Sept. 15, 1964 R. H. EICHORN 3,148,878

SHEET FEED MECHANISM

Filed April 2, 1962 3 Sheets-Sheet 1

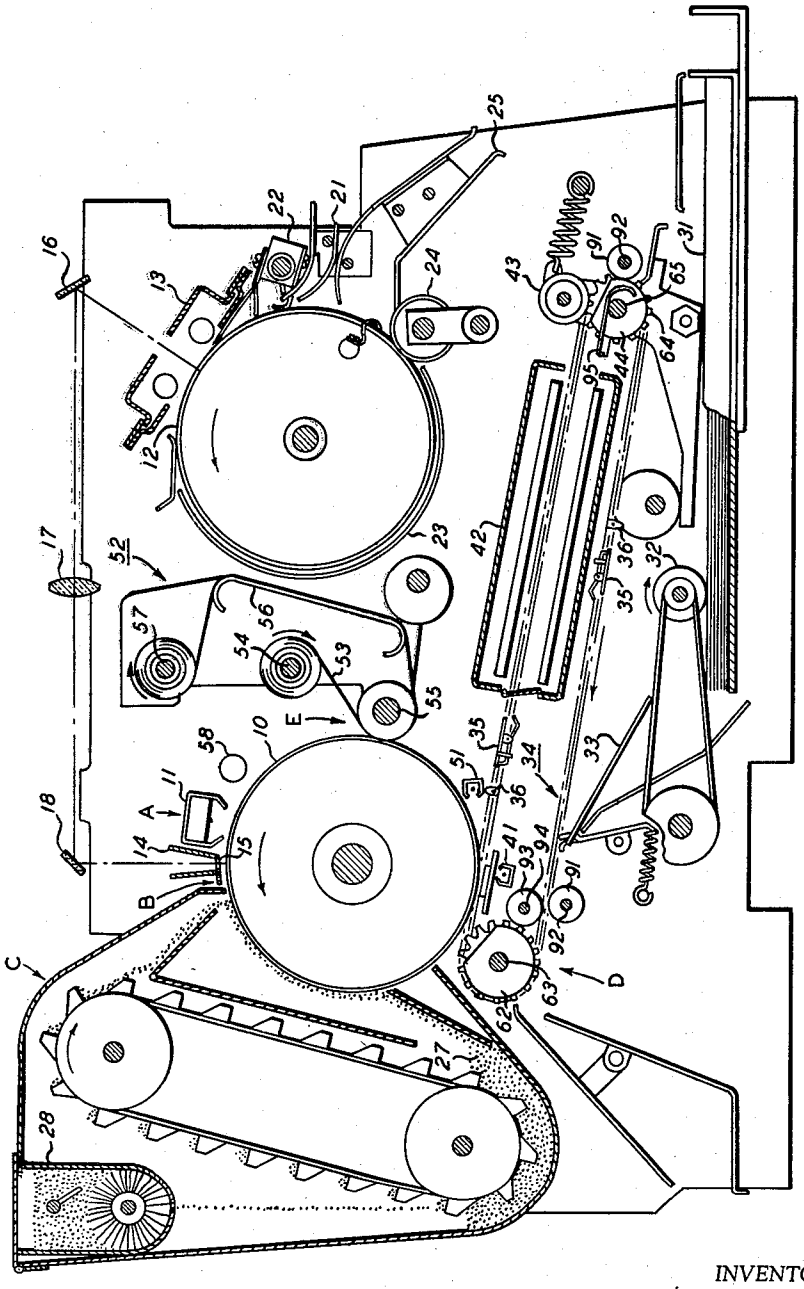

FIG. 1

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Sept. 15, 1964 R. H. EICHORN 3,148,878

