

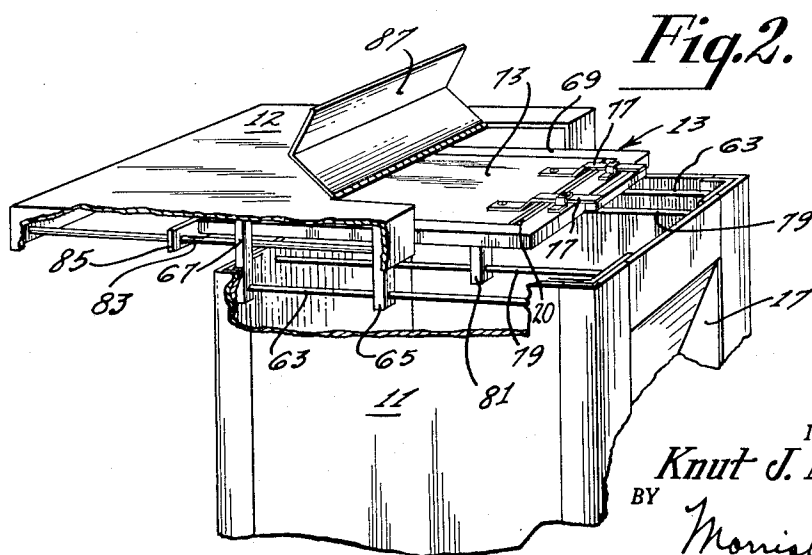
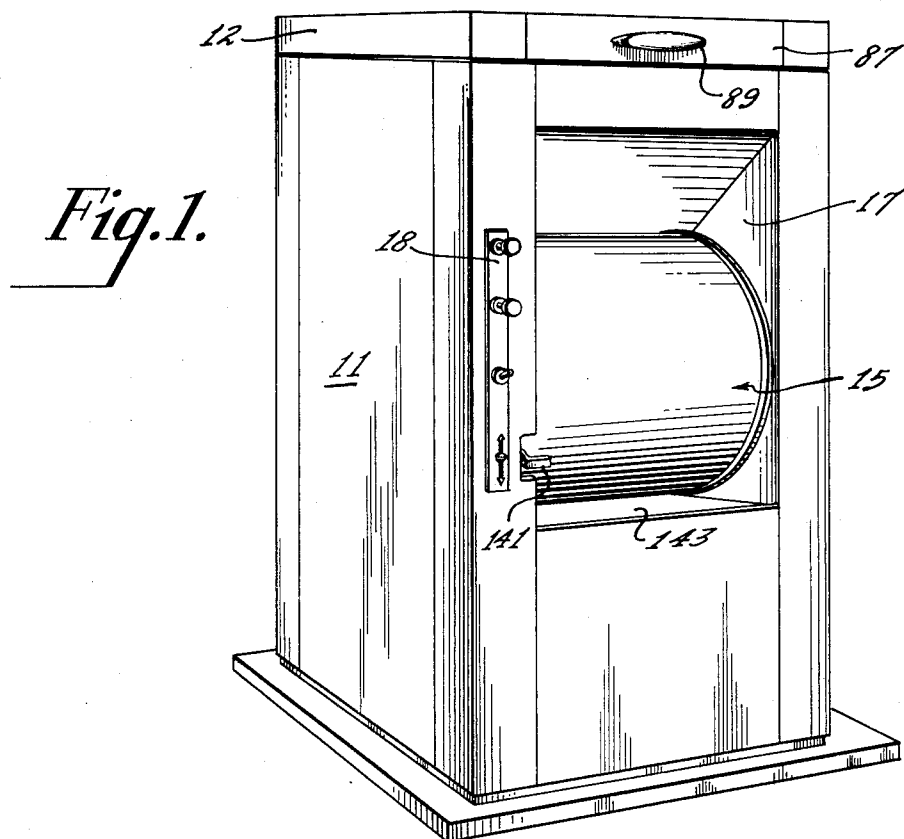
Nov. 8, 1960

