Feb. 11, 1964 D. V. BAGLOW ETAL 3,120,793

PHOTO COPYING MACHINES

Filed June 11, 1959 4 Sheets-Sheet 1

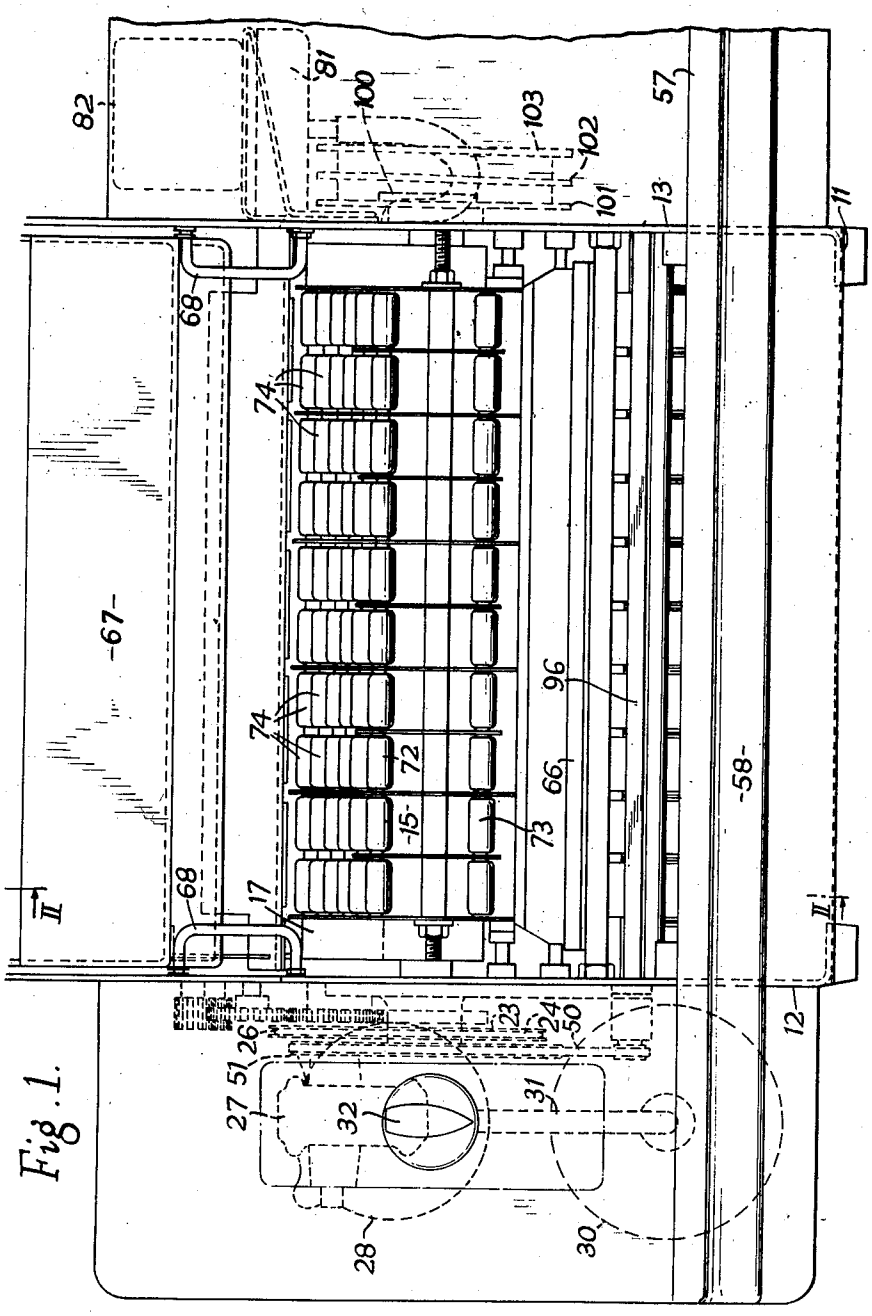


Fig. 1.

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Filed June 11, 1959 4 Sheets-Sheet 2

