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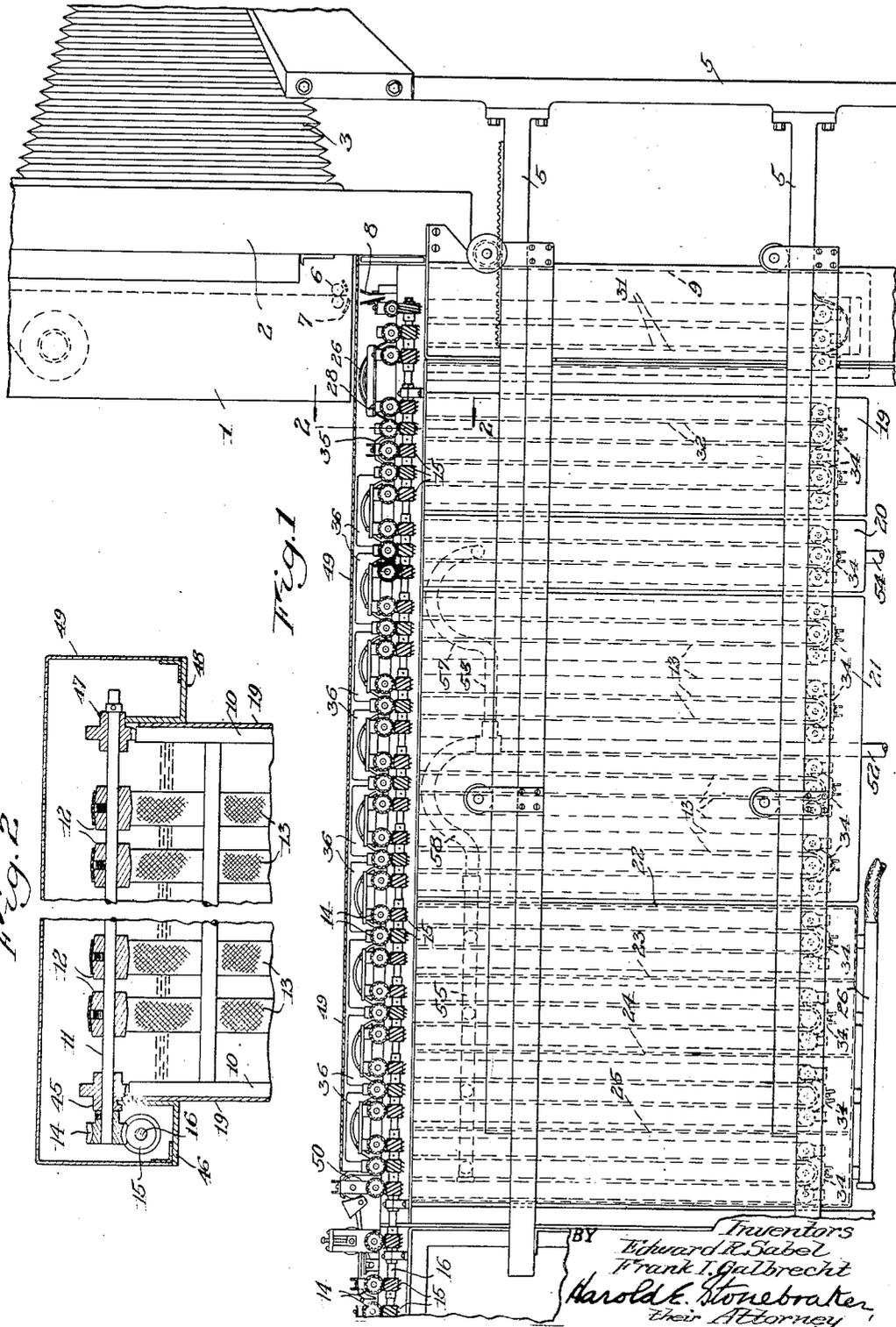
E. R. SABEL ET AL