K. J. MAGNUSSON
OFFICE COPYING MACHINE

2,959,095

Filed June 3, 1957

3 Sheets-Sheet 1



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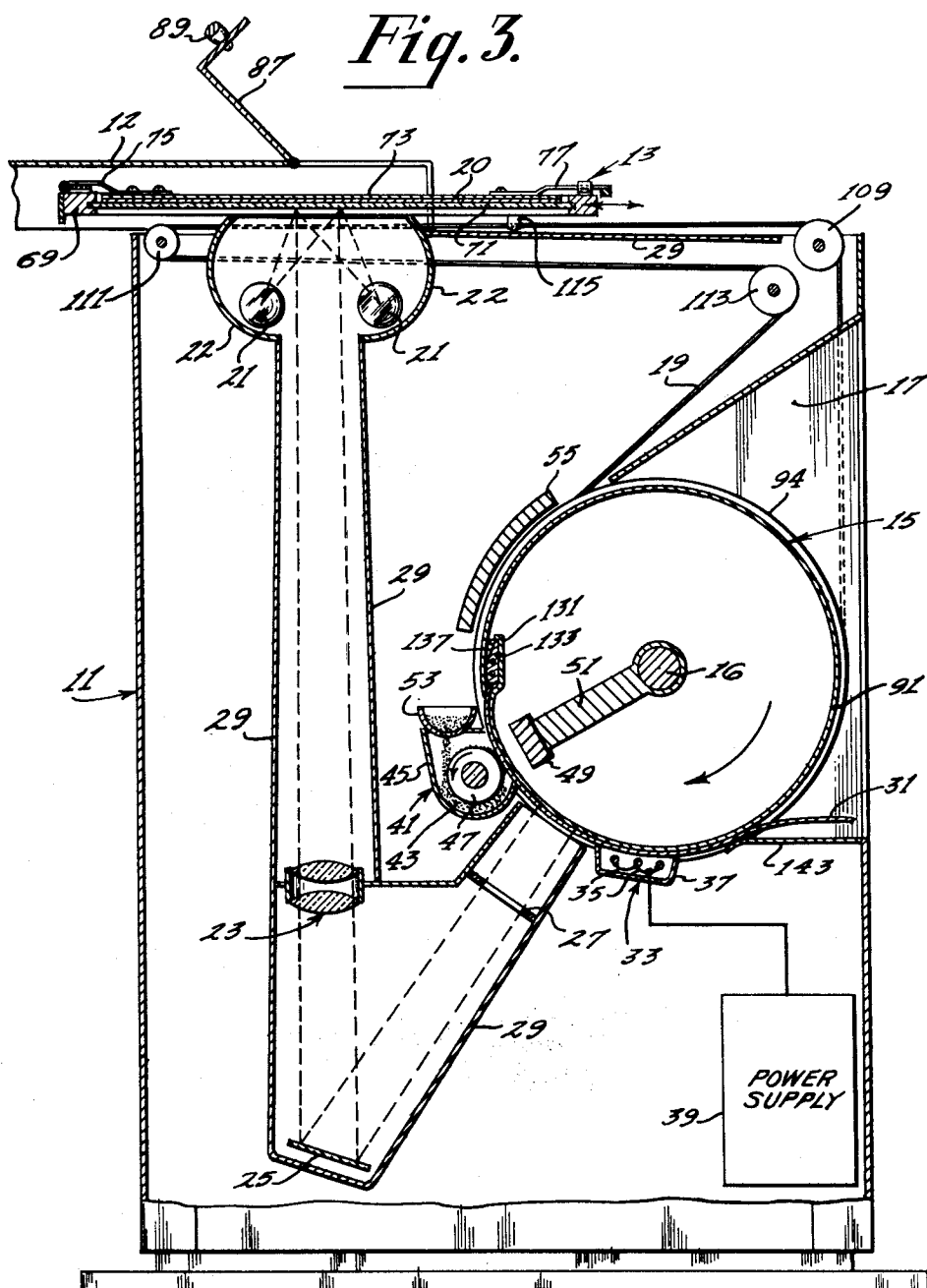
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K. J. MAGNUSSON
OFFICE COPYING MACHINE

