support material that is brought into moving overlying contact therewith. Transfer of the image is generally accomplished by electrically attracting the toner particles from the plate surface onto the contacting side of the support sheet in image configuration. The electrical force field for achieving the desired transfer operation can be created in many different ways, however, spraying the back side of the copy sheet with appropriately polarized corona is the most widely employed technique used in the art today.

It has been found, particularly when transferring images onto light bond paper, that the image is oftentimes smeared or otherwise degraded during the transfer operation thereby reducing the quality of the copy produced. Investigations of this smearing problem have shown that most smears are induced as a result of shock waves, that are generally propagated outside of the transfer zone, being transmitted by the support material into the transfer regions. These shock waves cause the support sheet, while moving in contact with the photoreceptor, to be displaced or otherwise disturbed during the transfer operation. The integrity of the transfer operation is thus violated which results in blurred or smeared images being recorded upon the final copy.

It is therefore an object of the present invention to improve apparatus for transferring xerographic toner images from a photosensitive plate onto a sheet of final support material.

It is a further object of the present invention to eliminate image smearing during a xerographic transfer operation.

A further object of the present invention is to prevent shock waves induced in the final support sheet from being transmitted into a xerographic image transfer zone.

These and other objects of the present invention are attained by means of an image transfer device wherein a sheet of final support material is brought into moving

contact with a moving toner image bearing photosensitive plate surface, the transfer station including a transfer corona generator arranged to effect transfer of the toner images from the plate surface to the contacting surface of the support sheet and dampening means located at both sides of the image transfer region being positioned to contact the support sheet moving through the transfer region such that external induced disturbances translated to the support material are absorbed by said dampening means whereby the support material is brought through the transfer region in an undisturbed posture.

For a better understanding of the present 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 connection with the accompanying drawings, wherein:

FIG. **1** is a schematic drawing of an automatic xerographic copying machine embodying the teachings of the present invention;

FIG. **2** is an enlarged view of the image transfer station of the automatic xerographic copying machine illustrated in FIG. **1** showing shock dampening means being strategically located therein to isolate the support material as it moves through the transfer region;

FIG. **3** is an enlarged perspective view of a typical dampening means employed in the preferred embodiment of the present invention; and

FIG. **4** is a cross-sectional view of the dampening means illustrated in FIG. **3.**

Referring now to FIG. **1,** there is illustrated a schematic representation of an automatic xerographic reproducing machine employing an image transfer mechanism embodying the teachings of the present invention. It should be noted that the apparatus of the present invention will be explained in conjunction with the reusable xerographic copying process. However, it should be clear to one skilled in the art that the apparatus of the present invention is not so limited in its usage and that the invention has wide application in any copying environment in which an image is to be transferred from an intermediate surface onto a sheet of final support material.

Because the xerographic copying process is well known and used in the art, the processing steps herein involved will be only briefly described with reference to FIG. **1.** A photosensitive plate **10,** in drum configuration, is mounted upon a horizontally aligned shaft **12** and caused to rotate in the direction indicated so that the drum surface passes sequentially through a series of processing stations. The xerographic plate basically consists of an outer layer **13** of photoconductive material, such as selenium or the like, that is placed over a grounded substrate **14.**

In operation, the plate is initially charged to a uniform potential at a charging station A by means of corona generator **15.** The uniformly charged plate is then moved into an imaging station B wherein a flowing light image of an original document, which is supported upon transparent viewing platen **17,** is projected onto the photoconductive plate surface by means of a moving scanning lens element **18** and a pair of mirrors **19** and **20.** As a result of the imaging process, a latent electrostatic image containing the original subject matter is recorded upon the photoconductive plate. The latent image is next transported on the drum surface through a developing station C wherein the latent image is ren-

dered visible by the application of an especially prepared charged toner material by cascading the material over the image plate surface.