SHEET FEED MECHANISM

Filed April 2, 1962

3 Sheets-Sheet 2

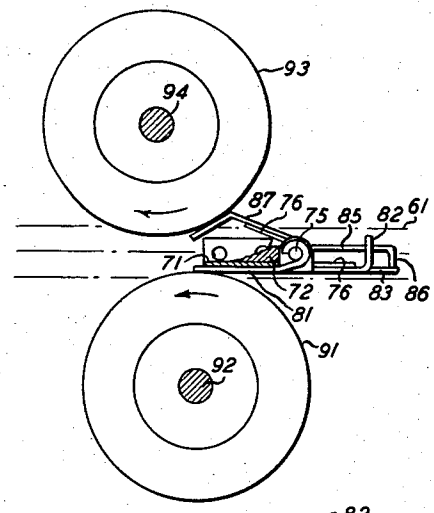

FIG. 2

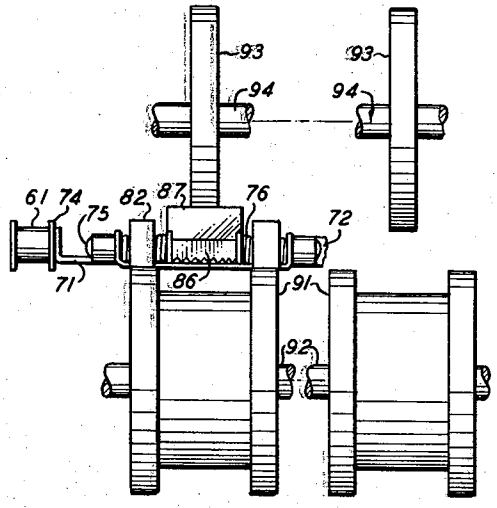

FIG. 3

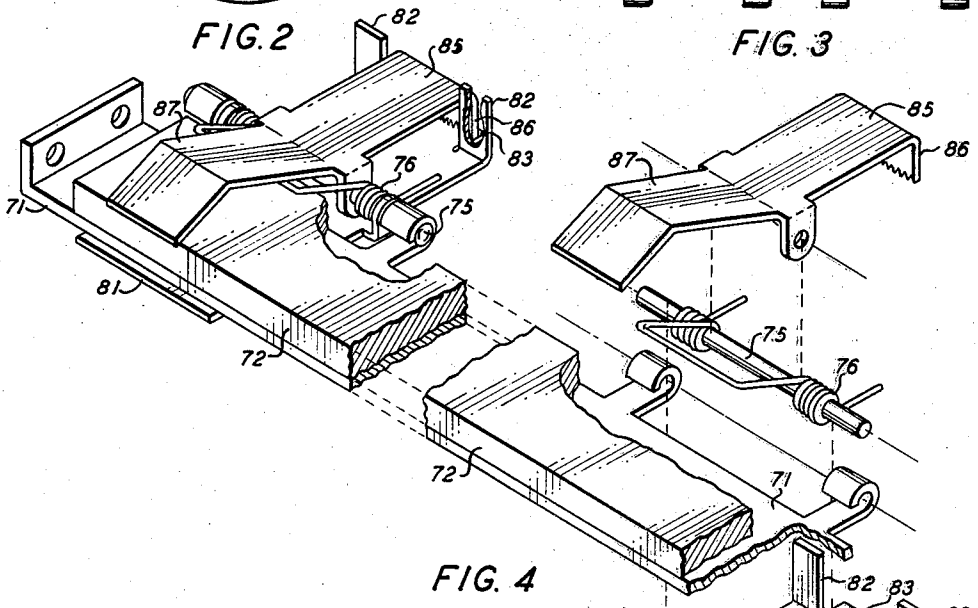

FIG. 4

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Sept. 15, 1964 R. H. EICHORN 3,148,878