2,547,979

PHOTOCOPY MACHINE

Filed Aug. 16, 1946

3 Sheets-Sheet 1



BY  
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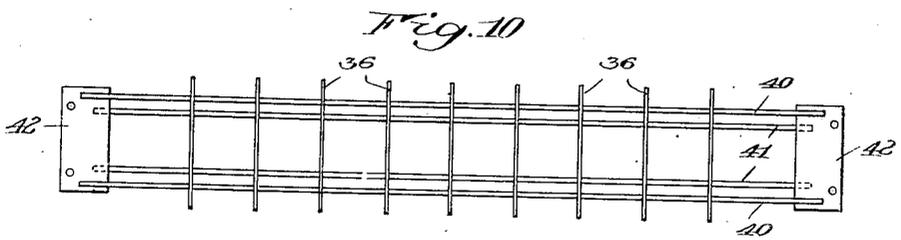
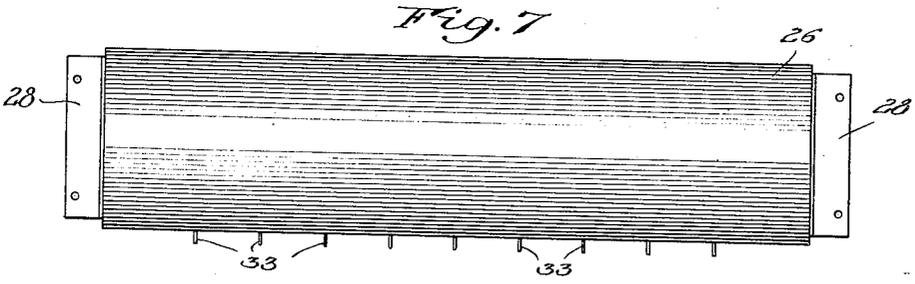
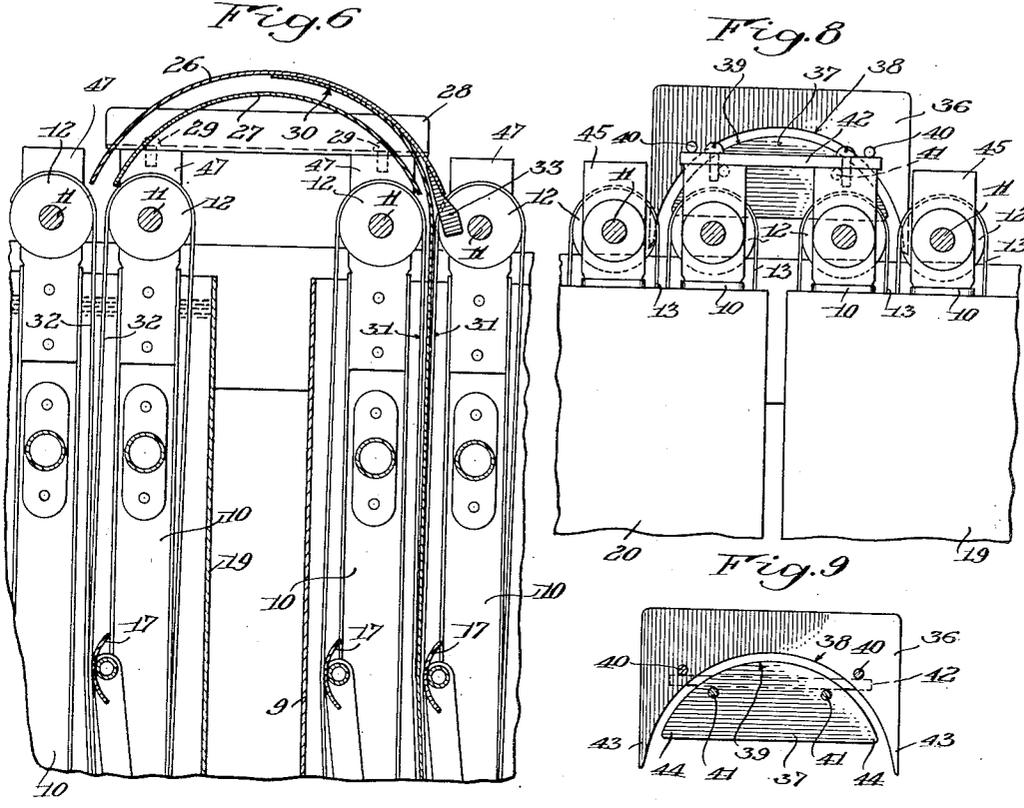
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# UNITED STATES PATENT OFFICE

2,547,979

## PHOTOCOPY MACHINE

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Application August 16, 1946, Serial No. 690,983

6 Claims. (Cl. 271-45)

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This invention relates to a photocopy machine, with more particular reference to the type of apparatus in which prints are conveyed from a camera immediately after exposure through a continuous processing mechanism, and has for its object to afford means for feeding prints successively through various liquid-containing tanks, between endless belt conveyors located in each tank and from one pair of conveyors to another in such manner as to handle the prints efficiently and successfully after they are thoroughly soaked in liquid, and to prevent their wrinkling, creasing, or becoming distorted due to stretching of the paper.