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3 Sheets-Sheet 2



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OFFICE COPYING MACHINE

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3 Sheets-Sheet 3

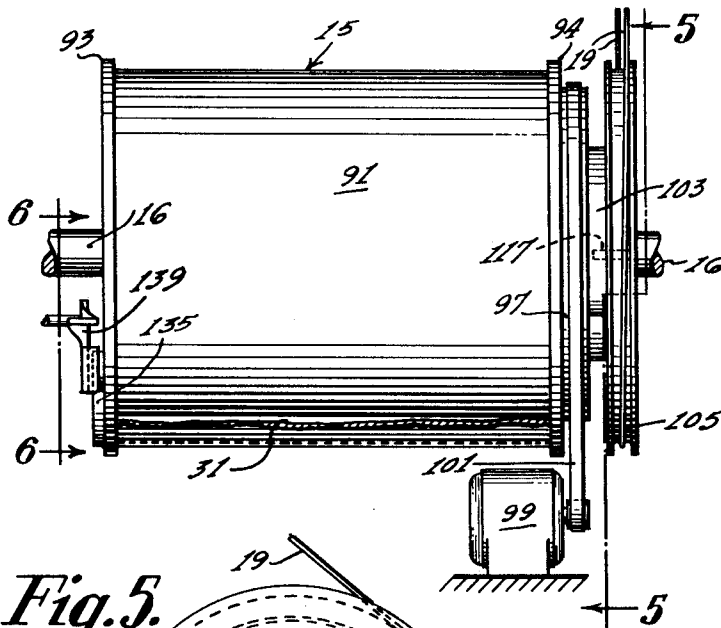


Fig. 4.

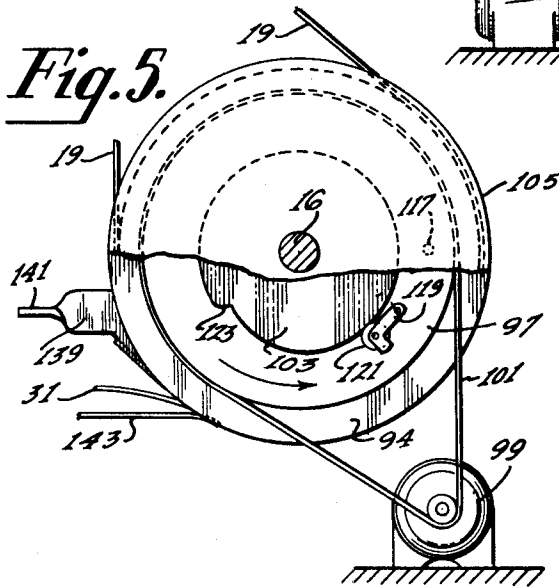


Fig. 5.

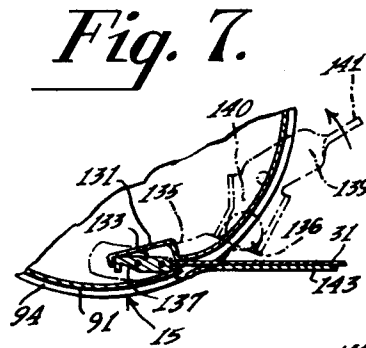


Fig. 7.

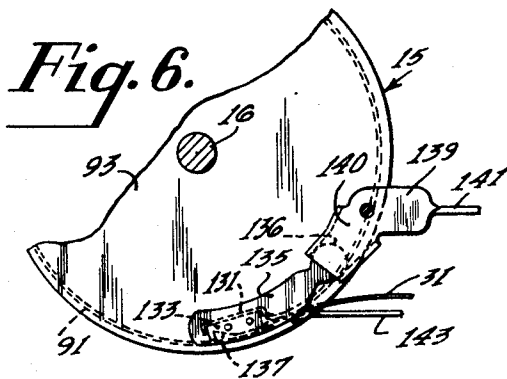


Fig. 6.



Fig. 8.

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2,959,095

OFFICE COPYING MACHINE

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4 Claims. (Cl. 88—24)

This invention relates to a copying machine, and more particularly to an improved office copying machine, of compact structure, for producing copies from subject sheets by an electrostatic printing process.

An object of this invention is to provide an improved office copying machine, of very compact structure, for producing copies of standard or legal size subject sheets.

A further object of this invention is to provide an office copying machine of compact structure having an extensible track for a reciprocable subject holder.

A still further object of this invention is to provide an office copying machine having a rotary drum copy holder including novel means for positioning and clamping a copy sheet in the drum.

A still further object of this invention is to provide an office copying machine having a rotary drum copy holder and a reciprocable subject holder and including novel means for synchronizing the movements of the two holders.

