Aug. 10, 1965 R. H. EICHORN ETAL 3,199,866

SHEET FEED MECHANISM

Filed May 24, 1963 3 Sheets-Sheet 1

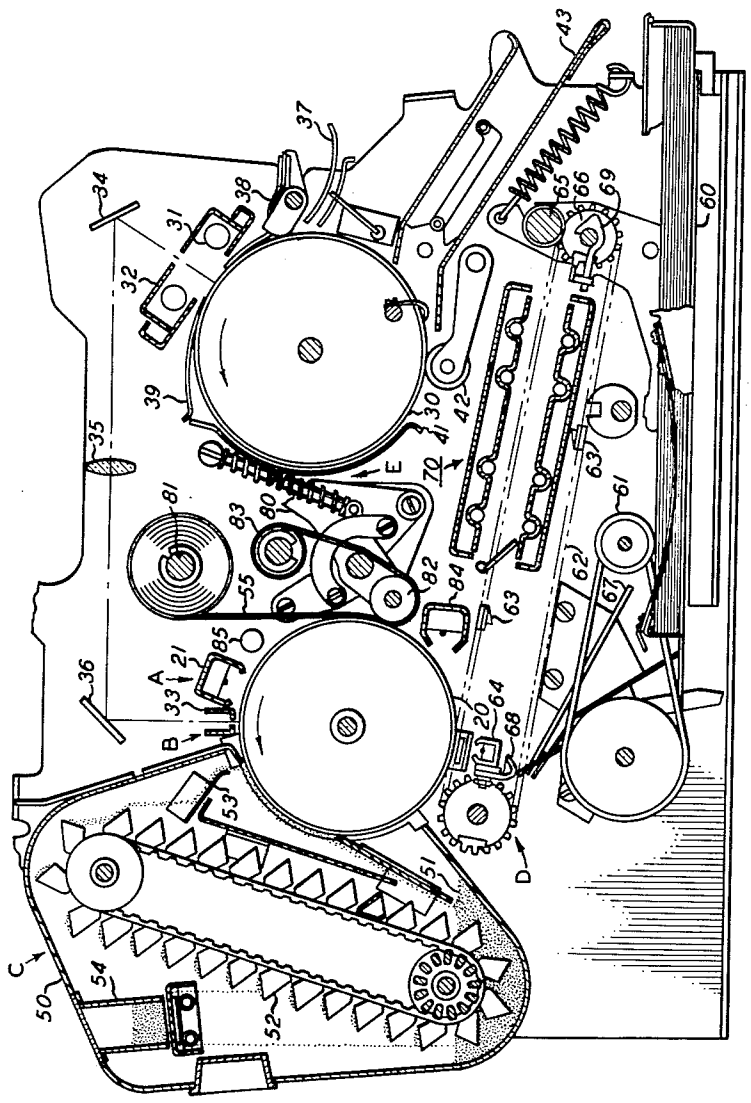


FIG. 1

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SHEET FEED MECHANISM

Filed May 24, 1963 3 Sheets-Sheet 2

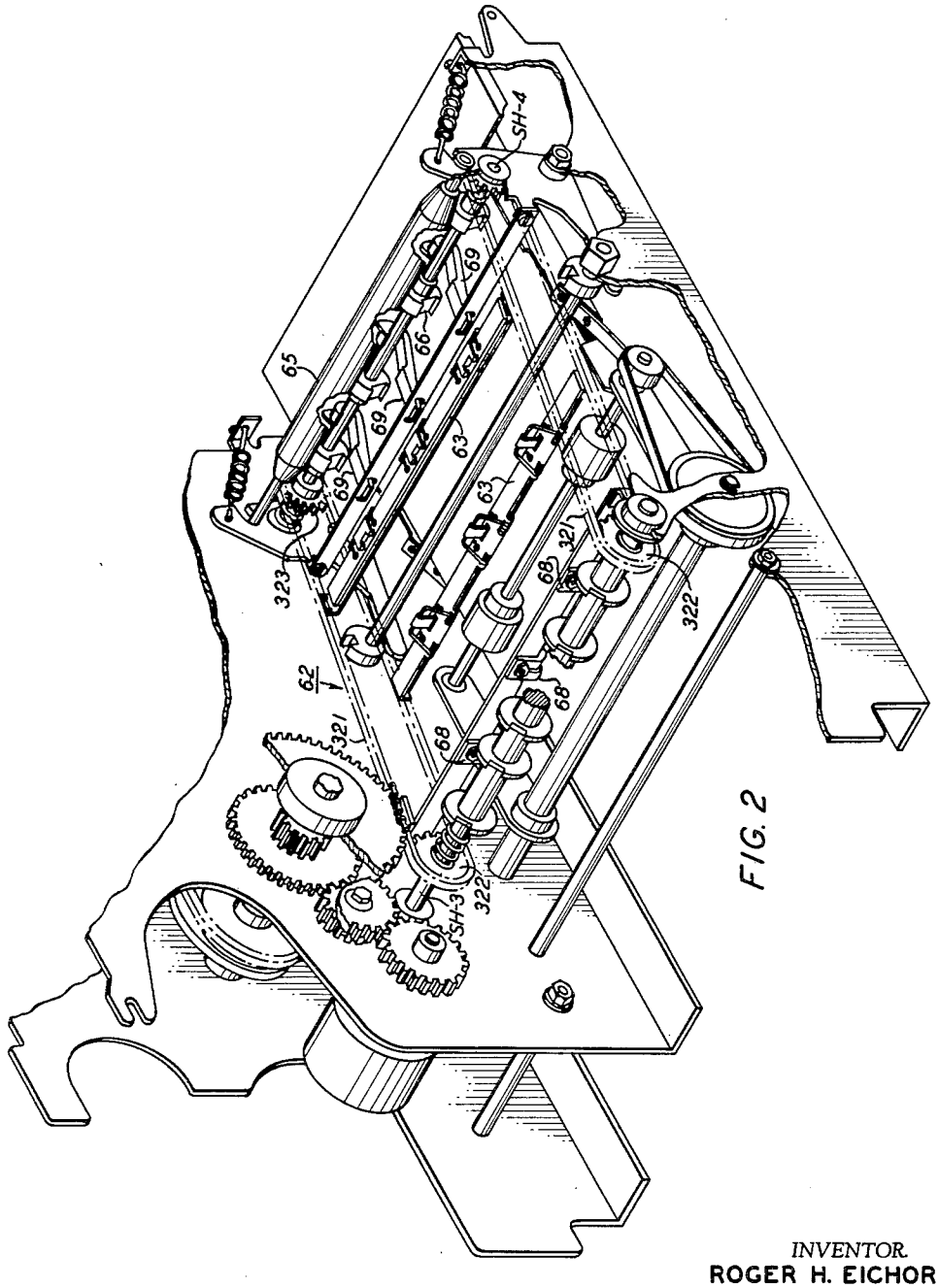


FIG. 2

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SHEET FEED MECHANISM

Filed May 24, 1963 3 Sheets-Sheet 3

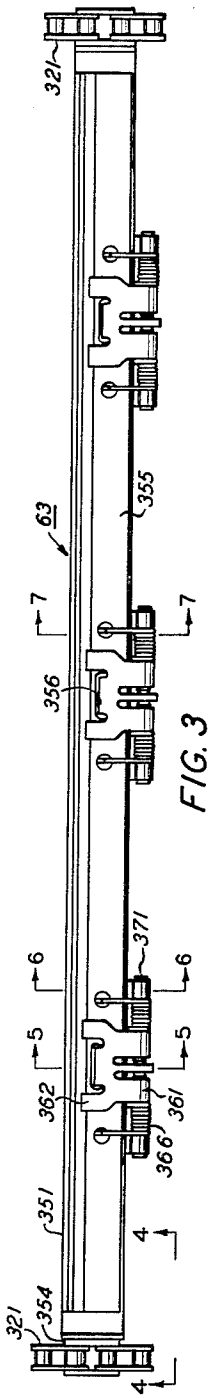


FIG. 3

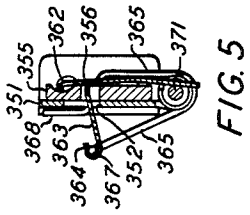


FIG. 5

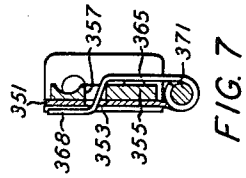


FIG. 7

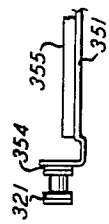


FIG. 4

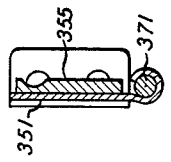


FIG. 6

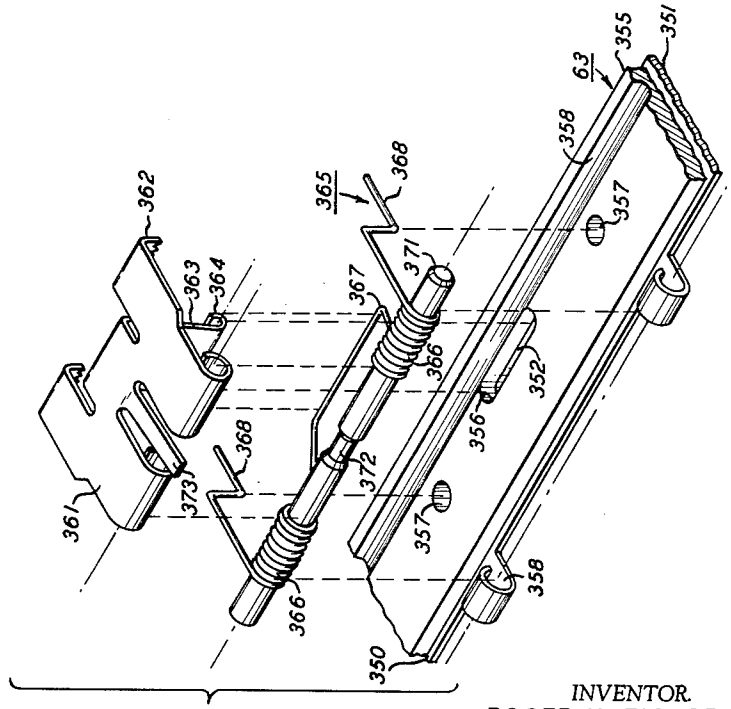


FIG. 8

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United States Patent Office

3,199,866

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3,199,866

SHEET FEED MECHANISM

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Filed May 24, 1963, Ser. No. 282,952

3 Claims. (Cl. 271—79)

This invention relates in general to a sheet feed mechanism and, in particular, to a sheet conveyor mechanism for seriatim feeding of sheet material to a xerographic drum.