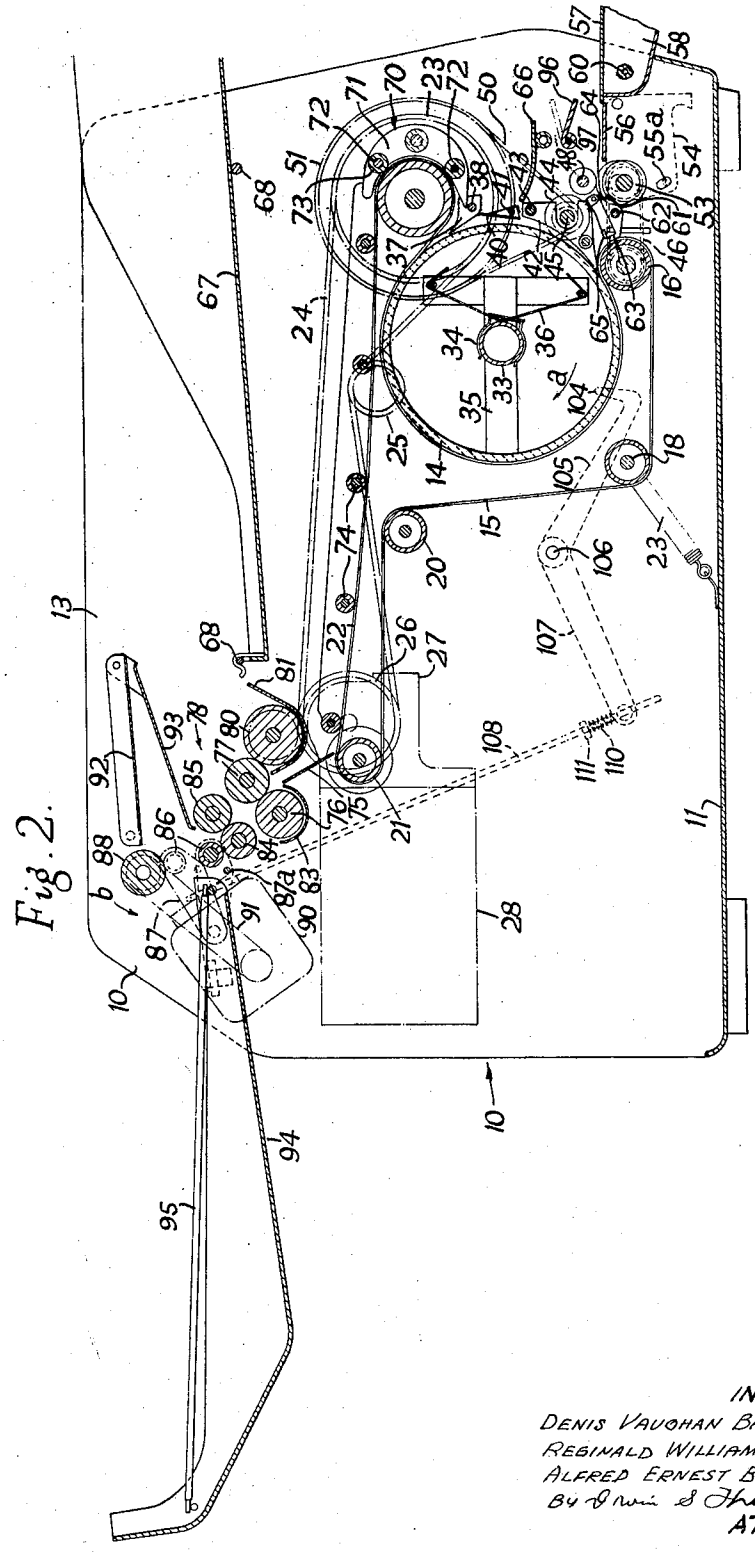


Fig. 2.

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Filed June 11, 1959 4 Sheets-Sheet 3

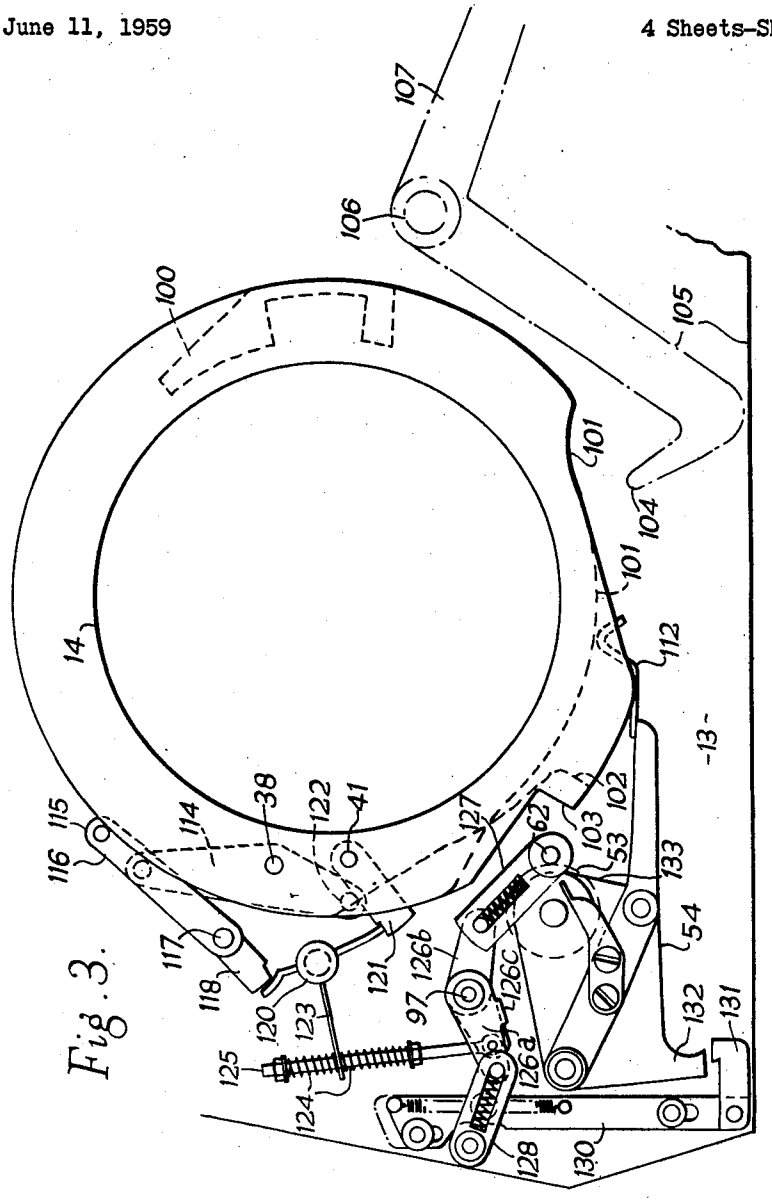


Fig. 3.

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Filed June 11, 1959 4 Sheets-Sheet 4

Fig. 5.

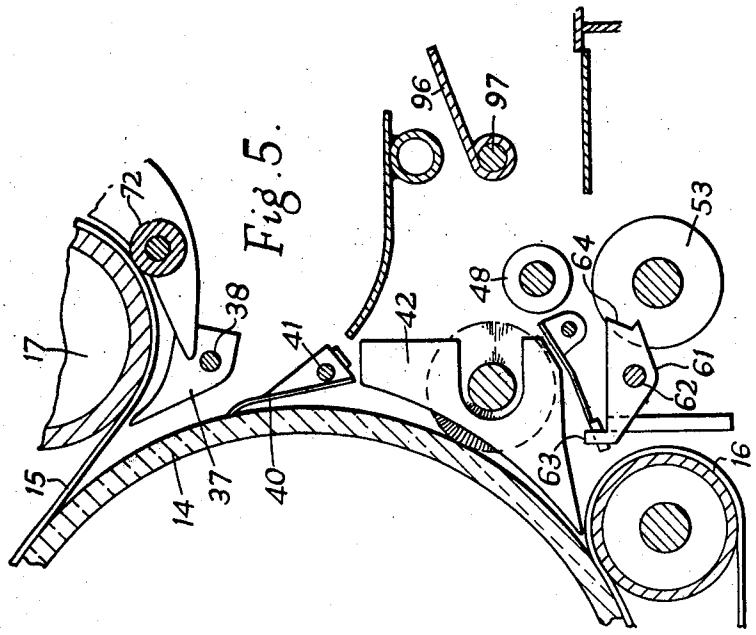
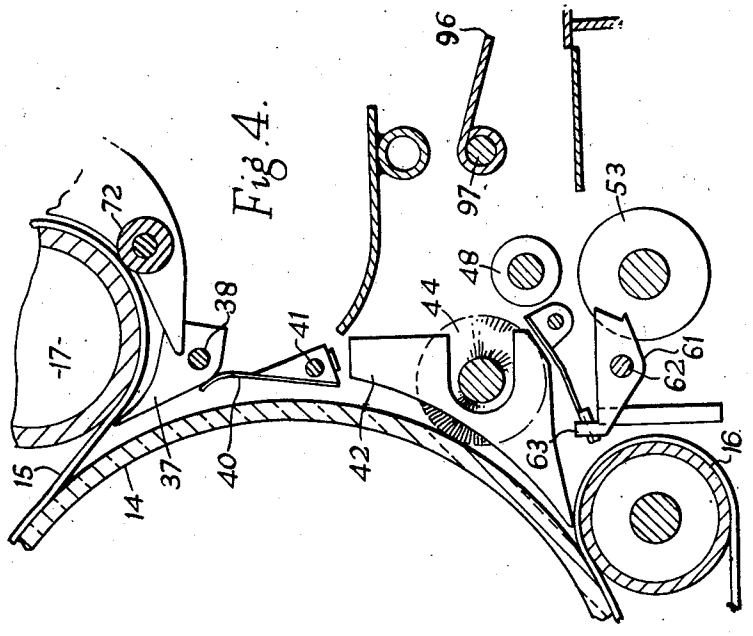