Another purpose of the invention is to provide an efficient and practical machine for feeding prints successively through various liquid-holding tanks and from one tank to another by feeding belts engaging opposite surfaces of the paper, thus obviating the necessity of gripping and pulling the paper prints by impaling or other gripping members.

In machines of this general type as heretofore proposed, it has been impossible with all thicknesses of paper to obtain prints free from wrinkles and other imperfections, due to the difficulties in conveying the prints from one tank to another or from one pair of belt-feeding units to another pair of belt-feeding units within a tank, after the paper has been thoroughly saturated with liquid, and one of the principal purposes of the invention is to afford a structure that will guide and carry the paper either in a dry or wet state from one tank to another, or from one pair of belt-feeding units to another pair of belt-feeding units in such a way as to allow transverse stretching of the paper when wet, thus eliminating the defects due to wrinkling resulting therefrom.

A further object is to afford a simple and practical form of paper guiding means effective to accomplish the purposes above mentioned, and which can be readily positioned in operative relation above adjacent belt-feeding units that are removable from the tanks, the paper guiding means being quickly separable from above the belt-feeding units when the latter are to be lifted from a tank for servicing.

To these and other ends, the invention consists in the construction and arrangement of parts that will appear clearly from the following description when read in conjunction with the accompanying drawings, the novel features being pointed out in the claims following the specification.

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In the drawings:

Fig. 1 is a view in side elevation, partly in section, showing a preferred embodiment of the invention as applied to a photocopy machine such as illustrated in copending application Ser. No. 688,200, filed August 3, 1946, Patent No. 2,429,896, dated October 28, 1947.

Fig. 2 is a transverse vertical sectional view, with parts broken away, taken centrally through one of the belt-feeding units and showing the drive and support therefor;

Fig. 3 is an enlarged front elevation of one of the belt-feeding units removed, and the paper guiding and conveying means, partially in section;

Fig. 4 is a view in end elevation of the belt-feeding unit, partially in section and with the drive gear omitted;

Fig. 5 is an enlarged detail sectional view on the line 5-5 of Fig. 3;

Fig. 6 is an enlarged vertical sectional view, partially broken away, showing the upper portion of two pairs of belt-feeding units in the transfer chamber and developer chamber respectively, with the means for conveying paper from one pair of belt-feeding units to the other;

Fig. 7 is a plan view of the paper guiding and conveying means illustrated in Fig. 6;

Fig. 8 is a view similar to Fig. 6, illustrating the paper guiding and conveying means associated with adjacent pairs of belt-feeding units in adjacent tanks or in the same tank;

Fig. 9 is a detail vertical sectional view taken through the paper guiding and conveying means illustrated in Fig. 8, and

Fig. 10 is a top plan view of the structure shown in Fig. 9.

Referring more particularly to the drawings in which like reference numerals refer to the same parts throughout the several views, the invention is illustrated in connection with a photocopy machine such as shown in copending application Ser. No. 688,200, filed August 3, 1946, Patent No. 2,429,896, dated October 28, 1947, and including a paper magazine 1, camera body 2, and bellows 3 provided with a lens system and prism, not shown, and connected by suitable arms to a frame including vertical legs and longitudinally adjustable side bars 5 on which a copy-board is suitably mounted.

The camera includes feeding rolls 6 for conveying the paper downwardly after exposure, and a movable cut-off knife 7 for severing the exposed portion, as usual in this type of apparatus, while 8 designates a chute through which the paper is

discharged into a transfer chamber 9. The paper is carried through the transfer chamber 9 in accordance with the disclosure of copending application Ser. No. 690,982, filed August 16, 1946, Patent No. 2,430,687, dated November 11, 1947, being fed upwardly and outwardly from the transfer chamber 9 between two belt-feeding units, as shown in Fig. 6.