Specifically, the invention relates to an improved sheet gripper mechanism, of the type disclosed in copending Roger H. Eichorn application, Serial No. 77,956, filed December 23, 1960, now Patent No. 3,100,109, for a sheet conveyor that is particularly adapted for use in a xerographic reproducing apparatus, and which is also suitable for use with comparable types of devices.

In the process of xerography, for example, as disclosed in either Carlson Patent 2,297,691, issued October 6, 1942, or in Carlson Patent 2,357,809, issued September 12, 1944, a xerographic plate, comprising a layer of photoconductive insulating material on a conductive backing, is given a uniform electrostatic 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 latter functions to carry and to generate triboelectric charges on the toner. More exactly, the function of the granular material is to provide the mechanical control to the powder, or to carry the powder to an image surface and, simultaneously, to provide almost complete homogeneity of charge polarity. In the development of the image, the toner powder is brought into surface contact wtih the xerographic plate and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the xerographic powder image is transferred to a support material to which it may be fixed by any suitable means.

The invention relates to conveyors and in particular to sheet gripper mechanism for conveying sheet material, such as paper or the like, to contact the xerographic plate in synchronized movement therewith whereby the developed xerographic image from the xerographic plate is transferred in proper registration onto the sheet material.

Because of cost and other considerations, it is desirable to use in the sheet conveyor, roller chains having relatively small diameter rollers. It is also desirable to have the sheet grippers carried by the roller chains of a minimum thickness, preferably of a thickness corresponding to the thickness of the roller chains.

It is apparent that the sheet gripper elements cooperating with each other to grip a sheet must be biased into cooperative engagement to securely grip the sheet. Because this biasing force can be relatively large whereas the thickness of the individual sheet gripper elements is relatively small, the sheet gripper elements can readily be

twisted or deflected as the sheet gripper is caused by cam action to open to receive or reject sheet material.