The visible or toner developed image is then transported on the moving drum surface into an image transfer station D embodying the teachings of the present invention. As will be explained in greater detail below, a sheet of final support material is fed from either one of two supply tray areas, an upper supply tray area **24** and a lower supply tray area **25**, via a sheet registering and forwarding mechanism **30**, into the transfer station in moving synchronous contact with the visible image carried on the drum surface. The support sheet and the charged toner image on the drum surface move together under a corona charging device **27** which serves to electrostatically transfer the toner images from the plate surface to the contacting side of the support sheet. The sheet is then stripped from the drum surface by means of a picker finger **28** and directed along a stationary vacuum transport **29** into the nip of a heat pressure roll fusing assembly F. For further details concerning this type of fusing device, reference is herein had to U.S. Pat. No. **3,498,596** which issued in the name of Moser.

As noted above, the automatic copier herein described has the capability of producing either single sided copy, that is, copy bearing a toner image on one side thereof, or double sided copy. In the single sided mode of operation, the final support sheets are fed from either the upper supply tray or the lower supply tray directly into the image transfer station D. Upon the accomplishment of the transfer step, the image sheet is then passed through the fuser roll assembly and forwarded directly into a collecting tray **21** where the copies are stored and held until such time as the operator removes them. On the other hand, when a two sided copy mode of operation is selected, a movable transport **26** in the paper path, is lowered to the dotted line position as shown in FIG. **1** and the upper supply tray, which has been previously emptied of all support materials, is automatically prepared to accept the copy sheet directed therein. The copy sheets are fed from the lower support tray through the image transfer station and the image fusing station, and are delivered into the upper support tray area where the once imaged copy sheets are stored until the machine is further programmed for a second copy run. Upon the initialization of the second copy run, the movable transport **26** is once again raised to the solid line position shown in FIG. **1** and the once imaged copy sheets are fed once again directly from the upper supply tray through the transfer and fusing stations wherein a second image is created on the opposite non-imaged side of the sheet. After fusing, the two sided copy sheet is then fed directly into the copy tray in the manner herein described.

Referring now more specifically to FIG. **2**, there is shown in greater detail the image transfer station of the automatic copying machine herein described. At the beginning of each sheet feeding cycle, individual sheets of final support material are fed from either the upper supply tray or the lower supply tray into a sheet registration and forwarding mechanism **30** which is described in greater detail in U.S. Pat. No. **3,601,392.** Herein, the leading edge of the individual sheets of material are registered with the visible toner image created on the moving drum surface and are then engaged by a pair of advancing rollers **32, 33** which serve to forward the sheet at drum speed into the transfer station D. A pair of guide elements **35, 36** are provided to insure that the sheet contacts the drum surface prior to entering the corona stream emitted from transfer corona generator **27** and which herein defines the boundaries of the transfer region.

The sheet in process and the toner image contained on the drum surface move together through the corona stream wherein the toner image is transferred from the plate to the support sheet. Invariably, during the electrical transfer operation, the copy sheet becomes electrically tacked to the moving photoconductive surface. A pick off finger **28** is positioned downstream from the transfer region with the tip of the finger arranged to move between the support sheet and the plate surface and thus strip the sheet from the drum. The finger is further adapted to direct the sheet of material upwardly into communication with a vacuum platen **37** associated with the stationary transport **29.** Once in contact with the platen, the sheet is guided along the platen surface into the nip of fuser assembly F wherein the image is affixed to the support material in the manner described in the previously noted Moser patent.

As can be seen, as the support sheet is moved through the transfer station, many different sheet handling instrumentalities come into play that act upon the sheet either alone or in concert, depending upon the position of the sheet at any given point in time. For example, as shown in FIG. **2**, in the extreme case, the support sheet is simultaneously handled or acted upon by the cooperating advancing rolls **32, 33,** the sheet pick off finger **28,** the stationary vacuum transport **29** and the fuser rolls **40, 41** in fuser assembly F. Any obstacles or other impediment to the sheet's motion during this period is imparted to the support material and is ultimately reflected as a shock wave which is transmitted along the length of the support material. This shock wave, as it moves through the transfer region, produces a movement of the sheet in the transfer region which results in a smeared or blurred image being recorded on the final copy.