Each of the belt-feeding units includes a removable frame consisting of uprights 10 that are removably positionable by a vertical motion within guideways in the tanks in the general manner disclosed in Patent Reissue No. 22,654. Each belt-feeding unit includes top and bottom shafts 11 with pulleys 12 mounted thereon around which travel the endless belts 13 of suitable plastic material, the upper pulley shaft 11 being provided with a worm gear 14 that is driven by a worm 15, see Fig. 2, mounted on the worm shaft 16 which is operated from any suitable source of power to drive the belts on the various belt units, while 17 designates followers pivoted at 18 on the frame which supports the belts, and actuated by suitable springs to move the belts toward adjacent belts and thereby to feed the paper prints between contacting belts of adjacent belt units.

In the transfer chamber 9, the prints are fed downwardly by fast moving feeding belts, actuated by a higher speed worm and worm gear drive, and these belts slide the prints against a stationary surface, as disclosed in copending application Ser. No. 690,982, filed August 16, 1946, Patent No. 2,430,687, dated November 11, 1947. The prints are then fed upwardly by the two belt-feeding units shown at the right in Fig. 6, and carried thence over to a point between the belt-feeding units at the left of Fig. 6 which carry the prints into the developer solution. Referring to Fig. 1, the prints are carried downwardly and upwardly twice in the tank 19 containing the developer solution, thence downwardly and upwardly once in the tank 20 containing a short-stop bath or water, thence downwardly and upwardly four times in the tank 21 containing the hypo solution, and thence downwardly and upwardly once in each of the four washing tanks 22, 23, 24 and 25 respectively.

In order to accomplish these several movements of the prints through the various processing liquids, the belt-feeding units are preferably arranged in groups or series of three each, each series of three belt-feeding units operating to carry the prints downwardly and upwardly once through a tank, combined with guiding and conveying means extending between the groups or series of units and operating to carry the prints in a curved path upwardly out of one feeding unit and downwardly into the adjacent feeding unit, while freeing the prints from the belts and supporting them at various points laterally and thus preventing wrinkling, creasing, or distortion of the paper due to its lateral stretching after it has become thoroughly soaked with liquid.

Figs. 6 and 7 illustrate the curved guiding and conveying means for carrying the prints from the transfer chamber or dry tank 9 to the developer tank 19, and consisting of arcuate metal plates 26 and 27 which are fixedly mounted on a frame including cross-pieces 28 attached to the ends of the arcuate plates 26 and 27 and suitably fastened by means of screws 29 or other attaching means to the tops of the adjacent belt-feeding units. The arcuate plates 26 and 27 afford a guideway for the paper 30, extending from a point between the upper ends of the upwardly feeding belts indi-

cated at 31, to a point between the upper ends of the downwardly feeding belts indicated at 32, and in order to deflect the paper when it reaches the upper ends of the belts 31, the top arcuate plate 26 is provided with a series of spaced deflectors or fins 33 suitably fastened thereto in spaced relation to each other and extending between adjacent pulleys, thus preventing the paper from being carried backwardly around the right-hand set of belts 31. Thus the paper is carried around through the curved guideway, the smooth surfaces of the metal plates 26 and 27 permitting sliding of the paper without injury to its sensitized surface, until it reaches a point between the belts 32 and is carried downwardly thereby through the developer solution. When the paper print reaches the bottom of the developer tank between the belts 32, it is deflected around the belts of one belt-feeding unit by means of deflecting fingers 34, and thence carried upwardly between the belts 32 of the extreme left-hand belt-feeding unit of Fig. 6 and the next adjacent belt-feeding unit, being carried around the belts at the top of the tank by means of the deflecting fingers 35 and thence downwardly for a second immersion in the developer tank between the next adjacent belt surfaces.

The paper is carried around the bottoms of the belts in all the tanks by fingers such as shown at 34, and when the paper reaches the deflecting fingers 35 after its first immersion in the developer tank, it is not sufficiently wet to cause any appreciable stretching, but when it emerges from its second dip into the developer tank preparatory to entering the next processing tank 20, the paper is thoroughly saturated so as to cause lateral stretching and consequent creasing or wrinkling if conveyed directly around and in contact with the belts as by means of fingers 35. At the bottoms of the tanks where deflected around the belts by fingers 34, the paper is floating in the liquid as it travels around the bottoms of the belts, and can thus be readily guided at the bottom of a tank without causing wrinkling or creasing, but at the tops of the tanks where the paper is necessarily out of the liquid while being conveyed from an upwardly feeding pair of belt units to a downwardly feeding pair of belt units, if the paper is deflected directly around the belts in contact therewith, similarly to its movement at the bottoms of the tanks, creases and wrinkles in the paper result and the prints are unsatisfactory.