Fig. 4.



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United States Patent Office

3,120,793
Patented Feb. 11, 1964

3,120,793

PHOTO COPYING MACHINES

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Filed June 11, 1959, Ser. No. 819,760
Claims priority, application Great Britain June 16, 1958
13 Claims. (Cl. 95—77.5)

This invention relates to photo copying machines, more particularly to machines of relatively small size and particularly adapted for office and like use. A particular application of the invention is to the provision of a photo copying machine employing the diazotype process and suitable for production and control system work in offices and factories and in which a plurality of copies is required to be taken from a given master, certain of such copies being of the whole of the image carried by the master and others being of only a part of such master image.

According to one aspect of this invention, a photo copying machine comprises means for conveying a master image-bearing sheet around an endless movement path with its leading edge in a predetermined leading positional relationship to a superimposed copy sheet which is conveyed around a part only of said movement path, and means operated in timed relationship to the movement of said master, for selectively engaging and deflecting only said copy sheet from said movement path so as to remove it from said master sheet and for replacing it with a further copy sheet occupying the same relative position on said master sheet as that of said first copy sheet.

According to another aspect of the invention, a photo copying machine comprises a rotatable transparent cylinder surrounding a stationary light source, one or more endless loop-form feed belts arranged to overlie and embrace said cylinder over an angle which is less than 360° thereby to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belt or belts to be conveyed around a circular path about said light source without any positive intercoupling of said master sheet or copy sheet to said cylinder or said belt or belts, and controllable guide means for constraining said master sheet to conjoint movement with said cylinder over that region which is not embraced by said belt or belts while deflecting the overlying copy sheet away from said cylinder and master sheet through the gap produced by said unembraced region.

In order that the nature of the invention may be more readily understood, one constructional embodiment thereof will now be described by way of illustrative example and with reference to the accompanying drawings in which:

FIGURE 1 is a front elevational view, with certain parts removed, of one form of photo copying machine according to the invention.

FIGURE 2 forms a longitudinal sectional view taken approximately on the line II—II of FIG. 1.

FIGURE 3 is an enlarged scale detail view of the principal control cams and associated members, while FIGURES 4 and 5 are fragmentary sectional views similar to part of FIG. 2 illustrating different relative

positions of certain members under different operating conditions.

Referring to the drawings, the machine shown comprises a suitable rigid framework and casing 10 of box-like form and including a base plate 11 and opposing vertical left and right hand side plates 12, 13 respectively. Within the casing 10 and extending horizontally between the side plates 12, 13 is disposed a cylinder 14 of transparent material, such as glass, said cylinder being mounted for free rotation about its axis by means of suitable bearing arrangements carried in the opposing side plates 12, 13. A plurality of axially spaced endless belts 15, conveniently of composite rubber/fabric construction, is arranged to contact with and embrace the outer surface of the cylinder 14 over some 270° arc, said belts at the points of entering into contact with and of disengaging from said cylinder being supported respectively by their passage around horizontal rollers 16 and 17 which are also suitably journalled in the opposing side frame plates 12, 13 at positions lying towards the front of the machine. Each belt loop is completed to the rear of the cylinder 14 by passage of the belts, first around a further horizontal roller 18, then over another horizontal roller 20 and finally around a rearward horizontal roller 21 before returning along an uppermost stretch 22 to the roller 17.

The rollers 20 and 21 are supported in fixed positions within the side plates 12, 13 but the roller 18 is mounted for movement bodily away from the cylinder 14 under the influence of tension springs 23 for the purpose of maintaining the belts in a state of constant tension.

The cylinder 14 is arranged for continuous rotation in the direction of arrow *a*, FIG. 2, by means of the aforesaid belts 15 and for this purpose the shaft supporting the roller 17 has secured thereto a chain sprocket 23 engaged by an endless chain 24 which passes over an idler sprocket 25 and a driving sprocket 26 secured to the output shaft of a speed reducing gearbox 27 secured to and driven by an electric motor 28 mounted on the outside of the side plate 12. The speed of this motor is adjustable as by means of a variable resistance 30, FIG. 1, having its control shaft 31 extended forwardly to the front of the casing 10 for reception thereon of an exposure-time control knob 32.

Passing axially through the centre of the rotating cylinder 14 is a stationary light source in the form of a tubular mercury-vapour discharge lamp 33 supported at its opposite ends in clips 34 mounted on frame members 35 secured to the adjacent side plates 12, 13 of the casing 10. Such lamp is continuously energised at constant intensity; variation of the exposure time being by control of the speed of rotation of the cylinder 14 and hence of the time required for the passage of a master sheet with an overlying copy sheet around the arc of the cylinder surface which is embraced by the belts 15. A reflector plate 36 within the cylinder 14 operates to concentrate the available light on to the useful region of the cylinder path.