It is therefore the principal object of this invention to improve sheet feeding mechanisms for use in a xerographic apparatus or similar device.

A further object of this invention is to improve sheet gripper devices and their actuators to sheet gripper devices to securely grip sheet material without deflection of the sheet gripper elements.

Another object of this invention is to improve sheet gripper devices for use in a sheet conveyor whereby various sized sheet material can be conveyed.

These and other objects of the invention are attained by means of a sheet conveyor including two endless belts, in the form of roller chains, supported by pulley means for travel in unison in two spaced substantially parallel planes to transport a sheet gripper mechanism from a sheet receiving station to a sheet delivery station. The sheet gripper mechanism includes a gripper bar connected to the endless belts along a line perpendicular to the spaced planes of travel of the endless belts. The gripper bar supports sheet gripping means including at least one movable gripper having a jaw adapted to cooperate with the jaw of a second gripper to grip a sheet therebetween. Pairs of cam means are located adjacent and between the endless belts at the sheet receiving station and the sheet delivery station.

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 connection with the accompanying drawings, wherein:

FIG. 1 is a schematic illustration of a xerographic reproducing apparatus having a sheet feed mechanism using a preferred embodiment of a sheet gripper mechanism of the invention;

FIG. 2 is a perspective view of the sheet feed mechanism of the apparatus of FIG. 1;

FIG. 3 is a top view of a preferred form of paper gripper mechanism constructed in accordance with the invention;

FIG. 4 is an enlarged view of the paper gripper taken along line 4—4 of FIG. 3;

FIG. 5 is an enlarged view taken along line 5—5 of FIG. 3;

FIG. 6 is an enlarged view taken along line 6—6 of FIG. 3;

FIG. 7 is an enlarged view taken along line 7—7 of FIG. 3; and

FIG. 8 is an enlarged exploded view in perspective of a portion of the paper gripper mechanism.

As shown, the xerographic apparatus comprises a xerographic plate including a photoconductive layer or light-receiving surface on a conductive backing and formed in the shape of a drum, generally designated by numeral 20, which is journaled in a frame to rotate in the direction indicated 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, at which a uniform electrostatic

charge is deposited on the photoconductive layer of the xerographic drum;

An exposure station, 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 and thereby form a latent electrostatic image of the copy to be reproduced;

A developing station, at which a 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 to be reproduced;

A transfer station, at which the xerographic powder image is electrostatically transferred from the drum surface to a transfer material or support surface; and,

A drum cleaning station, at which the drum surface is first charged and then brushed or wiped 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.

The charging station is preferably located as indicated by reference character A in the schematic illustration of the apparatus. In general, the charging apparatus or corona charging device **21** includes a corona discharge array of one or more discharge electrodes that extend transversely across the drum surface and are energized from a high potential source and are substantially enclosed within a shielding member.

Next subsequent thereto in the path of motion of the xerographic drum is an exposure station B provided with an optical scanning or projection system to project a flowing image of a document onto the photoconductive surface of the xerographic drum from a suitable original.

The optical scanning or projection assembly consists of a copyboard in the shape of a drum, hereinafter referred to as copy drum **30**, which is adapted to support copy to be reproduced and arranged to rotate in light projection relation to the moving light-receiving surface of the xerographic plate. Uniform lighting is provided by suitable lamps **31** attached to a slotted light reflector **32** mounted adjacent to the copy drum.

A slotted light shield **33**, adapted to protect the xerographic plate from extraneous light, is positioned adjacent to the surface of the xerographic plate. A slot aperture in the light shield extends transversely to the path of movement of the light-receiving surface of the xerographic drum **20** to permit reflected rays from the copy drum to be directed against a limited transverse area of the light-receiving surface as it passes thereunder.

To enable the optical system to be enclosed within a relatively small cabinet, a folder optical system including an object mirror **34**, a lens **35**, and an image mirror **36**, is used in the preferred embodiment of the apparatus.

