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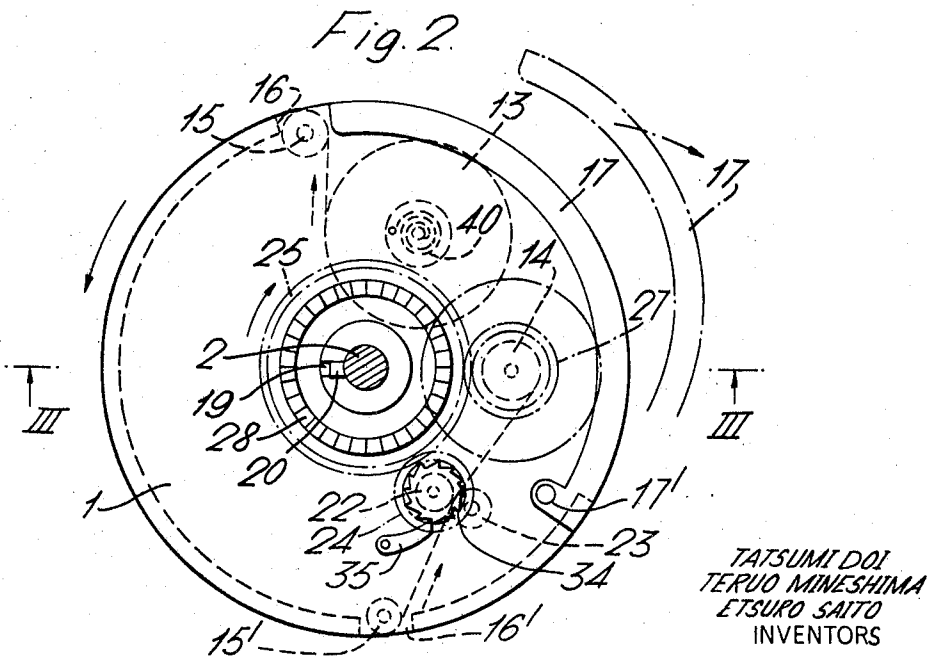
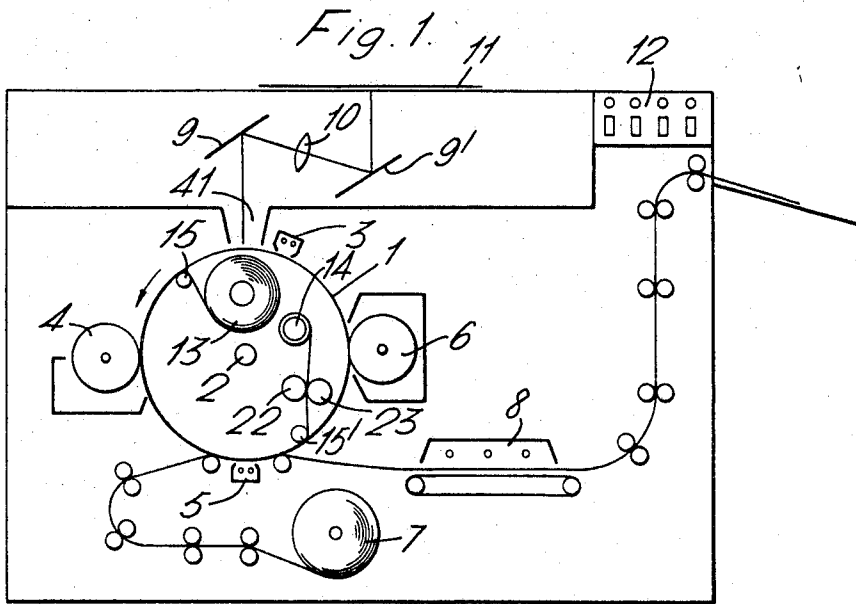
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PHOTOGRAPHIC COPYING MACHINE