It is a feature of the invention that the rotating cylinder 14 is not provided with any means, such as a fixing clip, for positively connecting the master sheet or the copy sheet thereto during its revolution. Conveyance of the master and the copy sheet is ensured solely by the pressure of the aforesaid plurality of belts 15. Addi-

tional means are provided for guiding the master sheet and maintaining it in intimate contact with the surface of the cylinder 14 over the arcuate gap which is formed between the uppermost sheet discharge point where the belts 15 leave the cylinder 14 to pass around roller 17 and the lower sheet entry point where such belts 15 again enter into contact with the cylinder 14 after leaving roller 16. Such guiding means comprise a first rockable guide and separator member 37 in the form of a transversely disposed series of spaced and shaped metal plates or an equivalent metal bar secured to a horizontal spindle 38 rotatable in the side plates 12, 13 and disposed just below the discharge point, a second similar guide and stripper member 40 in the form of a transversely directed metal blade secured to a horizontal spindle 41 also rotatable in the side plates 12, 13 and disposed just below the first member 37 and a further guide member in the form of a plurality of spaced vertical sheet metal guide plates 42 having rearward edges of arcuate shape held in fixed position on tie rods 43 with a small radial clearance from the surface of the cylinder 14 between the member 40 and the sheet entry point. In addition, at a position a little above the sheet entry point, there is provided a horizontal rotating brush roller 44 extending along the length of the cylinder with its bristles lightly contacting the outer surface thereof. This brush comprises a plurality of separate bristle sections located between the different guide plates 42 and is secured to a shaft 45 journalled in the side plates 12, 13. This shaft is arranged to be driven continuously by means of a belt 50 passing around a pulley on the shaft and around a pulley 51 also secured to and rotated in unison with the roller 17. The brush roller 44 is so driven that its peripheral region is moving in the same direction as but appreciably faster than the adjacent surface of the cylinder 14 thereby to execute a continuous smoothing and tautening action upon the leading edge of the master sheet as it is delivered from the upper or sheet discharge point for reinsertion at the lower or sheet entry point.

Associated with the mechanism already described is sheet feeding mechanism in the form of a first horizontal feed roller 48 freely rotatable in fixed position in the side plates 12, 13 and a second lower feed roller 53 which is arranged to be rotated continuously in anticlockwise direction, FIG. 2, by means of a belt drive 46 from the shaft of roller 16. This lower roller is carried at each end in rocking plates 54 rigidly interconnected by a transverse tie rod 55*a* and each pivotally mounted on the respective side plates 12, 13 at 55. As described later, this lower feed roller 53 is arranged to be raised in timed manner once during each revolution of the cylinder 14 whereby any sheet previously placed between the rollers while separated, is gripped and propelled into the sheet entry point between the cylinder 14 and the belts 15. The presentation of such sheets is facilitated by a horizontal fixed transverse plate 56 secured between the side plates 12, 13 and forming a rearward extension of a feed table 57 constituted by the inner surface of a hinged front cover member 58 pivoted at 60 in the side plates 12, 13. Such feed table may be provided with one or more adjustable position side lays for accurately positioning sheets therein. A master sheet delivery guide plate 66 extends transversely across the front of the machine just below the level of the second guide and stripper member 40.

Between said sheet feed rollers 48, 53 and the sheet entry point is arranged adjustable lay stop means consisting of a plurality of spaced rocking lever arms 61 carried upon a horizontal shaft 62 also journalled in the side plates 12, 13. The inward end of each of these lever arms 61 is provided with an upstanding abutment 63 adapted to engage and stop, at a first lay position of such arms 61 (FIG. 5), any sheet which is presented from the feed table 57 through the open nip between the

feed rollers 48, 53. The opposite, outward end of each of said lever arms 61 is shaped to provide, when the lever arms are moved to their opposite or second lay position (FIG. 2), a further sheet stop abutment surface 64 providing a second, less advanced, lay stop position. These rocking lever arms 61 are arranged to be controlled in a manner which will be described in detail later. A sheet retaining member 65 pivotally mounted on a transverse spindle rests by gravity upon the upper surface of each presented sheet to ensure its even and flat presentation at the entry point.

Above the transverse feed plate 56 and extending transversely across the full width of the machine between the side plates 12, 13, is an operating bar 96 connected to a rock shaft 97 mounted for rotation in such side plates. This operating bar 96 is movable between a depressed or "copy" position as shown in full lines in FIG. 2 and a raised "master change" position as shown in chain dotted lines in such figure. The operation of this bar will be described later.

The upper region of the casing 10 is open to receive therein a delivery tray 67 which, in the operative position as shown in FIG. 2, rests upon transverse support bars 68. This tray, however, is arranged to be reversible whereby it can form an upper closure wall for the casing 10 when the machine is out of use.

For the purpose of maintaining copy sheets discharged from the cylinder 14 in contact with the surface of the belts 15, additional copy sheet guiding means 70 are provided. This takes the form of a plurality of spaced vertical metal plates 71 carried upon transverse tie rods 72 each provided with a series of spacing rollers 73 which lightly bear upon the surface of the belts 15 or on the copy sheets carried thereby. The inner, rearward facing, edges of the plates 71 are of arcuate shape as shown in FIG. 2 to have a small clearance only from the belts 15. The whole structure of plates 71, tie rods 72 and rollers 73 is preferably resiliently mounted so as to be urged continuously towards the roller 17.

Located at spaced intervals along the upper stretch 22 of the belts 15 are disposed further transverse guide rollers 74 in contact with the belt surfaces and serving to maintain each discharged copy sheet in driving contact with the belts up to a deflector plate 75 leading upwardly to the nip between two parallel transverse rollers 76, 77 forming part of a developer section 78. This developer section includes a further roller 80, the rollers 76 and 80 being partially immersed in interconnected liquid troughs 81, 83 containing developer fluid supplied from a tank 82 removably secured to the outside of the side plate 13.

Above the discharge side of the rollers 76, 77 is disposed a further pair of contacting conveyor rollers 84, 85. These rollers, together with those of the developer section, are driven at a peripheral surface speed relating to that of the belts 15 by direct geared interconnection with the output shaft of the gearbox 27.

Immediately above the conveyor roller 84 is disposed a further transverse roller 86 journalled at each end in rocker arms 87 which are pivotally mounted one on each side plate 12, 13 and rigidly interconnected by a transverse tie bar 87*a* for effecting movement of the roller 86 bodily between the lower position shown in full lines in FIG. 2 and that shown in dotted lines where the said roller engages with a further roller 88 which is journalled in fixed position in the side plates 12, 13 and is arranged to be continuously rotated at relatively high speed in the direction of arrow *b*, FIG. 2, by a further small electric motor 90 through a belt drive 91.

Somewhat forward of the rollers 86, 88 which jointly form a sheet transfer means, are disposed two transversely directed and forwardly convergent sheet metal plates 92, 93. The low plate 93 is hingedly connected to the upper plate 92 at its right hand end and the upper plate 92 is itself pivotally connected to the side plates 12, 13 to permit

separation of the plates for cleaning purposes. Behind the movable roller 86 is disposed a sheet transfer tray 94. This tray 94 is made readily removable and is so shaped that it forms a rear closure wall for the casing 10 when the machine is out of use.