A document fed through document guides **37** to the copy drum is removably secured thereon by a suitable gripper mechanism for movement therewith in timed relation to the movement of the xerographic drum whereby a flowing image of the copy is projected onto the xerographic drum. The copy is held against the surface of the copy drum until gripped by means of document retaining guides **38**. Pressure guides **39** and document guard **41** retain and guide the trailing edge of the document on the copy drum. After the copy is scanned, it is released from the copy drum to be transported out of the machine by the copy drum and document feed out rollers **42** through document feed out guide **43**.

Adjacent to the exposure station is a developing station C in which there is positioned a developer apparatus **50** including a developer housing having a lower or sump portion for accumulating developer material **51**. Mounted within the developer housing is a driven bucket-type conveyor **52** used to carry the developer material previously supplied to the developer housing to the upper portion of the developer housing from where the developer material is cascaded over a hopper chute **53** onto the drum.

As the developer material cascades over the drum, toner particles of the developer material adhere electrostatically to the previously formed electrostatic latent image areas on the drum to form a visible xerographic powder image; the remaining developer material falling off the peripheral surface of the drum into the bottom of the developer housing. Toner particles consumed during the developing operation to form the xerographic powder images are replenished by a toner dispenser **54**, mounted within the developer housing.

Positioned next adjacent to the developing station is the image transfer station D which includes suitable sheet feeding mechanism adapted to feed sheets of paper successively to the xerographic drum in coordination with the presentation of the developed image on the drum at the transfer station. The sheet feeding mechanism includes a sheet source such as paper tray **60** for a plurality of sheets of a suitable support material, that is, sheets of paper or the like, separator rollers **61** adapted to feed the top sheet of the stack of support material through a guide **67** to a sheet conveyor mechanism **62** having sheet gripper mechanisms **63** thereon which carry the sheet support material into contact with the rotating xerographic drum in coordination with the appearance of a developed image at the transfer station.

The transfer of the xerographic powder image from the drum surface to the support material is effected by means of a corona transfer device **64** that is located at or immediately after the point of contact between the support material and the rotating xerographic drum. The corona transfer device **64** is substantially similar to the corona discharge device that is employed at the charging station in that it also includes an array of one or more corona discharge electrodes that are energized from a suitable high potential source and extend transversely across the drum surface and are substantially enclosed with a shielding member. In operation, the electrostatic field created by the corona transfer device is effective to tack the transfer material electrostatically to the drum surface and simultaneously with the tacking action, the electrostatic field is effective to attract the toner particles comprising the xerographic powder image from the drum surface and cause them to adhere electrostatically to the surface of the support material.

As the paper gripper mechanism continues to move forward in its closed circuit, it will strip the support material from the xerographic drum and carry it to a fixing device, such as, for example, heat fuser **70**, whereat the developed and transferred xerographic powder image on the support material is permanently fixed thereto.

After fusing, the finished copy is preferably discharged from the apparatus at a suitable point for collection externally of the apparatus. To accomplish this, there is provided a pair of delivery rollers **65** and **66** by means of which the copy is delivered from the machine after it is released by the gripper mechanism. Suitable cam means **68** and **69** are provided at the receiving and delivery stations of the conveyor mechanism, respectively, to actuate the paper grippers of the sheet gripper mechanisms at these stations to receive or discharge a sheet of support material.

The next and final station in the device is a drum cleaning station E whereat any powder remaining on the xerographic drum after the transfer step is removed and whereat the xerographic drum is flooded with light to cause dissipation of any residual electrical charge remaining on the xerographic drum.

To aid in the removal of any residual powder remaining on the xerographic drum, there is provided a corona precleaning device **84** that is substantially similar to the

corona discharge device that is employed at charging station A. Removal of residual powder from the xerographic drum is effected by means of a web cleaner device 80 adapted to continuously feed a clean fibrous web material into wiping contact with the xerographic drum. As shown, the web material 55 is taken from a supply roll 81 and transported around a cleaning or pressure roll 82, preferably made of rubber, onto a take-up or rewind roll 83.

Any residual electrical change remaining on the xerographic drum is dissipated by light from the fluorescent lamp 85 mounted in a suitable bracket above the xerographic drum, a suitable starter and ballast being provided for energizing the fluorescent lamp.