Filed Jan. 30, 1967

2 Sheets-Sheet 1



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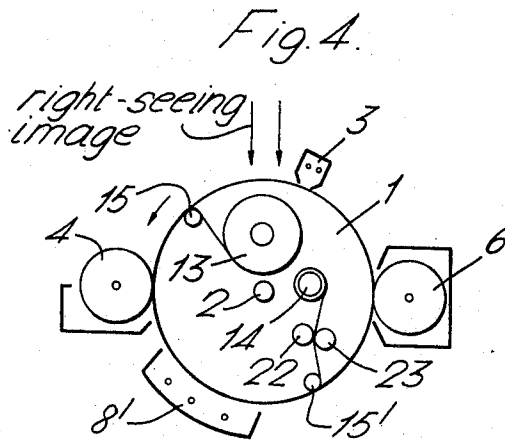
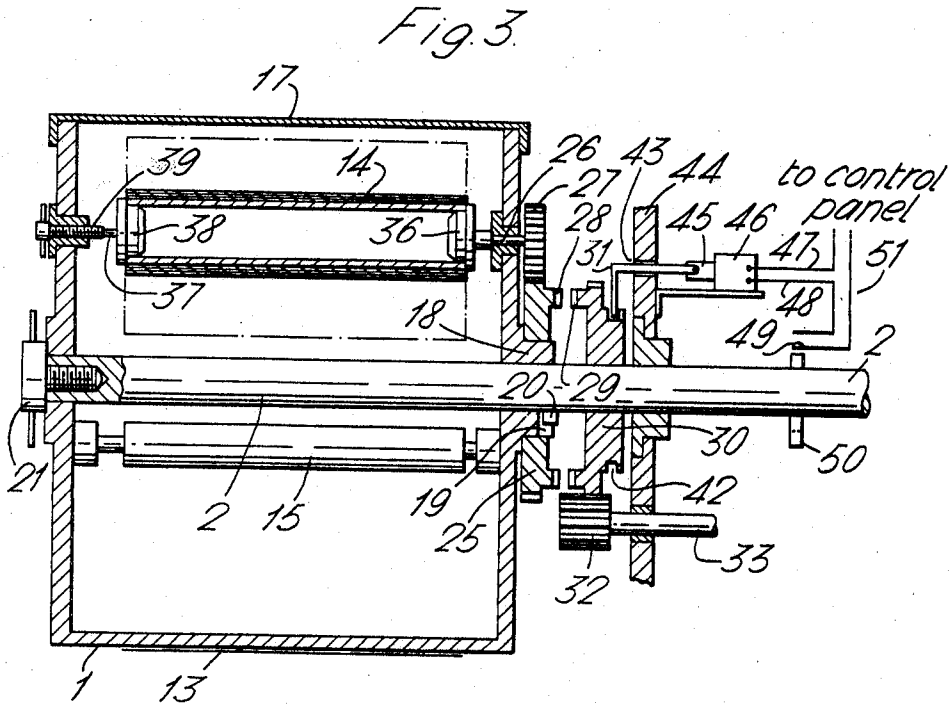
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PHOTOGRAPHIC COPYING MACHINE

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U.S. Cl. 355—16

8 Claims

ABSTRACT OF THE DISCLOSURE

A photographic copying machine includes a drum housing a roll of light sensitive paper. The drum rotates at selective times to feed the light sensitive paper to its surface for the copying of documents. The drum includes an internal supply roll, a take-up spool, and a pair of slits in its periphery.

The invention relates to a photographic copying machine of the type in which a light-sensitive paper is attached on the surface of a rotating drum for the purpose of continuous copying. More particularly the invention relates to such machine in which the drum houses a roll of light-sensitive paper from which unused light-sensitive paper may be supplied to the surface of the drum.