The control mechanism for the various cyclically operating elements will now be described with reference, more particularly, to FIG. 3.

Secured to the right hand end of the cylinder 14 for rotation in unison therewith is a series of cam members 100, 101, 102 and 103.

The cam member 100 co-operates with the nose end 104 of an arm 105 of a bell crank lever secured upon a stub shaft 106 journalled in the side plate 13. The other arm 107 of such bell crank lever (see FIG. 2) carries a lug at its free end in slidable connection with an operating rod 108 which is connected at its uppermost end to the associated rocker arm 87. Such rod carries a helical spring 110 trapped between the lug on the lever and a fixed position abutment 111. As the cylinder 14 rotates, at an appropriate instant during each revolution the cam member 100 depresses the lever arm 105 to raise the lever arm 107 and rocker arms 87 thereby raising the transfer roller 86 into resilient contact with the continuously rotating roller 88.

The cam member 101, FIG. 3, co-operates with a follower nose 112 rigidly secured to the adjacent rocking plate 54 supporting the lower sheet feed roller 53 (FIG. 2). This plate is spring biased by means not shown in an anticlockwise direction (FIG. 3) whereby such sheet feed roller is normally held by the cam member 101 in its lowered position but is periodically raised, once in each revolution of the cylinder 14, into engagement with the upper feed roller 48.

The cam member 102 co-operates with a follower pin 113 carried by the free end of lever arm 114 which is rigidly secured to the spindle 38 of the first guide and separator member 37. The lever arm is biased by spring means, not shown, in a clockwise direction, FIG. 3, whereby the separator member 37, normally in the position shown in FIG. 2, is periodicaly moved, once in each revolution of the cylinder 14 to the position shown in FIG. 5.

The cam member 103 co-operates with a follower pin 115 carried by an interlock lever arm 116 pivoted at 117 on the adjacent side plate 13. The opposite end of this arm 116 carries a nose 118 co-operating with an escapement pawl 120 pivotally mounted at its centre point on the adjacent side plate 13. The opposite lower end of the pawl co-operates with an arm 121 rigidly secured to the spindle 41 of the second guide and stripper member 40 (FIG. 2). This spindle 41 is spring loaded by means not shown to rotate in clockwise direction, FIG. 3. The lower end of arm 114 carries a lug 122 which engages and moves the arm 121 in anti-clockwise direction.

The escapement pawl 120 is provided with an intermediate arm 123 whose free end is located between two opposing compression springs 124 carried upon a link rod 125 connected at its lower end to a two-armed lever 126*b* which is freely rotatable on the rock shaft 97 of the operating bar 96 (FIG. 2). The right hand end (FIG. 3) of lever 126*b* is connected by a toggle or over-centre coupling to arm 127 rigidly secured to the shaft 62 carrying the lay stop rocker arms 61 (FIG. 2). The left hand end of the same lever 126*b* co-operates with a lug 126*c* carried by a further lever arm 126*a* rigidly secured on rock shaft 97. This further arm 126*a* is connected by an over-centre coupling to a compound lever 128 which is coupled by means of a balanced spring structure, similar to that of 124, to a vertically slidable lock bar 130. This lock bar has a hook 131 at its lower end for engagement with a mating hook piece 132 on the adjacent rocking plate 54 carrying the movable lower feed roller 53 (FIG. 2). Such rocking plate also carries a kick plate 133 which engages the arm 127.

The manner of operation of the machine under different conditions will now be briefly described.

Upon supply of current to the driving motor 28, the conveyor belts 15 and the cylinder 14 will be continuously driven at a speed determined by the setting of the exposure-time control knob 32.

Initially the operating bar 96 is raised to prepare for the insertion of a master sheet laid upon feed table 57 and plate 56. The resultant rotation of rock shaft 97 in clockwise direction, FIG. 3, rotates attached lever 126*a* and through coupling lug 126*c* thereon, also rotates lever 126*b* which rocks arm 127 and thereby moves shaft 62 anti-clockwise. This rocks the attached lay stop rocker arms 61, FIG. 2, to the position shown in FIGS. 4 and 5 whereby the inward abutments 63 are raised and the forward abutment surfaces 64 are lowered. The master sheet can, therefore, now be presented to engage such rearward abutments 63 provided the sheet feed rollers 48 and 53 are separated. Simultaneously, the rocking of the lever 126*a* moves compound lever 128 upwardly to stress the spring coupling and thereby to urge lock bar 130 upwardly. At some time during the rotation of the cylinder 14, the cam member 101 operates on the follower nose 112 to lower the rocking plate 54 and the lower feed roller 53 and when this occurs the hook end 131 on bar 130 locks behind the hook piece 132 on the plate 54. The lower feed roller 53 is now locked in its lowered position and is out of control of the associated cam member 101.

After presentation of the master sheet, the operating bar 96 is then depressed. This returns shaft 97 and lever arm 126*a* anticlockwise, FIG. 3, and thereby moves lever 128 downwards to bias the lock bar 130 downwards also. Such lock bar 130 will only disengage its hook 131 from hook piece 132 on plate 54 when cam 101 causes lower feed roller 53 to be fully lowered. When this occurs, plate 54 is freed for timed control by cam 101 and at the appropriate instant during following rotation of the cylinder 14, such lower feed roller 53 is raised to press the presented master sheet against the upper sheet feed roller 48 thereby to propel the master sheet, which has been placed between such rollers, to the sheet entry point where its leading edge is gripped between the surface of the cylinder 14 and the conveyor belts 15. This rocking of the plate 54 causes the kick plate 133 to engage arm 127 thereby rocking shaft 62 clockwise, FIG. 3, to restore the lay stop rocker arms 61 to the position shown in FIG. 2. Thereafter the master sheet is fed on to the surface of the cylinder and rotates in unison therewith with its leading edge accurately located at a predetermined position relative to the various operating points of the associated cam members which are secured to such cylinder.

The resultant rocking of lever arm 126*b* upon return of arm 127 causes the upper spring 124 on link rod 125 to be compressed, thereby to bias the escapement pawl 120 for rotation in an anticlockwise direction, FIG. 3. At an appropriate instant during further rotation of the cylinder 14, coincident with the arrival of the leading edge of the master sheet at the sheet discharge point adjacent roller 17, the cam member 102 engages the follower pin 113 on lever arm 114 and thereby rocks spindle 38 momentarily to lift the upper ends of the first guide and separator members 37 away from the surface of the cylinder 14, FIGS. 4 and 5. This allows the leading edge of the master sheet to continue to travel around with the cylinder. Simultaneously the lug 122 on lever 114, FIG. 3, engages and moves the arm 121 and thereby rocks spindle 41 anticlockwise, FIG. 3. This rocks the second guide and stripper member 40 away from the cylinder 14, FIGS. 2 and 4 and, thereafter, this deflected position is maintained by engagement of the lower arm of the already biased escapement pawl 120 on top of the lever arm 121.