Suitable drive means drive the xerographic drum, the copy drum, the sheet conveyor mechanism at predetermined speeds relative to each other, and to effect operation of the paper separator roll, and the web cleaner mechanism, the latter being driven at a speed or speeds whereby relative movement between the xerographic drum and the web material is effected. Suitable drive means are also provided for effecting operation of the conveyor mechanism and toner dispenser of the developing apparatus assembly.

It is believed that the foregoing description is sufficient for the purposes of this application to show the general operation of the xerographic reproducing apparatus. For further details concerning the specific construction of the xerographic reproducing apparatus, reference is made to copending Eichorn et al. application, Serial No. 162,779, now Patent No. 3,099,943 filed December 28, 1961, and to portions of this specification wherein specific elements cooperating with the sheet feed mechanism are illustrated and described although they form no part of the instant invention.

Referring now to the subject matter of the invention, the sheet conveyor mechanism 62 includes two endless belts, in the form of roller chains 321, which extend from a set of drive sprockets 322 carried by shaft SH3 to, and around, a set of sprockets 323 on shaft SH4. These two sets of sprockets are fixedly positioned on their respective shaft to space the roller chains apart from each other by a distance greater than the length of the drum to afford complete use of the xerographic drum surface.

In the embodiment of the sheet conveyor mechanism shown, the roller chains carry two sheet gripper mechanisms. The sheet gripper mechanisms 63 are equally spaced from each other along the length of the chains, and are positioned on the chains at right angles to the path of travel of the chains for movement therewith in a circuit between sheet receiving and sheet delivery stations, identified as the output area of the paper guide 67, and the delivery rollers 65 and 66, respectively. Suitable cam elements 68 and 69 are provided at these stations to actuate the sheet gripper mechanisms.

Two paper grippers are used in the machine shown so that as one sheet gripper mechanism is moved from the receiving station carrying sheet material to the delivery station, the other sheet gripper mechanism will advance from the delivery station to the receiving station to be in position to receive the next sheet from paper guide 67. For further details concerning the specific construction of the sheet feeding mechanism of the xerographic reproducing apparatus, reference is made to the referenced copending Eichorn et al. application, Serial No. 162,779.

Referring now to the subject matter of the invention, there is shown in FIGURES 3–8, inclusive, a preferred embodiment of the sheet gripper mechanism of the invention.

As shown, each sheet gripper mechanism 63 includes a gripper bar 350 of a length to extend substantially between the two roller chains 321 to be connected thereto by means of clips 354 forming part of the chains when connected thereto, as is well known in the art. The gripper bar includes a gripper bar bracket 351 and a sheet gripper jaw 355 formed so that the top surface of the gripper bar is positioned tangentially to or slightly below the pitch line of the chains, whereby the gripper bar as it passes beneath the xerographic drum will not jam against the peripheral surface of the xerographic drum.

A sheet gripper jaw 355, which may be a separate element fixed to the gripper bar bracket, as shown, or formed integral therewith, extends across the rear of the gripper bar bracket (in terms of the direction of travel of the gripper bar). The sheet gripper jaw 355 is positioned to have surface contact with the leading edge of a sheet of support material as it advanced from the paper guide 67. The sheet gripper jaw cooperates with the tang portions of jaws 362 of the grippers 361 to grip a sheet of support material inserted therebetween. Preferably, the sheet gripper jaw 355 is provided at its trailing edge (in terms of the direction of travel), with a concave shape cutout 358 with which the tang portions or jaws 362 cooperate to slightly bend the leading edge of a sheet gripped therebetween.

Each of the grippers 361 is mounted, by means of pins 371 suitably secured to the pin retaining portions 358 on the leading edge of the gripper bar bracket, for movement in two directions relative to the fixed sheet gripper jaw 355; that is, for movement from a first position in which the tangs or jaws of the gripper are in spaced relation to the sheet gripper jaw to receive a sheet of support material therebetween, and for movement to a second position in which the tangs or jaws of the gripper are in engagement with the sheet gripper jaw or with a sheet of support material sandwiched therebetween.