A set of dampening transport rollers, generally referenced **45,** are strategically positioned along the path of travel of the support material as it is being advanced through the transfer station between the advancing rolls and the fuser assembly. As seen in FIGS. **3** and **4,** the rollers consist of a stationary vacuum cylinder **46** and a rotatable sleeve **47** which is mounted thereupon so that the sleeve is capable of freely rotating about the peripheral surface of the cylinder. The cylinder is provided with an elongated longitudinally extending vacuum port **48.** In each end of the cylinder there is provided a hollow tube **49** through which a vacuum is drawn by any suitable vacuum drawing means (not shown) whereby a relatively uniform negative pressure is created along the length of the port **48.**

A pulley means **50** is affixed to the outboard end of the sleeve with the pulley being operatively connected to the main drive system of the machine. The pulley is arranged to rotate the sleeve so that the velocity of the outer periphery of the sleeve is equal to the velocity at which the support material is advanced through the transfer station. The sleeve is provided with a series of obliquely offset apertures **52** which are adapted to move in and out of fluid flow communication with the elongated suction port **48** as the apertures are moved

thereover so as to exert a uniform holding pressure upon the material within the transfer region.

In practice, the dampening transports are mounted along the sheet's path of travel so that the sheet comes into contact with the dampeners sleeve directly over the suction port **48.** The rollers thus exert a holding pressure upon the sheets as they move through the transfer station and thus serve to absorb any shock waves induced in the support material as it is moving through the region immediately below the transfer generator **27.**

Although three dampening rollers are utilized in the preferred embodiment of the present invention, it should be clear that in most cases only two rollers, positioned at the exits and entrance zones to the transfer region, are generally required in order to successfully isolate induced shock waves from entering this critical area. As seen in FIG. **2,** a dampening roller **45** (*a*) is positioned at the entrance to the transfer region between the advancing rollers **32, 33** and the point where the copy sheet contacts the moving drum surface. Any shock waves initiated within the sheet registering and forwarding mechanisms **30** are thus absorbed by the roller prior to the waves entering the transfer region. Similarly, a second dampening roller **45** (*b*) is positioned at the exit to the transfer region and serves to absorb downstream induced shocks as for example those created by the stripper finger acting upon the copy sheet or the copy sheet being buckled or otherwise disturbed as it is moving along the stationary vacuum transport. It should be noted that the exit dampening roll **45** (*b*) is positioned so that it communicates with the back side, or non-image side of the copy sheet thus preventing the roller from degrading the unfused toner images thereon. The two rollers, that is, the entrance dampening roller **45** (*a*) and the exit dampening roller **45** (*b*), coact to apply a holding force upon the sheet thus producing a uniform tension over the entire length of the material as it moves through the transfer region. A third dampening roller **45** (*c*) is also herein provided which is positioned between the stationary vacuum transport and the fuser nip to further prevent shock waves provocated in the fuser assembly from being transmitted back along the sheet into the transfer region.

Although a vacuum drawing transport roller is herein described, it should be clear that any type of dampening means that is capable of preventing shock waves from entering a xerographic transfer region is considered within the scope of the present invention. For example, the dampening rollers can take the form of a solid cylindrical bar or cylinders of low durometer rubber with the rollers being positioned to uniformly tension the support material as the transfer step is being accomplished.

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

What is claimed is:

1. Apparatus for transferring a charged toner image from the surface of an image bearing plate onto a sheet of final support material including

means defining an image transfer zone for transferring the toner image from the image bearing plate to the sheet of final support material brought in contact therewith within the transfer zone,

means for moving the sheet of final support material into and through the image transfer zone wherein at least a portion of the sheet moves in contact with the image bearing plate, and

dampening means positioned at the support material entrance and exit regions to the transfer zone for preventing shock waves which may be induced in the support material outside of the transfer zone by the moving means from moving into the transfer zone, the dampening means including at least one roller positioned at each of the regions and mounted to rotate so that the velocity of the outer periphery of each roller is at least substantially equal to the velocity at which the support material is advanced through the transfer zone, and vacuum drawing means associated with each roller for placing a uniform tension upon the support material as it moves through the transfer zone, and wherein the roller positioned at the exit to the transfer zone is arranged to contact the non-image bearing side of the support material.

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