The master sheet thereafter continues to travel with

the cylinder 14 until its leading edge is engaged by the rapidly rotating brush roller 44 which operates to pull the master sheet tightly on to the cylinder surface and represent it at the entry point.

In the meantime, a copy sheet presented on the feed table 57 is registered against the now-raised forward abutment surfaces 64 of the lay stop arms 61 and as the master sheet re-enters the entry point, the lower feed roller 53 is again raised by the action of the cam 101 to cause the registered copy sheet also to be fed to the entry point but with its leading edge displaced behind that of the master sheet by the difference of spacing distance between the abutments 63 and 64. Thereafter the copy sheet proceeds to be drawn in overlying relationship to the master sheet and to travel with the latter around the circular path of cylinder rotation while being exposed to the light from the lamp 33 until it arrives at the sheet discharge point adjacent roller 17.

The cam 102 is so shaped that the arm 114 and spindle 38 are rocked first to lift the first guide and separator members 37 clear of the leading edge of the arriving master sheet as it emerges at the discharge point but to return such members 37 into contact with the surface of the master sheet before the arrival of the following leading edge of the overlying copy sheet. The second guide and stripper member 40 is, as already stated, now continuously locked out of engagement with the cylinder. In consequence, the master sheet proceeds again to travel around in contact with the surface of the cylinder 14 but the copy sheet is deflected and travels with the belts 15 on to the upper stretch 22 under the applied pressure of the rollers 73 and 74. A further copy sheet presented in the meantime on the feed table 57 can then be drawn in and positioned behind the same master sheet to make a second copy from such master sheet whilst the first copy sheet is being conveyed along the stretch 22.

Upon arrival of the discharged copy sheet at the end of this upper stretch 22 of the belts 15, it is deflected by plate 75 into the nip of developer rollers 76, 77, where it is coated with developer fluid, and immediately thereafter passes through the subsequent squeegee and conveyor rollers 84, 85 to emerge and pass over the top of roller 86, now in lowered position, on to the grid-like support of wires in transfer tray 94. If desired, heating means may be associated with the apparatus at this point to assist in drying the now developed copy sheet. The moment the rear edge of the developed copy sheet has emerged from the rollers 84, 85 it is no longer subject to any propulsion and accordingly comes to rest with its rear edge lying on the roller 86. At a slightly later instant, the cam member 100 engages nose end 104 of lever arm 105 to move the further lever arm 107 upwardly thereby to move the rocker arms 87 upwardly so as to bring the roller 86 against the continuously-driven roller 88. The latter is rotated at relatively high speed and immediately grips and propels the copy sheet in a forward direction through the convergent throat of plates 92 and 93 into the final delivery tray 67.

The above copying operation may be repeated as many times as necessary with the same master sheet retained around the cylinder 14 with its position thereon unaltered. When it is desired to change the master sheet, the operating bar 96 is again raised and this causes rocking movement of shaft 97 and attached lever arm 126*a* clockwise, FIG. 3, thereby to bias the lock bar 130 upwardly. This causes eventual locking of the lower feed roller 53 in its lowered inoperative position. Simultaneously the lug 126*c* on lever arm 126*a* engages lever arm 126*b* and transmits motion to arm 127 thereby rocking shaft 62 anticlockwise, FIG. 3, and causing the lay stop rocker arms 61 to assume the position shown in FIGS. 4 and 5 with the inward abutment 63 in raised position. At the same time, link rod 125 is raised and the resultant compression of lower spring 124 biases the escapement pawl 120 for clockwise movement, FIG. 3. When, at an instant determined by the action of cam 103 on follower pin 115, lever arm 116 falls to its lowest point, the intercoupled interlock nose 118 is raised clear of the upper limb of the pawl 120 whereby the latter rotates clockwise under the effect of its applied bias to free the arm 121. When next the cam member 102 operates arm 114 to rock the spindle 38 and first guide and separator members 37 towards the cylinder 14, the lug 122 moves upwardly, FIG. 3, and the arm 121 follows to lower the attached second guide and master stripper member 40 on to the surface of the cylinder 14 ahead of the approaching leading edge of the master sheet. The latter is accordingly deflected off the cylinder 14 and is discharged over the delivery plate 66. A new master sheet may be presented and taken in at the same time, if desired.

It is only possible to raise the operating bar 96 when the feed rollers 48, 53 are either opening or fully open by reason of the locking action of the kick plate 133 upon the arm 127. In order to ensure or assist in ensuring that copy sheets are not presented late, i.e. after closure of the feed rollers 48, 53 with resultant faulty positioning thereof with respect to the master sheet, visual indicator means operated by a further cam on the cylinder may be provided or, alternatively, an additional obstructing stop provided on the feed plate 56 and brought into and taken out of such obstructing position at appropriate times by such further cam. The constant rotation of the lower feed roller 53 tends to drive each presented sheet up to the operative lay stop and thereafter maintain it in such registered position until the feed rollers close.

A further feature of this invention resides in the selective printing from different parts of a given master by the method of reducing the area of the copy sheet applied thereto, such copy sheet being laid with relation to predetermined lay stop means on the feed tray. Thus, given a predetermined datum edge on the left hand side of the master sheet and a second datum edge along the leading edge of the copying area, after having placed the master sheet in position around the cylinder, a complete copy or series of complete copies of the whole of the master text can be obtained by feeding full sized copy sheets sufficient to cover the whole of the text area of the master. A selected column of any desired width measured towards the right from the left hand datum edge can be obtained by using copy sheets of suitably restricted width while any desired curtailment of the copied material measured from the upper datum edge of the master can be achieved by restricting the length of the copy sheet applied to the machine, such restriction taking place automatically merely by choice of appropriate size of copy paper.

It will be apparent that numerous alterations and modifications of the arrangements described with reference to the particular embodiment illustrated, may be made without departing from the scope of the invention.