In such machines, a light-sensitive paper has been usually delivered sheet by sheet from a supply station arranged at one location along the periphery of the drum and the loaded sheet must be firmly held in position on the drum by clamping means to prevent a copy getting blurred by shift of the sheet on the drum during the copying process. After such sheet has served a number of copying processes, it is removed from the rotating drum by releasing the clamp, when the loaded sheet comes opposite to an unloading station arranged at another location along the periphery of the drum. However, when the above drum is used in an electrophotographic process, a number of units required therefor occupy the space around the drum, so that it is desirable to save space which is used for the provision of the supply and unloading stations. In addition, the above mentioned construction has a disadvantage that more than one sheet of the light-sensitive paper may be picked up and delivered by a feeder at the time when a fresh light-sensitive paper is to be supplied to the drum from the stack of such papers.

Therefore, it is the object of the invention to provide a photographic copying machine of the type specified above in which the drum houses a roll of unused light-sensitive paper and a spool for taking up a used portion of the light-sensitive paper.

According to the invention, the photographic copying machine comprises a rotary drum having a groove formed at a portion thereof allowing communication between the exterior and interior of the drum, a roll of unused light-sensitive paper detachably and rotatably supported within said drum, a take-up spool rotatably arranged within said drum and for taking up used portion of the light-sensitive paper, a pair of slits in the periphery of the drum for allowing the light-sensitive paper to pass therethrough from the interior to the exterior of the drum or reversely, the free end of said light-sensitive paper being initially pulled from the roll, led through one of said slits, extended a predetermined length along the outer surface of the drum in close contact therewith and thereafter tied to said take-up spool through the other of said slits, and means for transmitting a driving force to said take-up

spool when it is desired to replace the light-sensitive paper on the outer surface of the drum.

The invention will be described below in more detail with reference to the drawing wherein:

FIG. 1 is a schematic view of an electrophotographic copying machine showing one embodiment of the invention,

FIG. 2 is a partly transverse section of the drum used in the embodiment of FIG. 1,

FIG. 3 is a longitudinal section taken along the line III—III shown in FIG. 2, and

FIG. 4 is a schematic view similar to FIG. 1, illustrating another embodiment of the invention.

In the drawing, like parts are denoted by same reference numeral. Referring to FIG. 1, a drum 1 is supported and driven by a shaft 2. Around and opposite to the drum 1 are arranged, in turn, a charging electrode 3, a developing brush 4, a transfer electrode 5 and a cleaner brush 6 which constitute a copying assembly together with the drum as well as a light-sensitive paper carried on the drum. The light-sensitive paper is pulled out from the roll 13 which is housed inside the drum, passed by a guide roller 15 and through a slit 16, wrapped around a part of the peripheral length of the drum 1, and then led through another slit 16' and tied at its free end to a take-up spool 14 through another guide roller 16 and a pair of feed rollers 22 and 23.

An optical projector device consisting of a pair of reflecting mirrors 9, 9' and a lens 10 projects successive portions of an original 11 through the slit 41 onto the light-sensitive paper on the drum as the latter rotates in the direction indicated by an arrow. To this purpose, the projector may be arranged to move in synchronism with the rotation of the drum. As is well known, imagewise exposure at the slit 41 produces a latent image on the charged light-sensitive paper which is then developed at the developing brush 4 and transferred, at the electrode 5, to a transfer paper furnished from a roll 7 through feed rollers shown. The transfer paper having the developed image transferred thereon is passed through a fixing unit 8 to complete the copying. The transfer paper is shown to be supplied from the roll 7, but is cut to a predetermined length by a cutter not shown. Alternately, the transfer paper may be supplied in sheets of desired length. After the image transfer has been finished, the light-sensitive paper is subject to cleaning by the brush 6 to remove residual toners before again passing under the charging electrode 3. Such cycle is repeated to provide several tens of copies with a single light-sensitive paper. The operation of the copying machine is controlled from a control panel 12 by which number of copies to be obtained is set and by which the timing of various parts of the machine is properly controlled. Since such control is conventional in the art, further detail of it will not be described herein.