SHEET FEED MECHANISM

Filed April 2, 1962 3 Sheets-Sheet 3

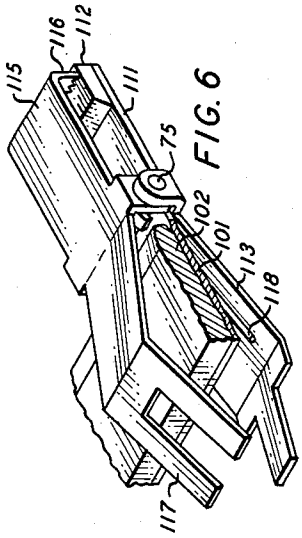

FIG. 6

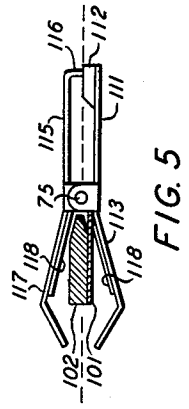

FIG. 5

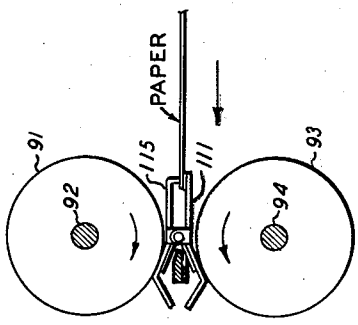

FIG. 9

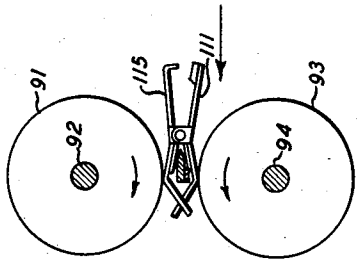

FIG. 8

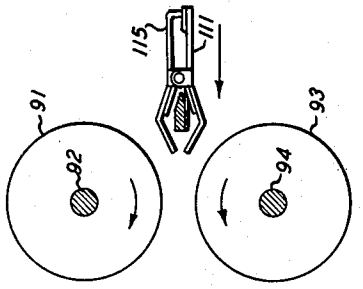

FIG. 7

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United States Patent Office 3,148,878 Patented Sept. 15, 1964

3,148,878

SHEET FEED MECHANISM

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Filed Apr. 2, 1962, Ser. No. 184,205
6 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 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 with 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 mechanisms 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 correpsonding 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 sheet gripper is relatively small, a sheet gripper of sufficient length to grip wide sheet material 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 wide sheet material without deflection of the sheet gripper devices.

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. The cam means include a first cam and a second cam mounted in spaced relation to each other for passage of the sheet gripper mechanism between the cams whereby the sheet gripper mechanism is supported and actuated by these cams.

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 an enlarged side view of the sheet gripper mechanism and cam arrangement of FIG. 1;

FIG. 3 is a front view of the sheet gripper mechanism of FIG. 2;

FIG. 4 is an enlarged perspective view of the sheet gripper mechanism of FIG. 2;

FIG. 5 is an enlarged side view of a second embodiment of a sheet gripper mechanism;

FIG. 6 is an enlarged perspective view of the sheet gripper mechanism of FIG. 5; and

FIGS. 7, 8 and 9 are side views illustrating schematically the sequence of operation of the sheet gripper mechanism of FIG. 5 and the cam arrangement for effecting its operation.

General

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 10, 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 on 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 and discharge station, at which the drum surface is first charged and then 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.

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 11 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. This exposure station may be one of a number of types of mechanisms or members such as desirably an optical scanning or projection system or the like designed to project a line copy image onto the surface of the photoconductive 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 12, 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 attached to a slotted light reflector 13 mounted adjacent to the copy drum.

A light shield 14 adapted to protect the xerographic plate from extraneous light is positioned adjacent to the surface of the xerographic plate. A slot aperture 15 in the light shield extends transversely to the path of movement of the light-receiving surface of the xerographic drum 10 to permit reflected rays from the copy drum to be directed against a limited transverse area of the light-receiving surface as it passes therebeneath.

To enable the optical system to be enclosed within a relatively small cabinet, a folded optical system including an object mirror 16, a lens 17, and an image mirror 18 is used in the preferred embodiment of the apparatus.

Copy fed through paper guides 21 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 by means of guides 22 and 23, the latter also preventing the trailing edge of the copy from contacting the web cleaner. After the copy is scanned, it can be released from the copy drum to be transported out of the machine by copy feed out roller 24 coacting with the peripheral surface of the copy drum to forward the copy through copy guide 25.