We claim:

1. A photo copying machine which comprises a transparent cylinder having a smooth unbroken cylindrical outer surface and mounted for rotation about its longitudinal axis, an elongated light source within said cylinder, at least one endless conveyor belt arranged to overlie and embrace the outer surface of said cylinder over an angle which is greater than 180° but less than 360° for conveying paper sheets fed between said belt and said cylinder around a circular movement path about said light source, between a sheet entry end and a sheet discharge end of said movement path, intermittently operative sheet feed means adjacent said sheet entry end of said movement path, for feeding paper sheets along an input path to enter between said belt and said cylinder at said sheet entry end of said movement path, a master sheet lay stop movable between an operative position obstructing said input path and an inoperative position clear of said input path, a copy sheet lay stop movable between an operative position obstructing said input path at a position further from said sheet entry end than said master lay stop and an

inoperative position clear of said input path, selective lay stop control means for rendering one or the other of said lay stops operative and the other inoperative and sheet feed control means for rendering said sheet feed means operative to commence feeding movement of sheets abutting either of said lay stops at a predetermined angular position of said cylinder during each revolution thereof whereby the leading edge of a master sheet fed between said cylinder and said belt during one revolution of said cylinder with said master lay stop in operative position is positioned in advance of the leading edge of a copy sheet also fed between said cylinder and said belt during a subsequent revolution of said cylinder with said copy sheet lay stop in operative position.

2. A photo copying machine according to claim 1 which includes movable sheet deflector means adjacent the sheet discharge end of said movement path and controlled by rotation of said cylinder to move into contact with the outer surface of a master sheet behind its leading edge but ahead of the leading edge of an overlying copy sheet thereby to deflect said copy sheet only from said cylinder through the gap provided by the unembraced region of said cylinder.

3. A photo copying machine according to claim 2 which includes additional controlled means for engaging and deflecting said master sheet from said movement path.

4. A photo copying machine according to claim 2 in which said means for selectively engaging and deflecting the copy sheet comprises a member extending parallel with the leading edge of said master and copy sheets and movable towards and away from said movement path and means for controlling said member whereby it is moved away from said movement path whilst the leading edge of the master sheet is passing thereunder and is moved towards and into said movement path before the leading edge of the copy sheet arrives thereat.

5. A photo copying machine according to claim 4 in which said master sheet engaging and deflecting means comprises a member extending parallel with the leading edge of said master sheet and movable towards and away from said movement path and positioned beyond said copy sheet engaging and deflecting means in the movement direction, said member being normally held positioned away from said movement path and arranged for movement towards and into said movement path only when removal of said master sheet from said path is required.

6. A photo copying machine according to claim 5 in which said engaging and deflecting means each consist of blade-like members arranged for rocking movement about an axis parallel with the direction of the leading edges of said master and copy sheets.

7. A photo copying machine according to claim 1 which includes sheet engaging and tightening means disposed in said gap adjacent the sheet entry point between said cylinder and said conveyor belts for engaging and re-presenting the leading edge of the master sheet to said entry point.

8. A photo copying machine according to claim 7 in which said sheet engaging and tightening means comprises a rotating cylindrical brush arranged to be driven at a speed such that its peripheral region has an appreciably higher velocity than the speed of movement of said master and copy sheets.

9. A photo copying machine according to claim 2 which include copy sheet developing means and in which the deflected copy sheet is automatically transferred to said developing means.

10. A photo copying machine according to claim 9 in which said copy sheet is conveyed to said developing means by being maintained in frictional contact with said conveyor belts after being deflected from said cylinder.

11. A photo copying machine according to claim 2 which comprises one or more cam surfaces secured to said cylinder for rotation in unison therewith, said cam surface or surfaces serving to control said sheet engaging and deflecting means.

12. A photo copying machine according to claim 1 which includes visual indicator means for indicating correct and incorrect times for introduction of master and copy sheets to said sheet feeding means.

13. A photo copying machine which comprises a transparent cylinder having a smooth unbroken cylindrical outer surface and arranged for rotation about its longitudinal axis, an elongated stationary light source within said cylinder, a plurality of endless loop-form conveyor belts arranged to overlie and embrace said cylinder over an angle which is less than 360° but greater than 180°, said belts being located at longitudinally spaced positions along said cylinder and arranged to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belts to be conveyed around a circular movement path about said light source from a sheet entry to a sheet discharge end of said path without any positive intercoupling of either of said sheets to said cylinder or said belts, guide means for constraining said master sheet for conjoint movement with said cylinder over that region which is not embraced by said belts between said discharge end and said entry end of said movement path, movable sheet deflector means for engaging under the leading edge of said overlying copy sheet as it emerges from the discharge end of said movement path, said deflector means operating to deflect said copy sheet away from said cylinder and said master sheet through a gap provided by said unembraced region of said cylinder, automatic sheet feeding means for conveying sheets to said sheet entry end of said movement path, said feeding means including manually controllable alternative sheet entry positioning means for dealing with master and copy sheets respectively and control mechanism rotationally coupled to said cylinder for operating said sheet feeding means in synchronised relationship to each rotation of said cylinder thereby to feed either a master sheet or a copy sheet to said entry end of said movement path with the leading edges of said master and copy sheets in different predetermined positional relationships to the surface of said rotating cylinder and with the master sheet leading edge lying in advance of the copy sheet leading edge and for controlling said sheet deflector means to a position to effect copy sheet deflection at an instant during revolution of the cylinder when said master sheet leading edge has passed said deflector means but before said copy sheet has reached said deflector means.

14. A photo copying machine which comprises a transparent glass cylinder having a smooth unbroken cylindrical outer surface and arranged for rotation about its longitudinal axis an elongated stationary light source disposed co-axially within said cylinder, a plurality of endless loop-form conveyor belts arranged to overlie and embrace said cylinder over an angle of the order of 270° of the circumference of said cylinder, said belts being located at longitudinally spaced positions along said cylinder and arranged to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belts to be conveyed around a constant radius movement path about said light source from a sheet entry to a sheet discharge end of said path without any positive intercoupling of either of said sheets to said cylinder or said belts, guide means for constraining said master sheet for conjoint movement with said cylinder over that region which is not embraced by said belts between said discharge end and said entry end of said movement path, a rockable sheet deflector plate for engaging under the leading edge of said overlying copy sheet as it emerges from the discharge end of said movement path, said deflector plate operating to deflect said copy sheet away from said cylinder and said master sheet through a gap provided by said unembraced region of said cylinder, automatic sheet feeding means for conveying sheets to said sheet entry end of said movement path, said feeding means including manually select-

able alternative sheet entry positioning means for dealing with master and copy sheets respectively and control mechanism rotationally coupled to said cylinder for operating said sheet feeding means in synchronized relationship to each rotation of said cylinder thereby to feed either a master sheet or a copy sheet to said entry end of said movement path with the leading edges of said master and copy sheets in different predetermined positional relationships to the surface of said rotating cylinder and with the master sheet leading edge lying in advance of the copy sheet leading edge and for controlling said sheet deflector means to a position to effect copy sheet deflection at an instant during revolution of the cylinder when said master sheet leading edge has passed said deflector means but before said copy sheet has reached said deflector means.