In order to overcome this and permit lateral stretching of the paper without consequent wrinkling or creasing, the paper is conveyed through a curved passage or guideway extending in a gradually curved path from the upwardly feeding belts to the downwardly feeding belts and permitting the paper prints to travel through such curved channel while out of contact with the belts and engaged by either surface of the curved guideway. This is preferably accomplished by the guiding and conveying means shown in Figs. 8 and 9 arranged over adjacent pairs of belt-feeding units, and affording a channel or guideway from the upwardly feeding belts in a gradually curved path to the downwardly feeding belts.

This structure includes a series of horizontally spaced vertically and oppositely arranged upper and lower plates 36 and 37 having vertically spaced parallel curved adjacent edges 38 and 39 respectively that are engageable with opposite surfaces of the paper as it travels therethrough,

and afford an arcuate passage of gradual curvature extending from between the tops of a pair of upwardly feeding belt units to between the tops of a pair of downwardly feeding belt units.

The plates 36 and 37 being spaced from each other in a horizontal plane can engage the paper sheets at various points laterally thereof, so as to maintain a relatively wide or a relatively narrow sheet in uniformly smooth relationship as it travels around between the curved edges 38 and 39, permitting free stretching of the paper laterally and avoiding the forming of wrinkles or creases as the paper enters and is engaged by the adjacent downwardly feeding belts. The upper plates 36 are fixedly mounted on cross-  
40 rods 40 and the lower plates 37 are fixedly mounted on cross-  
41 rods 41 extending there-through, the cross-  
40 rods 40 and 41 being rigidly attached at their ends to supporting plates 42, which are fastened in any suitable manner to the tops of the adjacent belt-feeding units.

In order to deflect the paper sheets away from the belts as they enter the curved guideway, the top plates 36 are provided with downwardly extending fingers 43 which project between adjacent pulleys of the outermost belt-feeding units, referring to Figs. 8 and 9, while the lower plates 37 include terminal fingers 44 that project between adjacent pulleys of the innermost belt-feeding units, thus acting to deflect the paper away from the upwardly feeding belts and to guide it properly to a point between the downwardly feeding belts. The curved edges 38 and 39 of the spaced plates forming the guideway for the paper preferably conform to circular arcs of from a four to five inch radius which has been found to give satisfactory results in conveying very thin paper that has been thoroughly soaked in liquid, attaining a degree of perfection in the finished prints that is impossible where they are conveyed directly around the belts at the upper ends of the tanks and follow the sharp arc of curvature of the pulleys and belts so as to be held in engagement with the belts as in the structure illustrated in Patent Reissue No. 22,654.

Each removable belt-feeding unit is slidably mounted in its tank in the manner already described, and when so positioned, the bearing 45, see Fig. 2, for the upper pulley shaft, rests on the edge of an angle iron support 46 forming a part of the stationary frame, the bearing 45 being slotted on its lower periphery to engage the upper edge of the support 46 and position the shaft accurately endwise in relation to the drive shaft 16 and worm 15, while at its opposite end the pulley shaft 11 is provided with a bearing 47 that has a flattened lower edge resting on the supporting angle iron 48, from which it is lifted vertically when the belt-feeding unit is removed for servicing, while 49 designates a hood or cover positionable over the various belt-feeding units and the tops of the several tanks.

When the paper prints emerge from the final washing tanks 25, they are fed from the upwardly traveling belts over a straightening roller 50, and conveyed thence to a suitable drying apparatus which forms no part of the subject matter of the present application but is disclosed in copending application Ser. No. 694,620, filed September 3, 1946, now Pat. No. 2,446,246 dated Aug. 3, 1948. 52 designates a water inlet from which a branch 53 leads to the short-stop tank 20 provided with an outlet 54 at the bottom, while 55 designates a pipe connected with the several

wash tanks 22, 23, 24 and 25 which are provided with suitable outlets at the bottom connected with a common outlet pipe 26, the pipes 53 and 55 including upwardly curved portions 57 and 58 respectively that determine the level of the water in the several tanks. The lower pulley shaft 11 of each belt-feeding unit is supported at each end in a bearing 59, see Fig. 5, forming part of the block 60 which is attached to the upright 10 by suitable fastening screws 61.