An office copying machine, embodying the invention, may be contained in a rectangular housing. As viewed from the top, the dimensions of the housing may be only slightly greater than the dimensions of the largest sheet to be copied. A rotary drum copy holder, mounted on a horizontal axis, faces an opening in the front wall of the housing. A traversing subject holder is mounted at the top of the housing to be reciprocated from the front to the rear of the housing. The subject holder is coupled to the drum so that it is automatically advanced, in one direction, in synchronism with the drum. An optical system causes light reflected from the subject holder to be projected onto the surface of the drum. The subject holder is mounted in a cover, for the housing, which is extensible to lengthen the path for the traversing subject holder.

Means are provided on the drum for clamping a copy sheet, such as a sheet treated so as to retain an electrostatic charge, to the drum and for automatically controlling the depth of insertion of the sheet into the clamping means. The clamping means may be controlled to select the depth to which a sheet is inserted. Means are positioned adjacent the periphery of the drum for providing a uniform electrostatic charge on the surface of the treated sheet clamped to the drum, for applying an electroscopic developer powder to the charged surface of the sheet, and for fusing the developer powder held to the sheet by the electrostatic charge.

The novel features of the invention, as well as additional objects and advantages thereof, will be understood more fully from the following description when read in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of an office copying machine embodying the present invention;

Figure 2 is a perspective view, partially broken away, of the top of the machine of Figure 1 showing the subject holder and its supporting mechanism;

Figure 3 is a sectional view, in side elevation, of the machine of Figure 1;

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Figure 4 is a view, in front elevation, of the rotary drum copy holder and associated mechanisms;

Figure 5 is a view, in end elevation, of the drive mechanism, taken along the line 5—5 of Figure 4 as viewed in the direction of the appended arrows; and

Figures 6, 7, and 8 are fragmentary end views of the drum, taken along the line 6—6 of Figure 4 as viewed in the direction of the appended arrows, illustrating the drum clamping mechanism.

The machine to be described, embodying the invention in illustrative form, is particularly adapted for use with an electrostatic printing process. In a typical electrostatic printing process, a record, such as a paper sheet having a photoconductive insulating layer on one surface, is provided with a uniform electrostatic charge. The charged surface is exposed to a light image, which bleeds the charge from portions of the surface, to form an electrostatic charge image. The light image may be formed from a photographic transparency or may be reflected from an opaque subject, for example. The charge image is made visible by applying a colored electroscopic developer powder to the surface. The powder adheres to the charged areas of the surface and may then be fused to the record to provide a permanent image.

Referring to Figures 1 and 2 of the drawing, a housing 11 for the office copying machine is rectangular in configuration. A cover 12 encloses the top of the housing and is movable rearwardly to overhang the housing 11. The cover 12 partially supports a reciprocable subject holder 13. An opening 17, in the front of the housing, exposes a rotary drum copy holder 15. A control panel 18 is mounted along one side of the opening 17.

Referring to Figure 3 of the drawing, the essential elements of the machine are shown in a preferred arrangement. The subject holder 13 is mounted for reciprocating movement across the top of the housing 11, from front to rear. The supporting means for the subject holder 13, to be described with reference to Figure 2, is not shown in Figure 3. The rotary drum copy holder 15 is mounted, for rotation about a fixed shaft 16, adjacent the opening 17. The subject holder 13 is coupled to the drum 15 by means of a cable 19 and is automatically advanced, in synchronism with the drum, through a mechanism to be described. Light, from a pair of lamps 21, is directed by elliptical reflectors 22 to a subject 20 supported in the subject holder 13. An optical system, for projecting the light reflected from the subject 20, includes a lens system 23, a mirror 25, and an optical slit 27. The reflected image is inverted in the optical system. The optical system is enclosed by light shields 29.

The subject 20, which may be a printed sheet or a photograph, for example, is supported in the subject holder by means to be described. One end of a copy sheet 31 is clamped to the external, cylindrical surface of the drum, by means to be described, and is carried around the drum as the drum rotates. The drum rotates in a clockwise direction, as viewed in Figure 3.

A corona charging device 33 is mounted at a station adjacent the periphery of the drum 15 beneath the drum. This device includes a plurality of spaced wires 35 which span the length of the drum and are enclosed in a shield 37 to direct the corona discharge toward the drum surface. The wires 35 are connected to a power supply 39 which impresses a high potential on the wires 35 with respect to the drum 15. The corona discharge from the wires 35 produces a uniform electrostatic charge on the coated surface of the copy sheet 31, which is the surface of the sheet facing away from the drum surface. The light, reflected from the subject, is projected onto

the copy sheet at an exposure station adjacent the charging device 33 in the direction of rotation of the drum.