15. A photo copying machine which comprises a transparent glass cylinder having a smooth unbroken cylindrical outer surface and arranged for rotation about its longitudinal axis, an elongated light source to lie coaxially within said cylinder, a plurality of endless loop-form conveyor belts arranged to overlie and embrace said cylinder over an angle of the order of 270° of the circumference of said cylinder, said belts being located at longitudinally spaced positions along said cylinder and arranged to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belts to be conveyed around a circular movement path about said light source from a sheet entry to a sheet discharge end of said path without any positive intercoupling of either of said sheets to said cylinder or said belts, movable guide deflector means for constraining said master sheet for conjoint movement with said cylinder over that region which is not embraced by said belts between said discharge end and said entry end of said movement path, a rockable sheet deflector plate for engaging under the leading edge of said overlying copy sheet as it emerges from the discharge end of said movement path, said deflector plate operating to deflect said copy sheet away from said cylinder and said master sheet through a gap provided by said unembraced region of said cylinder, automatic sheet feeding means for conveying sheets to said sheet entry end of said circular movement path, said feeding means including manually selectable alternative sheet entry positioning means for dealing with master and copy sheets respectively, control mechanism including rotating cam means connected to said cylinder for operating said sheet feeding means in synchronised relationship to each rotation of said cylinder thereby to feed either a master sheet or a copy sheet to said entry end of said movement path with the leading edge of said master and copy sheets in different predetermined positional relationships to the surface of said rotating cylinder and with the master sheet leading edge lying in advance of the copy sheet leading edge and for controlling said sheet deflector means to a position to effect copy sheet deflection at an instant during revolution of the cylinder when said master sheet leading edge has passed said deflector means but before said copy sheet has reached said deflector means and manual control means for moving said guide/deflector means to a position in which said master sheet is also deflected from said cylinder through said gap.

16. A photo copying machine which comprises a transparent cylinder having a smooth unbroken cylindrical outer surface and arranged for rotation about its longitudinal axis, an elongated stationary light source within said cylinder, a plurality of endless loop-form conveyor belts arranged to overlie and embrace said cylinder over an angle which is less than 360° but greater than 180°, said belts being located at longitudinally spaced positions along said cylinder and arranged to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belts to be conveyed around a circular movement path about said light source from a sheet entry to a sheet discharge end of said path without any positive intercoupling of either of said sheets to said cylinder or said belts, means including a rotatable brush roller engaging said cylinder for constraining said master sheet for conjoint movement with said cylinder over that region which is not embraced by said belts between said discharge end and said entry end of said movement path, movable sheet deflector means for engaging under the leading edge of said overlying copy sheet as it emerges from the discharge end of said circular path, said deflector means operating to deflect said copy sheet away from said cylinder and said master sheet through a gap provided by said unembraced region of said cylinder, automatic sheet feeding means for conveying sheets to said sheet entry end of said movement path, said feeding means including manually selectable alternative sheet lay stop means for dealing with master and copy sheets respectively and control mechchanism rotationally coupled to said cylinder for operating said sheet feeding means in synchronised relationship to each rotation of said cylinder thereby to feed either a master sheet or a copy sheet to said entry end of said movement path with the leading edge of said master and copy sheets in different predetermined positional relationships to the surface of said rotating cylinder and with the master sheet leading edge lying in advance of the copy sheet leading edge and for controlling said sheet deflector means to a position to effect copy sheet deflection at an instant during revolution of the cylinder when said master sheet leading edge has passed said deflector means but before said copy sheet has reached said deflector means.

17. A photo copying machine which comprises a transparent cylinder having a smooth unbroken outer cylindrical surface and arranged for rotation about its longitudinal axis, an elongated light source within said cylinder, a plurality of endless loop-form conveyor belts arranged to overlie and embrace said cylinder over an angle which is less than 360° but greater than 180°, said belts being located at longitudinally spaced positions along said cylinder and arranged to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belts to be conveyed around a circular movement path about said light source between sheet entry and sheet discharge end of said path without any positive intercoupling of either of said sheets to said cylinder or said belts and guide means for constraining said master sheet for continued conjoint movement in contact with said cylinder over that region which is not embraced by said belts and which lies between said discharge end and sheet entry ends of said conveyance path, said guide means including a movable member frictionally engaging the outward-facing surface of said master sheet and which is moving in the same direction as but at a faster speed than the adjacent region of the cylinder underlying said master sheet thereby to draw said master sheet taut on the surface of said cylinder immediately prior to the re-presentation of said master sheet to the entry end of said circular path.

18. A photo copying machine which comprises a transparent cylinder having a smooth unbroken outer cylindrical surface and arranged for rotation about its longitudinal axis, an elongated light source within said cylinder, a plurality of endless loop-form conveyor belts arranged to overlie and embrace said cylinder over an angle which is less than 360° but greater than 180°, said belts being located at longitudinally spaced positions along said cylinder and arranged to cause a master image sheet and a superimposed copy sheet inserted between said cylinder and said belts to be conveyed around a circular movement path about said light source between sheet entry and sheet discharge end of said path without any positive intercoupling of either of said sheets to said cylinder or said belts and guide means for constraining said master sheet for continued conjoint movement in contact with said cylinder over that region which is not

embraced by said belts and which lies between said discharge end and sheet entry ends of said conveyance path, said guide means including an elongated roller brush member frictionally engaging the outward-facing surface of said master sheet, such roller brush being continuously rotated with a peripheral speed which is faster than the peripheral speed of the adjacent region of the cylinder underlying said master sheet thereby to draw said master sheet taut on the surface of said cylinder immediately prior to the re-presentation of said master sheet to the entry end of said circular path.

References Cited in the file of this patent

UNITED STATES PATENTS

2,220,526	Kluitman	Nov. 5, 1940
2,371,925	Schade	Mar. 20, 1945
2,401,203	Trump	May 28, 1946
2,492,127	Hessert	Dec. 20, 1949
2,574,215	Kunstadter	Nov. 6, 1951
2,600,469	Breuers	June 17, 1952
2,600,470	Breuers	June 17, 1952
2,774,290	Mormann	Dec. 18, 1956
2,925,025	Conner	Feb. 16, 1960

FOREIGN PATENTS

643,566	Great Britain	Sept. 20, 1950