In accordance with the invention, the roll 13 of the light-sensitive paper is housed within the rotating drum 1, and the free end of the light-sensitive paper is pulled outside the drum to give a span of a predetermined length on the drum and is then returned inside the drum to be tied to the take-up spool 14 rotatably arranged therein. After such span has served a given number of copying processes, a drive is given to the take-up spool and/or the feed roller 22 to wind up the used light-sensitive paper and to load a fresh light-sensitive paper on the drum. Such arrangement will be described below with reference to FIGS. 2 and 3.

In FIG. 2, the roll 13 is indicated in broken lines and the free end of the roll is passed by the guide roller 15 to be pulled outside the drum 1 through the slit 16, which, for the purpose of removing and replacing the roll 13

and spool 14, is provided with a groove along a portion of its periphery and an arcuate cover 17, commensurate with the groove, is pivoted at 17' to the drum to cover such groove. The light-sensitive paper is then wrapped around a part of the drum 1, and led through the slit 16', by the guide roller 15' and between the pair of feed rollers 22 and 23 to be tied to the take-up spool 14. The groove may be arranged to include one or both of the slits 16 and 16'. It will be seen that a part of the light-sensitive paper lying between the guide rollers 15 and 16 can be effectively used in the copying process. Such part may be used in full length or a portion thereof may be used for the purpose of copying. In the latter case, the feed of the light-sensitive paper to replace used one may be adjusted suitably, as will be described later in detail. As is shown in FIG. 3, the drum 1 is provided at one end thereof with a hub 18 in which is formed a recess 19 for receiving a tupet 20 provided on the shaft 2. The drum is secured in its position on the shaft 2 by a clamping screw 21 which engages with the threaded bore of the shaft at the other end of the drum to thereby hold the latter axially with respect to the shaft 2. Thus, by loosening the screw 21, the drum 1 may be removed from the shaft 2.

The pair of feed rollers 22 and 23 which may be made from elastic materials such as rubber are rotatably supported by the end plates of the drum so as to press and feed the light-sensitive paper passed therebetween and a gear 24 which is fixed to the shaft of the roller 22 meshes with a central gear 25 loosely fitted over the hub 18. A pinion 27 fixedly mounted on the shaft 26 associated with the take-up spool 14 also meshes with the gear 25. In order to rotate the gear 25 with respect to the drum, the gear 25 has a clutch plate 28 provided on its side, which can be brought into engagement with the counterpart 29 provided on a gear 30 slidably and rotatably fitted on the shaft 2 when the gear 30 is moved by an operating rod 31 axially to the left, as it is viewed in FIG. 3. Another pinion 32 supported and driven by a shaft 33 meshes with the gear 30 at all times, and for this reason has a broad width to accommodate for the axial displacement of the gear 30. The shaft 33 is connected to a source of driving force not shown. In the position shown in FIG. 3, the gear 25 cannot rotate, but upon actuation of the rod 31 to cause the clutch 28, 29 to become operative, it is rotated on the hub 18 by the drive transmitted to the shaft 33, through pinion 32, gear 30, and clutch 28, 29. At this time, it is advantageous that the gear 25 rotates in a direction opposite to the direction in which the drum 1 is rotated. On the shaft of the feed roller 22 is fixed a ratchet wheel 34 which is engaged by a pawl 35, thereby preventing reverse rotation of the feed roller 22. The shaft 26 associated with the take-up spool 14 carries a disk 36 at its one end, and a shaft 37 carries another disk 38. The shaft 37 is integral with a bolt 39 screwed in one end plate of the drum, thereby allowing to remove the take-up spool. The take-up spool frictionally engages with the disks 36, 38. A suitable spring 40 is provided on the shaft of the support for the roll 13 to prevent loosening of the light-sensitive paper.