Apparatus for depositing electroscopic developer powder is mounted at a station next adjacent the exposure station in the direction of rotation of the drum. The developer powder is mixed with magnetic carrier particles to form a magnetic developer mix 43 which is contained in a trough 45. The mixing of the developer and the magnetic particles imparts a charge to the developer particles which is of polarity opposite from the charge on the copy sheet. A rotary, magnetic member 47 is rotatably mounted in the trough 45 about an axis parallel to the axis of rotation to the drum. The trough 45 and the member 47 span the length of the drum 15.

A magnetic pole piece 49 is mounted within the drum, adjacent the cylindrical surface of the drum, and opposes the rotary member 47. The pole piece is supported by brackets 51 which are secured to the fixed shaft 16. The brackets 51 are permanently magnetized bars and the pole piece 49 acts as an extension of the magnets 51. The magnetic field from the pole piece 49 passes through the drum wall and through the portion of the rotary member 47 nearest the drum. The rotary member 47 rotates in a counter-clockwise direction, as viewed in Figure 2, and carries the developer mix 43 from the bottom of the trough into engagement with a copy sheet carried on the drum. The developer mix adheres to the rotary member 47 in the form of a brush or bristles. In the area of contact with the copy sheet, the magnetic field passing through the copy sheet is concentrated by the pole piece 49. This tends to stiffen the brush or bristles at the point of contact with the paper. The developer powder particles are attracted from the rotary member to the copy sheet, while the magnetic particles are retained on the rotary member. At the portion of the rotary member 47, farthest from the drum, the magnetic field is so weak that the mix falls from the rotary member into the trough. This provides for remixing of the mix particles. A reservoir 53, mounted over the trough 45, replenishes the supply of developer powder in the developer mix. The peripheral speed of the cylindrical member 47 is greater than that of the drum 15 to provide a relative motion between these members.

A fusing device 55 is mounted at a station next adjacent the developer apparatus 41 in the direction of rotation of the drum. The fusing device may comprise any suitable heating apparatus for softening either the developer powder or the coating on the copy sheet to cause the developer powder to permanently adhere to the sheet and thereby provide a fixed image.

Referring now particularly to Figure 2, the cover 12 defines a rectangular top portion for the housing 11 and encloses the subject holder 13. The cover is supported by a pair of rods or tracks 63 which extend from front to rear of the housing, on either side. On each side of the cover 12, two brackets 65 and 67 extend downwardly and are provided with bearings for slidably engaging the rods 63. The brackets 65 are mounted adjacent the front of the cover and the brackets 67 are mounted intermediate the front and back of the cover. With this arrangement, the cover may be moved rearwardly with respect to the housing so that a substantial portion of the cover overhangs the housing.

As shown in Figures 2 and 3, the subject holder 13, which is supported within the cover 12, includes a frame 69 supporting a transparent glass plate 71. A pressure plate 73 is secured to the rear of the frame 69 by resilient hinges 75 and to the front of the frame by a resilient latch member 77. The pressure plate 73 may then be raised, with respect to the frame, for the purpose of inserting or removing the subject sheet 20. The pressure plate may have a resilient facing to assure uniform contact of the sheet with the glass plate 71 when the pressure plate is latched.

The subject holder is supported, at its front end, on

a pair of rods or tracks 79 which extend from front to rear of the housing adjacent to the rods 63. Brackets 81, extending downwardly from the frame 69, are provided with bearings for slidably engaging the rods 79. The subject holder is supported, at its rear end, on a pair of rods or tracks 83, which extend from front to rear of the cover 12 adjacent to and parallel to the rods 63 and 79. Brackets 85, extending laterally from the frame 69, are provided with bearings for slidably engaging the rods 83. The rods 79 and 83 provide a track for the subject holder extending from the rear of the cover to the front of the housing.

A front portion 87 of the cover 12 is hinged so that it may be raised out of the way to permit access to the subject holder and to permit movement of the subject holder relative to the cover. The cover portion 87 includes a handle 89 for manually moving the cover with respect to the housing 11. It will be seen that when the cover is moved to its rearward limit, a track is provided for the subject holder which is substantially longer than the depth of the housing 11. When the machine is not in use, the cover is positioned directly over the housing and completely encloses the subject holder. The housing then presents a neat, closed appearance and the office copier occupies a minimum of space.