The operation of the apparatus briefly is as follows: After exposure, a print is fed downwardly by the feeding rolls 6, cut off by the knife 7, and is then discharged through the chute 8 into the transfer chamber 9 through which it is conveyed downwardly at a fast speed to remove it from the path of succeeding prints, and is then carried upwardly between the upwardly feeding belts 31, see Fig. 6. The paper is deflected by fingers 33 to the guideway between the curved plates 26 and 27 and thence travels downwardly between the belts 32 in the developer tank 19. The print is carried downwardly and upwardly twice in the developer tank, being deflected at the bottom by the fingers 34 and at the top by the fingers 35, and after it travels upwardly through the last pair of belt-feeding units in the developer tank, it is deflected by the fingers 43, see Figs. 8 and 9, into the curved passage formed by the spaced curved edges 38 and 39 of the vertically arranged plates 36 and 37, and is thus guided to a point between the downwardly feeding belts of the tank 20 containing the short-stop liquid through which the print is conveyed downwardly and upwardly once. From the upwardly feeding belts of the short-stop tank, the print is conveyed and guided by a curved passage formed by vertically disposed spaced plates similar to that last described into the hypo solution tank through which the print is conveyed downwardly and upwardly preferably four times by means of four groups or series of belt-feeding units, each containing three of such units, which feed the paper downwardly and upwardly once, and from the hypo tank the print is conveyed successively to four wash tanks, each provided with a series of three belt-feeding units that convey the print downwardly and upwardly once in the tank. Above the belt-feeding units in the hypo tank and in the wash tanks are provided guiding and conveying means similar to that last described, including spaced vertically arranged plates with opposed curved edges affording curved passages therebetween, such guiding and conveying means being located above and between each pair of upwardly feeding belt units and downwardly feeding belt units, so as to convey the print in a smooth, unwrinkled and uniform state, regardless of its size, from one tank to another or between different series of feeding units in the hypo tank where it is desirable to immerse the print several times.

The structure described affords a practical and efficient machine that has in actual practice overcome the defects present in the mechanism of Patent Reissue No. 22,654, July 3, 1945, and which has produced prints at a much faster rate and of better quality than on prior commercial machines, thus enabling considerably greater production and a substantial saving in the cost of production.

While the invention has been described in connection with the particular embodiment illustrated, it is not confined to the details illustrated herein, and this application is intended to cover

7 such modifications, changes, or departures as may come within the purposes of the improvements and the scope of the following claims.

We claim:

1. In a photocopy machine, the combination 5 with pairs of belt-feeding units operating to feed prints upwardly and separate pairs of belt-feeding units operating to feed prints downwardly, each of said belt-feeding units comprising a series of top pulleys arranged endwise adjacent 10 to and spaced from one another and a series of bottom pulleys arranged endwise adjacent to and spaced from one another with a series of endless flat belts arranged edgewise adjacent to and spaced from one another and each extending 15 around a top and bottom pulley respectively, the belts of each belt-feeding unit acting to engage belts of the adjacent unit and to feed prints positioned between said belts and extending across a series of adjacently arranged belts, of print 20 guiding and conveying means comprising vertically spaced gradually curved guiding elements located above and below the path of the prints and extending entirely across the series of belts and pulleys endwise thereof affording a gradu- 25 ally curved passage from between the tops of one pair of belt-feeding units to a point between the tops of the other pair of belt-feeding units and operable to support a print of any size within the width of the belt-feeding units laterally and to convey the print in a curved path from between an upwardly feeding pair of belt units to a point between a downwardly feeding pair of belt units, the upper of said guiding elements including a series of downwardly extending spaced 35 fins located between adjacent pulleys and belts of the outermost belt-feeding unit of the upwardly feeding pair.

2. In a photocopy machine, the combination 40 with pairs of belt-feeding units operating to feed prints upwardly and separate pairs of belt-feeding units operating to feed prints downwardly, each of said belt-feeding units comprising a series of top pulleys arranged endwise adjacent to and spaced from one another and a series of bottom 45 pulleys arranged endwise adjacent to and spaced from one another with a series of endless flat belts arranged edgewise adjacent to and spaced from one another and each extending around a top and bottom pulley respectively, the belts of 50 each belt-feeding unit acting to engage belts of the adjacent unit and to feed prints positioned between said belts and extending across a series of adjacently arranged belts, of print guiding and conveying means comprising vertically spaced 55 gradually curved guiding plates located above and below the path of the prints and extending entirely across the series of belts and pulleys endwise thereof affording a curved guideway engageable with opposite surfaces of the prints at 60 different points laterally thereof and extending from between the tops of one pair of belt-feeding units in a gradually curved path to a point between the tops of the other pair of belt-feeding units, and a series of deflecting fins carried by the upper of said plates and extending between 65 the adjacent belts and pulleys of the outermost belt-feeding unit of the upwardly feeding pair, said guiding and conveying means acting to support a print of any size within the width of the belt-feeding units laterally and to convey it in a gradually curved path from between the upwardly feeding pair of belt units to a point between the downwardly feeding pair of belt units.