Each gripper is provided with a depending guide portion or tang 363 terminating in a curved-lip portion 364 which is slidably received in suitable elongated slots 356 and 352 formed in the sheet gripper jaw and gripper bar bracket, respectively. The guide portion or tang 363 serves as a guide or stop for the leading edge of a sheet and, also as an actuating lever by means of which the gripper is actuated. Each gripper is also provided with a central bent arm or spring tang 373 received in the notched or secured portion 372 of a pin 371. The central bent arm or spring tang of the gripper and the recess 372 in the pin 371 serve a dual function. They accurately restrain and retain the gripper and the pin relationship to gripper and, this arrangement permits quick and reliable changing of parts.

The tang portion or jaw 362 of a gripper 361 are normally biased into contact with the sheet gripper jaw 355 or with a sheet therebetween by means of a spring 365. Each spring 365 is formed with a central portion 367, coiled portion 366 on the opposite sides of the central portion and with bent arms 368 at opposite extremities, thereof. Each spring is mounted with its coiled portion 366 encircling a pin on opposite sides of the gripper with which it cooperates, the central portion of the spring engaging the curved lip portion 364 of the gripper 361 and with the bent arm portions extending through suitable apertures 357 and 353 in the gripper jaw and gripper bar bracket, respectively, to engage the underside of the the gripper bracket.

Referring now to FIG. 1, a sheet of support material, such as paper, forwarded into the paper guide 67 by the action of the separator rollers 61 is buckled as the separator rollers continue to advance the sheet after forward motion has been arrested by the gate of the paper guide. Thus, as a paper gripper advances over the guide, the gate will be forced open as the paper gripper strikes it and, at the same time, the cam follower of the sheet gripper mechanism, that is, the depending guide portion or tang 363 of each of the sheet grippers will strike the cam assembly 68 secured adjacent to the gate of the paper guide. As the cam follower of the sheet gripper mechanism contacts the cam assembly, the jaws of the individual paper grippers will be open to receive the

sheet from the paper guide. Because of the slight buckle in the sheet and because at this time the separating rollers are still attempting to advance the sheet, the sheet as it unbuckles will be forced between the jaws of the paper gripper. As the depending guide portion and curved lip portion of the grippers slide off cams 68, the jaws will close by the biasing action of springs 365 to grip the sheet.

At the delivery station, the sheet gripper mechanism passes between the delivery rollers 65 and 66 and as it does so, the grippers are again actuated by means of a cam 69 thereby releasing the sheet from the sheet gripper mechanism for discharge from the machine.

In operation, the electrostatic field created by the corona transfer device 64 is effective to tack the support material electrostatically to the drum surface, whereby the support material moves synchronously with the drum while in contact therewith. As the sheet gripper mechanism, carrying the sheet of support material, moves away from the xerographic drum to the delivery station, it pulls the sheet away from the surface of the drum, against the electrostatic forces tending to retain the support material to the drum. On a continuous straight line path of travel of the sheet gripper mechanism, the sheet of support material would be uniformly pulled away from the surface of the drum in a line substantially parallel to the path of travel of the paper gripper and a lineal speed equal to the peripheral speed of the xerographic drum. This, of course, would require the use of a conveyor having a straight line run from the drum of a length at least equal to the length of the largest sheet of support material to be transported by the sheet conveyor mechanism.

To reduce the overall size of the xerographic apparatus, a conveyor is used in the machine which has a straight run from the drum of a length less than the length of the largest sheet which can be conveyed by the sheet conveyor mechanism. Thus, in the apparatus shown, the trailing edge of a sheet of transfer material could still be in contact with the xerographic drum while the leading edge of the sheet carried by the sheet gripper mechanism would be at the delivery station of the apparatus.

As shown by the rise position of the cams 69, the sheet is carried by a sheet gripper mechanism which travels between delivery rollers 65 and 66 and partly around the sprockets 323 before the sheet grippers are actuated by the cams to release the sheet.

In the apparatus shown, the position of each gripper 361 on the gripper bar, and the shape of each cam 69 to actuate the gripper are such that the sheet is readily released to be fed between the delivery rollers 65 and 66, rather than being fully carried around the axis of delivery roller 65 by the sheet gripper mechanism. The sheet gripper mechanism is supported on the chains in a manner to allow the leading edge of the sheet gripper mechanism to be deflected outward as it travels around the sprockets 323 adjacent to the cams 69, while the trailing edge of the sheet gripper mechanism and therefore, the leading edge of the sheet is maintained on a substantially uniform radius of rotation about the sprockets thereby keeping the lineal speed of the paper uniform.