Referring now to Figures 3, 4, and 5, the copy holder drum 15 and the driving means for the drum and the subject holder 13 are shown in detail. The drum 15 is comprised of a cylindrical wall 91 supported by end plates 93 and 94. The plates 93 and 94 are rotatably supported on the fixed shaft 16. A pulley 97 is secured to the external face of the plate 94. The drum is driven by a motor 99 through a belt 101 which couples the pulley 97 to a motor pulley.

A cam 103, having a peripheral cam surface configuration as shown in Figure 5, is fixed to the shaft 16 adjacent the pulley 97. A pulley 105, rotatably mounted on the shaft 16 adjacent the cam 103, has a working diameter identical to the outer diameter of the drum surface. The subject holder 13 is advanced by the pulley 105 through the cable 19. Referring particularly to Figure 3, the cable 19 passes over the pulley 105 and idler pulleys 109, 111 and 113. The pulleys 109 and 111 define a horizontal run, for the cable, adjacent the path of the subject holder. The subject holder is secured to the cable by means of a clamp member 15 extending downwardly from the subject holder frame 69. Since the working diameter of the pulley 105 is equivalent to the diameter of the drum 15, the rate of advancement of the subject holder is identical to the linear speed of the peripheral drum surface. By this means, the rates of movement of the subject sheet and the copy sheet are synchronized.

A pin 117, fixed to the pulley 105, extends toward the drum pulley 97. Latch means such as a cam follower, in the form of an L-shaped dog 119, is pivotally mounted, at one end, on the drum pulley 97. A roller 121 is rotatably mounted on the dog 119 for engagement with the surface of the cam 103. The cam surface is cylindrical with the exception of a dip 123 provided at one portion of the surface. When the roller 121 is riding on the cylindrical portion of the cam surface, the dog 119 is positioned to engage the pin 117 whereby the cable pulley 105 is driven by the belt pulley 97. The configuration of the dog 119 is such that the load force, exerted by the pin 117 on the dog, urges or cams the dog against the cam surface. When the dog 119 rides into the dip 123, the dog becomes disengaged from the pin 117. The cam is oriented so that the dip 123 defines the limit of advance for the subject holder 13.

Referring now to Figures 4, 6, 7, and 8, a mechanism for clamping a copy sheet to the drum will be described. An opening, parallel to the axis of rotation of the drum, is formed in the drum wall 91 by an overlapping of the end portions of the drum wall 91. The outer end of

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the drum wall is rigidly positioned by the end plates 93 and 94. The inner end of the drum wall is unsupported and may be deflected inwardly. The inner end of the wall is made of a resilient material which is biased outwardly to engage the outer end in clamping relationship.

The inner end portion is formed in the shape of a channel 131 which faces the external end and extends across the drum. The channel 131 and the external end define a substantially closed rectangular chamber, as viewed from an end of the drum.

A substantially rectangular bar 133, having dimensions smaller than the dimensions of the above mentioned rectangular chamber, is disposed in the chamber and is rotatably supported in the end plates 93 and 94. An arcuate lever 135 is fixed, at one end, to one end of the bar 133 and lies adjacent the outer face of the end plate 93. The lever 135 lies adjacent the periphery of the end plate 93 and is contoured to correspond with the contour of the plate periphery.

The normal position of the bar 133 and the lever 135 is shown in Figure 6. In this position, the ends of the drum wall 191 are in clamping relation and the bar lies relatively loosely in the chamber defined by the channel 131. The lever 135 is aligned with the periphery of the end plate 93.

Referring now to Figures 7 and 8, it will be seen that if the bar 133 is rotated in either direction from its normal position, the chamber is expanded and the internal end of the drum wall is deflected away from the external end. This, then, opens the drum wall to permit the insertion or removal of a copy sheet. Referring to Figure 7, the bar 133 is rotated in a clockwise direction. In this position, the edge of the bar, nearer the opening, defines a limit to which a copy sheet may be inserted. In this case, only a small margin of the copy sheet is clamped in the drum providing a maximum sheet area for the purpose of printing. Referring to Figure 8, the bar is rotated in a counter-clockwise direction. In this position, a groove 137 in the bar, which is now positioned adjacent the outer end of the drum wall, defines a limit to which a copy sheet may be inserted. In this case, a wider margin of the copy sheet is clamped in the drum. The deep setting may be desirable, for example, for use with Multilith masters which have a relatively wide margin unavailable for printed matter.