Adjacent to the exposure station is a developing station C in which there is positioned a developer apparatus 26 including a developer housing having a lower or sump portion for accumulating developer material 27. Mounted within the developer housing is a motor driven bucket-type conveyor used to carry the developer material previously suppied to the developer housing to the upper portion of the developer housing from where the developer material is cascaded over a hopper chute 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 suitable toner dispenser 28 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 tray 31 for a plurality of sheets of a suitable material, that is, sheets of paper or the like. A separator roller 32 is positioned to feed the top sheet of the stack of material through a paper guide 33, provided with a suitable gate at one end, to a sheet conveyor mechanism 34 constructed in accordance with the invention. The sheet conveyor mechanism is provided with one or more sheet gripper mechanisms 35, constructed in accordance with a preferred embodiment of the invention, which carry the sheet support matermial into contact with the rotating xerographic drum in coordination with the appearance of a developed image at the transfer station. Suitable means, such as cams 36 connected to the chains of the conveyor mechanism, are provided to open the gate of the paper guide to release a sheet to the sheet gripper mechanism as it is opened at the sheet receiving 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 41 that is located at or immediately after the point of contact between the support material and the rotating xerographic drum. The corona transfer device 41 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 42, 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 rolls 43 and 44 by means of which the copy is delivered to a copy holder after it is released by the gripper mechanism. Cam elements, described in detail hereinafter, are provided at the receiving and delivery stations of the conveyor mechanism to actuate the sheet gripper mechanism 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 51 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 web cleaner device **52** adapted to continuously feed a clean fibrous web material into wiping contact with the xerographic drum. As shown, the web material **53** is taken from a supply roll **54** and transported around a cleaning roll **55**, preferably made of rubber, around a guide plate **56** to be wound onto take-up roll **57**.

Any residual electrical charge remaining on the xerographic drum is dissipated by light from a fluorescent lamp **58** 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 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.

Referring now to the subject matter of the invention, the sheet conveyor mechanism **34** includes two endless belts, in the form of roller chains **61**, which extend from a set of drive sprockets **62** carried by shaft **63** to and around a set of sprockets **64** on shaft **65**. These two sets of sprockets are fixedly positioned on their respective shafts 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 **35** are equally spaced from each other along the length of the chains, and 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 **33**, and the delivery rollers **43** and **44**, respectively. Cam elements 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 **33**.

Referring now to the subject matter of the invention, there is shown in FIGS. 1, 2, 3 and 4, a preferred embodiment of a sheet gripper mechanism adapted to accommodate various sized sheets.

As shown, each sheet gripper mechanism **35** includes a gripper bar bracket **71** of a length to extend substantially between the two roller chains **61** to be connected thereto by means of clips **74** forming part of the chains when connected thereto, as is well known in the art. A support bar **72**, which may be formed as a separate element fixed to the gripper bar bracket, as shown, or formed integral therewith extends across the gripper bar bracket to form a more rigid member.

Individual jaws are formed by a plurality of sets of sheet grippers **81** and **85**. The sets of sheet grippers **81** and **85** are mounted by means of pins **75** secured to the curved pin support portions of the gripper bar bracket.

Sheet grippers **81**, although shown as separate elements secured by pins **75** to the gripper bar bracket, may be formed integral with the gripper bar bracket. As shown, each sheet gripper **81** is provided with spaced leg portions **82** which serve as a guide and stop to align the leading edge of a sheet inserted into the sheet gripper mechanism, and with a jaw portion **83** which cooperates with the tang portion or jaw **86** of the respective sheet gripper **85** with which it is aligned on the gripper bar bracket.

Each sheet gripper **85** is mounted by a pin **75** for movement in two directions relative to its cooperating fixed sheet gripper **81**; that is, for movement from a first position in which its tang portion or jaw **86** is in spaced relation to the jaw portion **83** of sheet gripper **81**, to a second position in which the tang portion or jaw **86** is in engagement with the jaw portion **83** of sheet gripper **81**, or with a sheet sandwiched therebetween.