3. In a photocopy machine, the combination 75

with pairs of belt-feeding units operating to feed prints upwardly and separate pairs of belt-feeding units operating to feed prints downwardly, each of said belt-feeding units comprising a series of top pulleys spaced from one another and a series of bottom pulleys spaced from one another with endless belts spaced from one another and extending therearound, the belts of each pair acting to engage and feed prints positioned therebetween, of print guiding and conveying means comprising a series of horizontally spaced vertically arranged oppositely disposed upper and lower plates having vertically spaced gradually curved adjacent parallel edges engageable with opposite faces of paper prints and affording a gradually curved passage extending from between the tops of one pair of belt-feeding units to a point between the tops of the other pair of belt-feeding units and acting to convey paper prints of any size within the width of the belt-feeding units in a gradually curved path from between the upwardly feeding pair of belt units to a point between the downwardly feeding pair of belt units, said lower plates being located between adjacent pulleys and belts of the innermost belt-feeding units and said upper plates having depending portions extending downwardly between adjacent belts and pulleys of the outermost belt-feeding units.

4. In a photocopy machine, the combination 30 with pairs of belt-feeding units operating to feed prints upwardly and separate pairs of belt-feeding units operating to feed prints downwardly, each of said belt-feeding units comprising a series 35 of top pulleys spaced from one another and a series of bottom pulleys spaced from one another with endless belts spaced from one another and extending therearound, the belts of each pair acting to engage and feed prints positioned there- 40 between, of print guiding and conveying means comprising a series of horizontally spaced vertically arranged oppositely disposed upper and lower plates having vertically spaced gradually curved adjacent parallel edges engageable with 45 opposite faces of paper prints and affording a gradually curved passage extending from between the tops of one pair of belt-feeding units to a point between the tops of the other pair of belt-feeding units and acting to convey paper prints of any size within the width of the belt-feeding 50 units in a gradually curved path from between the upwardly feeding pair of belt units to a point between the downwardly feeding pair of belt units, said upper plates having deflecting portions at their lower portions extending between adja- 55 cent pulleys and belts of the outermost belt-feeding units and said lower plates being located between adjacent belts and pulleys of the innermost belt-feeding units, a frame comprising end members supported on adjacent belt-feeding units, and longitudinally extending upper and lower rods fixed to said end members and extending through said upper and lower vertical plates 60 respectively which are secured thereto.

5. A structure according to claim 1, in which there are a multiplicity of series of belt-feeding units, each of said series including three belt-feeding units and operating to feed prints downwardly and upwardly once and the downwardly 70 extending spaced fins are located between adjacent pulleys and belts of the inner belt-feeding units of said multiple series of three belt-feeding units.

6. In a photocopy machine, the combination 75 with a multiplicity of series of belt-feeding units,

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each of said series consisting of three belt-feeding units operating to feed prints downwardly and upwardly once and each of said belt-feeding units comprising top pulleys spaced from one another and bottom pulleys spaced from one another with endless belts extending therearound, and spaced from one another, the belts of adjacent belt-feeding units acting to engage and feed prints positioned therebetween, of print guiding and conveying means comprising a series of horizontally spaced vertically arranged oppositely disposed upper and lower plates having vertically spaced gradually curved adjacent parallel edges extending entirely across the several belts and pulleys and engageable with opposite faces of paper prints and affording a gradually curved passage extending from the outlet point of one series of belt-feeding units to the inlet point of the adjacent belt-feeding units and acting to convey prints in a gradually curved path from said outlet point to said inlet point, the upper of said plates including a series of downwardly extend-

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ing portions located between adjacent belts and pulleys of the outermost of said belt-feeding units and the lower of said plates being located between adjacent belts and pulleys of the innermost of said belt-feeding units.

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