In order to actuate the clutch 28, 29, the operating rod 31 may be operated manually. However, in the embodiment shown in FIG. 3, the rod 31 has two arms and engages at the end of one arm thereof with an annular slot 42 formed in the gear 30. The other arm of the rod 31 passes through an opening 43 in a stand 44 and is connected at its end with the plunger 45 of an electromagnet 46 suitably supported by the stand 44. Leads 47, 48 are connected to the electromagnet and the lead 48 is connected to a switch 49 which is normally open and operated by a cam 50 carried by the shaft 2. Leads 47 and 51 provide a circuit for energization of the electromagnet when a pushbutton (not shown) is operated in the control panel 12 to connect them with a power supply. It will be appreciated that the period during which the electromagnet 46 is energized depends on the shape of the contour of the cam 50. Thus by suitable design of the cam

50, the length of the light-sensitive paper which is fed by the feed roller 22 and taken up by the spool 14 may be selected as desired. In addition, such length may be changed by replacement of the cam 50. Although the length of the light-sensitive paper which extends along the outer surface of the drum is fixed to the distance measured along the periphery of the drum between the slits 16 and 16', such span of the light-sensitive paper may not be used in full length, but a portion thereof may be utilized as the effective length of the light-sensitive paper. In such case, the feed length of the light-sensitive paper must be varied correspondingly.

In operation, the roll 13 of unused light-sensitive paper and the take-up spool 14 is mounted in the interior of the drum 1 while the cover 17 is turned open as indicated by chain line. Then the free end of the roll is loaded on the surface of the drum and tied to the take-up spool 14 as mentioned previously. The light-sensitive paper, thus loaded, is held stationary with respect to the drum 1 and therefore, when the cover 17 is replaced, the machine is ready for copying operation, which takes place as described above. When the loaded light-sensitive paper has served a given number of copying processes, the operating rod 31 is actuated either manually or automatically whereupon the clutch 28, 29 becomes operative and the driving force imparted to the shaft 33 can be transmitted to the gear 25 through the pinion 32, gear 30, and the clutch 28, 29. Rotation of the gear 25 causes rotation of the gear 24 meshing therewith so that the feed roller 22 rigidly mounted on the same shaft as the gear 24 is rotated, thereby feeding the light-sensitive paper toward the take-up spool 14. Simultaneously, the pinion 27 is driven by the gear 25 so that the take-up spool 14 is driven by frictional engagement with the disks 36, 38, thus taking up the light-sensitive paper as fed by the roller 22. The frictional engagement mentioned above permits to wind up only that length of the light-sensitive paper fed by the roller 22, and when the diameter of the roll of used light-sensitive paper on the take-up spool 14 increases, slip occurs between the latter and the disks 36, 38. Thus it is assured that used light-sensitive paper is taken up by the spool 14 and a fresh, unused paper is released from the roll 13 to give a renewed span of light-sensitive paper. When the feed roller has fed the predetermined length of the light-sensitive paper, the operating rod 31 is returned to its original position either manually or by deenergization of the electromagnet, whereby the clutch 28, 29 becomes disengaged and the parts restore to the positions shown in FIG. 3. The machine is ready for effecting another series of copying processes.

In the above description, the light-sensitive paper has been used as a master plate for transferring an image formed thereon to a separate transfer paper. However, the light-sensitive paper on the drum may be used to prepare a copy from itself. FIG. 4 shows such an arrangement in which a fixing unit 8' is arranged along the periphery of the drum 1 between the developing brush 4 and the cleaner brush 6. As shown in FIG. 4, the right-seeing image of an original to be copied must be projected onto the light-sensitive paper. The modification required in the projector device for this purpose will be obvious to those skilled in the art, and therefore will not be particularly described herein. The light-sensitive paper having the image of the original fixed during its passage through the fixing unit 8' will be taken up by the spool 14 as before. In this case, the feeding operation for the light-sensitive paper occurs after every copying process. It is possible to complete such feeding operation during a fragment of one revolution of the drum. It will be noted the cam 50 which has been described in connection with FIG. 3 serves to determine the point during the rotation of the drum at which the feeding operation for the light-sensitive paper starts. Therefore, a timed

relationship can be established between the copying and feeding operations in one revolution of the drum.