Each sheet gripper **85** is provided with a work arm or cam portion **87** at its front end (in terms of the direction of travel of the gripper bar bracket) which serves as a lever by means of which the sheet gripper is actuated.

The tang portion or jaw **86** of a sheet gripper **85** is normally biased into cooperative gripping relation with the jaw portion **83** of a sheet gripper **81**, by means of spring **76**. In order to resiliently hold the tang or jaw of sheet gripper **85** in gripping relation to the jaw portion **83**, spring **76** is mounted with its coiled portions encircling pin **75**. The central portion of the spring engages the work arm or cam portion **87** of sheet gripper **85** and the arm portions of the spring engage the sheet gripper **81**.

In a xerographic reproducing apparatus used to make reproductions on wide sheets of paper, it is apparent that the sheet gripper mechanism must be of a length greater than the width of the largest sheet on which a reproduction is to be made.

In handling large sheets, it is necessary to securely grip the leading edge of a sheet without deflection of the sheet gripping mechanism as it is actuated by an operating mechanism to receive or release a sheet.

In the arrangements of the operating mechanism shown, the sheet gripper mechanism, provided with a plurality of sets of sheet grippers, is actuated in a manner whereby the load imposed by the individual sets of sheet grippers as they are actuated is transposed equally to two support members.

In the preferred embodiment of an operating mechanism, as shown at the receiving station in FIG. 1, and in FIGS. 2 and 3, the operating mechanism consists of two rollers **91** and **93**, mounted on shafts **92** and **94**, respectively, spaced on opposite sides of the path of travel of the sheet gripper mechanisms.

Although individual sets of rolls **91** and **93** are shown for each set of sheet grippers, it is apparent that a single set of rolls extending across the full length of the sheet gripper mechanism can be used.

Although the rolls **91** and **93** may be journaled on their respective shafts for rotation relative thereto, the rolls are preferably fixed to their respective shafts and the shafts are driven at a speed whereby the linear speed of the roll is equal to and in the same direction as the speed of movement of the sheet gripper mechanism to effect rolling contact between the rolls and the sheet grippers. This reduces the frictional contact between these elements and reduces the forces acting on the chains during opening of the sheet gripper mechanism.

In operation, the sheet gripper mechanism is carried between the gap imposed by the rolls. The action of the work arm of each sheet gripper **85** as it contacts a roll **93** opens the sheet gripper against the biasing action of the springs **76**. Heavy springs, in terms of their biasing force, can be used since the sheet gripper mechanism is supported on opposite sides and the resultant force, as the sheet grippers are opened, is reduced to substantially zero as far as deflection of the gripper bar bracket is concerned.

Another embodiment of an operating mechanism to actuate the sheet gripper mechanism is shown at the delivery station of the xerographic reproducing apparatus, in FIG. 1. In this embodiment, a rotatable roll **91**, mounted on shaft **92**, and a stationary cam **95** are used to actuate and to prevent deflection of the sheet gripper mechanism.

In the embodiment shown in FIGS. 5 through 9, inclusive, the sheet gripper mechanism includes a gripper bar bracket **101** and support bar **102** similar in construction to the gripper bar bracket **71** and support bar **72**, respectively. A plurality of sets of sheet grippers **111** and **115**, formed complementary to each other, are pivotally connected to the gripper bar bracket by pins **75**, for movement with respect to the gripper bar bracket and with respect to each other.

Sheet gripper **111**, is provided with a jaw **112** adapted to cooperate with the tang portion or jaw portion **116** of sheet gripper **115**. Sheet gripper **111** is also provided with a work arm or cam portion **113** at its front end (in terms of the direction of travel of the sheet gripper mechanism).

Sheet gripper **115**, similar in construction to sheet gripper **85**, is also provided with a work arm or cam portion **117**.

In order to resiliently hold the jaw **112** of sheet gripper **111** in gripping relation to the tang portion or jaw **116** of sheet gripper **115**, a spring **118**, similar to spring **76**, encircles an intermediate portion of pin **75** with one end portion of the spring engaging the cam follower portion **113** of the sheet gripper **111** and the opposite end portion of the spring engaging the work arm or cam portion **117** of sheet gripper **115**.