The lever 135 is controlled by means of a control lever 139 which is pivotally mounted, intermediate its ends, on the machine frame (not shown) adjacent the end plate 93. The control lever 139 includes a channel portion 140 at one end, through which the arcuate lever 135 passes as it is carried by the drum 15, and an operating finger 141 at the other end. The operating finger extends outwardly from the front of the housing adjacent the control panel 18 (see Figure 1). In the index position of the drum, a substantially circular end portion 136 of the arcuate lever 135, opposite from the point of attachment of the bar 131, is positioned within the channel portion 140 of the control lever. When the control lever is then manually rotated about its pivot point, in one direction or the other, it, correspondingly, rotates the arcuate lever 135 in one direction or the other to place the rectangular bar 133 in one or the other of the above described positions. A copy sheet may then be inserted into the drum. A guide member 143, which forms the lower wall of the opening 17, is positioned to guide the copy sheet into the drum opening.

In operation, the hinged portion 87 of the cover 12 is raised to permit movement of the cover to its rearward limit as shown in Figure 2. This exposes the subject holder 13. The pressure plate 73, of the subject holder, is then raised by releasing the latch member 77 so that a subject sheet 20 may be placed in the subject holder. The subject sheet is placed face down on the glass plate 71 with the top of the sheet toward the front of the sub-

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ject holder. The subject holder is then pushed back manually to its rearward limit, which is the start position.

The copy holder drum is in its index position, indicated in Figures 6, 7, and 8, wherein the circular end of the lever 135 is positioned within the channel portion of the lever 139 and wherein the drum opening is positioned adjacent the guide member 143. The control lever finger 141 may then be deflected in either direction, to select the clamping depth for a copy sheet 31, and the leading edge of the sheet is inserted in the drum opening. The photoconductive surface of the sheet is positioned away from the drum. The control finger 141 is then released, returning to its normal position as the copy sheet is clamped within the drum opening.

The machine is then operated by pressing a start button which causes the motor 99 to drive the drum through one revolution. The drum is automatically stopped (by means not shown) when it returns to its index position. The drum carries the copy sheet, first, past the charging station where a uniform electrostatic charge is provided on the exposed surface of the sheet. The electrostatic charge acts to hold the sheet tightly to the drum so that it does not slip during subsequent operations. The sheet is next carried to the exposure station. As the leading edge of the sheet approaches the exposure station, the dog 119, which is rotating with the drum, engages the pin 117 on the pulley 105. The subject holder 13 now begins to advance toward the front of the machine at a linear speed identical to the linear speed of the copy sheet on the drum. Simultaneous with the beginning of advance of the subject holder, the projection lamps 21 are energized. The lamps may be controlled by micro-switches actuated by a projection on the drum (not shown), for example, or by any other known means.

As the subject holder and the copy holder now continue to advance together, the subject sheet 20 is scanned by a slit of light from the lamps 21 and the light image reflected from the subject sheet is projected onto the copy sheet through the lens system 23 and the optical slit 27, which accurately defines the slit of light projected onto the copy sheet. The optical system inverts the light image so that it is right-reading on the copy sheet. The electrostatic charge on the copy sheet is bled off in proportion of the amount of light striking the copy sheet. In this manner, a latent electrostatic charge image is formed on the copy sheet which is identical to the subject sheet.

The copy sheet is next carried past the developer station where the rotary member 47, which may also be driven by the motor 99, carries the developer mix 43 into engagement with the copy sheet. The developer powder, having a charge opposite to that of the copy sheet, is attracted from the developer mix to the copy sheet in proportion to the charge now existing on the copy sheet. The developer powder is colored so that the latent electrostatic charge image now becomes a visible image. The reservoir 53, which may be agitated by known means, replenishes the supply of developer powder to the developer mix in the trough 45.

The copy sheet is next carried past the fusing station 55 wherein the surface of the copy sheet is heated to soften thermoplastic portions of the developer powder or the copy sheet coating to permanently fuse the developer powder to the copy sheet. In this manner, the visible image is made permanent.

After the trailing edge of the copy sheet has been carried past the exposure station, the lamps 21 may be turned off by the means described above. At this time, the dog 119 has been carried to the point where it rides into the dip 123 of the cam 103. When this occurs, the dog is released from its engagement with the pin 117 and the subject holder is not advanced further, having reached its forward position. The drum continues to rotate until it reaches its index position wherein the copy

sheet may then be manually removed by again moving the control finger 141 in the desired direction.