The sheet is carried in this path until the grippers are opened by cams 69 to release the sheet. As the grippers are actuated by the cams 69, to release the sheet, the jaws of the gripper are cammed upon in an arc. The radius of the grippers is a faster opening radius than the radius of the paper, as it tends to straighten, to prevent regripping of the paper as the grippers are gripped again. As shown in FIG. 1, the leading edge of the paper would start to travel in an arc around the sprockets, but as the leading edge of the sheet is released by the sheet gripper mechanism, the elasticity of the paper will cause the leading edge of the sheet to snap up into a straight line into the plane of the remainder of the sheet whereby the paper is discharged in a straight line path from the delivery rollers 65 and 66.

It is apparent that a sheet gripper mechanism constructed in accordance with the invention can be fabricated from relatively thin sheet metal stock material because of the novel configuration of the individual sheet gripper mechanisms and the particular configuration of the spring which prevents warping or distortion of the sheet gripper, the spring acting as a stiffener to the cam follower portion of each individual sheet gripper.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth. It is also apparent that the term "depending" is used to describe the structure, as shown in the drawing, and this term is not used to limit the definition of the apparatus. 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. In a sheet feeding apparatus having a pair of conveyor chains adapted to transport a sheet gripper device from a sheet receiving station to a sheet delivery station,

wherein the sheet gripping device includes a gripper bar secured to said conveyor chains transversely therebetween,

a sheet gripper jaw portion on said gripper bar serving as a common lower gripper jaw, and apertures and elongated slots therein positioned between said gripper jaw portion and the leading edge of said gripper bar as determined by its direction of travel as conveyed by said conveyer chains,

a plurality of pins secured to the leading edge of said gripper bar,

a plurality of grippers pivotably secured to said pins on said gripper bar, each of said grippers having a centrally located depending tang portion terminating in a curved-lip portion, said depending tang portion extending through one of said elongated slots, jaw portions positioned on opposite sides of said depending central tang portion adapted to cooperate with said common lower gripper jaw to grip the leading edge of a sheet therebetween,

a plurality of springs,

each of said springs being formed with a central portion, coiled portions on opposite sides of the central portion and with bent arms at opposite extremities thereof, each of said springs being mounted with its coiled portions encircling a pin on opposite sides of the gripper with which it cooperates and with the central portion of the spring engaging the curved-lip portion of the gripper and with the bent arm portions extending through apertures in the sheet gripper jaw portion to engage the underside of the gripper bar to normally bias the grippers into cooperating relation with the lower gripper jaw,

and said depending tang portion being adapted to be actuated by cams located adjacent and between said conveyor chains at said sheet receiving station and said sheet delivery station.

2. In a sheet feeding apparatus having a pair of conveyor chains adapted to transport a sheet gripping mechanism from a sheet receiving station to a sheet delivery station,

wherein the sheet gripping mechanism includes a gripper bar secured to said conveyor chains transversely therebetween, said gripper bar having a concave depressed portion at its trailing edge with respect to its direction of travel as carried by said conveyor chains, said gripper bar having a plurality of sets of spaced apart pin retaining means at its leading edge,

a plurality of pins secured to said gripper bar, by said pin retaining means,

a plurality of grippers pivotably secured by said pins to said gripper bar,

each of said grippers having jaw portions thereon adapted to cooperate with said concave depressed portion of said gripper bar to grip the leading edge of a sheet therebetween and a depending cam guide portion terminating in a curved-lip portion positioned to contact cams located adjacent and between said conveyor chains at said sheet receiving station and said sheet delivery station,

and springs operatively connected to said gripper bar and to said grippers to normally bias said jaw portions of said grippers into cooperative engagement with said concave depressed portion of said gripper jaw, each of said springs having a central portion, coiled portions on opposite sides of said central portion and bent arms at opposite extremities

thereof, each of said springs having its coiled portion encircling one of said pins, the central portion engaging said curved-lip portion of said gripper.

3. The apparatus of claim 2 wherein each of said pins includes a central notched portion and each of said grippers includes a spring tang extending into a central notched portion of one of said pins.

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