As shown in FIG. 6, the work arm **113** of sheet gripper **111** is preferably formed with a reduced central portion adapted to clear the bifurcated work arm **117** of sheet gripper **115** whereby these work arms will intercross as they are actuated.

It is apparent that a sheet conveyor mechanism having a sheet gripper mechanism of the type disclosed can be constructed to accommodate large size sheets while still permitting the conveyor to operate effectively on smaller size sheets.

For example, when it is desired to convey two or three foot width paper, six or eight sets of sheet grippers can be positioned across the length of the gripper bar bracket, with each set being biased into gripping engagement by a relatively heavy torsion spring. However, the resultant force, as the sets of sheet grippers are actuated, is reduced to substantially zero as far as deflection of the gripper bar bracket is concerned.

Sheets of paper of any size are held uniformly along substantially the entire leading edge of the sheets because of the novel arrangement of the sheet gripper mechanisms and their operating mechanisms.

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 sheet conveyor including two endless belts,
pulley means supporting said endless belts for travel in unison in two spaced planes,
a gripper bar bracket connected at opposite ends to said endless belts along a line substantially perpendicular to the two spaced planes of travel of said endless belts,
a plurality of first sheet grippers and
an equal number of second sheet grippers mounted on said gripper bar bracket,
said first sheet grippers and said second sheet grippers each having jaw portions adapted to cooperate with each other to grip a sheet therebetween,
at least said first sheet grippers being pivotally mounted on said gripper bar bracket and each having a cam follower portion thereon,
spring means connected to each set of said first sheet gripper and to said second sheet gripper pairs to normally bias said jaw portions of said sheet grippers into cooperative engagement with each other,
and operating means positioned adjacent said belts and on opposite sides of the path of travel of said gripper bar bracket adapted to contact said grippers to actuate said sheet grippers on opposite sides of said gripper bar bracket and to support said sheet grippers to prevent deflection of said gripper bar bracket.

2. The apparatus of claim 1,
wherein said operating means includes first roller means positioned for rolling contact with said first sheet grippers
and a second roller means positioned for rolling contact with said second sheet grippers.

3. The apparatus of claim 2,
wherein said second sheet grippers are pivotally mounted on said gripper bar bracket
and each of said second sheet grippers are provided with a cam follower portion adapted to actuate said second sheet grippers when said cam follower portion of each of said second sheet grippers contacts said second roller means.

4. A sheet conveyor including two endless belts,
pulley means supporting said endless belts for travel in unison in two spaced planes,
a gripper bar bracket connected at opposite ends to said endless belts along a line substantially perpendicular to the two spaced planes of travel of said endless belts,
a plurality of first sheet grippers and
an equal number of second sheet grippers; and an equal number of pins secured on said gripper bar bracket,
said first sheet grippers and said second sheet grippers being positioned on opposite sides of said gripper bar bracket and pivotably mounted in sets in cooperative relation to each other by said pins,
said first sheet grippers and said second sheet grippers each having jaw portions adapted to cooperate with each other to grip a sheet therebetween,
at least each of said first sheet grippers having a cam follower portion thereon,
spring means connected to each set of said first sheet gripper and to said second sheet gripper sets to normally bias said jaw portions of said sheet grippers into cooperative engagement with each other,
and operating means positioned adjacent said belts and on opposite sides of the path of travel of said gripper bar bracket in position to contact said sheet grippers to actuate said sheet grippers and to support said sheet grippers to prevent deflection of said gripper bar bracket as said sheet grippers are actuated.

5. The apparatus of claim 4,
wherein said operating means includes a first roller means positioned for rolling contact with said first sheet gripper
and a second roller means positioned for rolling contact with said second sheet gripper.

6. The apparatus of claim 5,
wherein said second sheet grippers are each provided with a cam follower portion adapted to actuate said second sheet grippers when said cam follower portion of each of said second sheet grippers contacts said second roller means.

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