The feeding operation for the light-sensitive paper may be performed during the rotation of the drum or when the drum stands still. In one example, the drum 1 can contain a roll of light-sensitive paper which corresponds to two hundred sheets of B4 size (about 10 x 14½ inches). A single light-sensitive paper may be used to obtain fifty copies so that 10,000 copies of B4 size can be obtained without requiring replacement of the roll.

While the invention has been described with a particular embodiment thereof, it should be apparent to those skilled in the art that various modifications can be made without departing from the spirit of the invention. Thus the drive to the gear 25 may be provided by a small motor arranged inside the drum and the parts 28, 29, 30, 31, 32 and 33 may be omitted. Alternately, the clutch plate 28 on the gear 25 may be slidably arranged to be pressed against a stationary brake disc, thereby causing relative motion between the gear 25 thus held and the gears 24, 27 which are rotatably supported on the drum. Therefore, above description and illustration should not be construed as limiting the scope of the invention, which is solely defined by the appended claims.

What is claimed is:

1. A photographic copying machine comprising a base, a drum rotatably mounted on said base and having a removable cover means allowing communication between the exterior and interior of the drum, means to detachably and rotatably support a roll of unused light-sensitive paper within said drum, a take-up spool rotatably arranged within said drum for taking up used portions of the light-sensitive paper, pair of slits in the periphery of the drum for allowing the light-sensitive paper to pass therethrough from the interior to the exterior of the drum or reversely, the free end of said light-sensitive paper as released from the roll being initially led through one of said slits, extended a predetermined length along the outer surface of the drum in close contact therewith and thereafter tied to said take-up spool through the other of said slits, means for selectively transmitting a driving force to said take-up spool; and means for selectively transmitting a driving force to selectively rotate said drum.

2. A photographic copying machine according to claim 1 characterized in that said remote removable cover means includes a flange at a portion of the periphery of the drum and an arcuate cover member removably joined to the drum so as to normally complement said flange.

3. A photographic copying machine according to claim 2 characterized in that said groove spans at least one of said slits.

4. A photographic copying machine according to claim 1, characterized by further provision of a feed roller arranged in the path of the light-sensitive paper from

the other of said slits to the take-up spool and driven by said means, the arrangement being such that the feed roller positively feeds the light-sensitive paper, while the take-up spool is adapted to wind up only that length of the light-sensitive paper which is fed by the feed roller.

5. A photographic copying machine according to claim 1, characterized in that said means comprises a gear loosely fitted over a part of the drum to thereby permit relative rotation therebetween, and a clutch coupled between the gear and an external source of driving force for imparting rotational motion to the gear, said gear being adapted, when driven, to cause said spool to take up used portion of the light-sensitive paper, said gear being driven in opposite direction to the rotational direction of the drum.

6. A photographic copying machine according to claim 1, characterized in that said take-up spool is driven when the drum stands still.

7. An electrophotographic copying machine according to claim 1, characterized by the provision of a charging electrode, an exposure station, a developing brush and a transfer electrode arranged, in turn, along and opposite to the periphery of the drum, said exposure station being associated with a projector which projects the image of successive parts of an original to be copied onto the light-sensitive paper spanned on the outer surface of the drum as the latter rotates, further characterized by the provision of a supply of transfer papers adapted to furnish the transfer paper sheet by sheet to said transfer electrode, each sheet of the transfer paper having the image of the original transferred from the light-sensitive paper being thereafter passed through a fixing unit.

8. An electrophotographic copying machine according to claim 1, characterized by the provision of a charging electrode, an exposure station, a developing brush and a fixing unit arranged, in turn, along and opposite to the periphery of the drum, said exposure station being associated with a projector which projects the image of successive parts of an original to be copied onto the light-sensitive paper spanned on the outer surface of the drum as the latter rotates, the light-sensitive paper having the image of the original developed and fixed thereon being thereafter taken up by said spool through the other of said slits.

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