A machine, as described in the foregoing specification, has been constructed for reproducing original size copies of standard and legal size sheets. The overall dimensions of this machine, with the cover in the closed position, are height 26 inches, width 15 inches and depth 18 inches. With respect to the small size of the machine, a feature of the machine is the mounting means for the subject holder wherein a traverse path for the holder is substantially longer than the depth dimension of the machine. Another feature of the machine is the coupling mechanism whereby the subject holder is advanced only during the desired portion of each cycle of the copy drum and whereby the movement of the subject holder is perfectly synchronized with the copy drum so that any irregularities in the drum rotation are accurately duplicated in the subject holder. A sharp image is therefore assured, even though a low cost and a not very steady drum drive is used. A further feature of the machine is the drum clamping means wherein a copy sheet may be inserted to two predetermined depths which are readily selective by the operator. Further features are the ease of operation and the clean appearance of the machine housing, which are desirable features in office equipment.

What is claimed is:

1. In a copying machine including a linearly movable subject holder for supporting a subject to be copied, a rotatable copy holder drum, and means for reflecting light from said subject to said drum, apparatus comprising: means for cyclically imparting rotation to said drum, a rotary member associated in axial alignment with said drum and having a working diameter substantially equal to that of said drum, a clutch mechanism associated with said drum and said rotary member and adapted to couple said rotary member to said drum to provide coincident rotation thereof after said drum has rotated a first predetermined distance and adapted to uncouple said rotary member from said drum after an additional predetermined rotation, a flexible endless member adapted to be driven by said rotary member and having a portion thereof coupled to said movable subject holder, said endless member being thereby adapted to impart linear motion to said subject holder and to synchronize the linear speed of said subject holder with the peripheral speed of said drum.

2. In a copying machine including a linearly movable subject holder for supporting subject matter to be copied, a rotatable copy holder drum, and means for reflecting light from said subject matter to said drum; apparatus comprising: means for cyclically driving said drum, a rotary member axially aligned with and adjacent to said drum and freely rotatable with respect to said drum, latch means mounted on said drum between said drum and said rotary member, latch engaging means mounted on said rotary member, said latch means and said engaging means being so positioned as to engage one with the other a predetermined time after initiation of a drum rotation cycle, and a stationary cam member mounted between said drum and said rotary member adapted to disengage said latch means from said latch engaging means after a predetermined coincident rotation of said drum and said rotary member, a flexible endless member adapted to be driven by said rotary member and having a portion thereof coupled to said movable subject holder, said

endless member being thereby adapted to impart linear motion to said subject holder and to synchronize the linear speed of said subject holder with the peripheral speed of said drum.

3. In a copying machine including a linearly movable subject holder for supporting subject matter to be copied, a rotatable copy holder drum, and means for reflecting light from said subject matter to said drum; apparatus comprising: a first pulley on said drum for cyclically applying rotational motion thereto, a second pulley adjacent to and in axial alignment with said drum and said first pulley, said second pulley being mounted to rotate independently of said first pulley and having a working diameter substantially equal to the working diameter of said drum, an endless cable coupling said second pulley to said subject holder, a portion of said cable defining a linear path parallel to said subject holder, latch means mounted on said first pulley, latch engaging means mounted on said second pulley, said latch means and said latch engaging means being so positioned as to engage one with the other a predetermined time after initiation of a drum rotation cycle, and a stationary cam member mounted between said pulleys adapted to disengage said latch means from said latch engaging means after a predetermined coincident rotation of said pulleys.

4. In a copying machine including a linearly movable subject holder for supporting subject matter to be copied, a rotatable copy holder drum, and means for reflecting light from said subject matter to said drum; apparatus comprising: a first pulley on said drum for cyclically applying rotational motion thereto, a second pulley adjacent to and in axial alignment with said drum and said first pulley, said second pulley being mounted to rotate independently of said first pulley and having a working diameter substantially equal to that of said drum, an endless cable coupling said second pulley to said subject holder, a portion of said cable defining a linear path parallel to said subject holder, a pin mounted on said second pulley and extending toward said first pulley, a cam follower mounted on said first pulley and adapted to engage said pin, said cam follower and said pin being so positioned as to engage one with the other a predetermined time after initiation of a drum rotation cycle, and a stationary cam member mounted between said pulleys adapted to disengage said cam follower from said pin after a predetermined coincident rotation of said pulleys.

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