RESERVE COPY

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,089,536

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COMPLETE SPECIFICATION

Xerographic Apparatus

We, RANK XEROX LIMITED, of Mortimer House, 37—41 Mortimer Street, London, W.1., a British Company do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates in general to xerography and, in particular, to an optical scanning apparatus for projecting the image of a stationary object onto a moving xerographic plate.

More specifically, the invention relates to an improved image projecting apparatus that is particularly adapted for use in xerographic reproducing machines, and is also suitable for use with comparable types of devices.

According to the invention there is provided xerographic apparatus comprising a support for an original to be copied, illuminating means for illuminating the original, a rotatable xerographic drum, an optical system for transmitting to the xerographic drum light reflected from the original system including an oscillatable object mirror receiving light reflected from the original, a cam mounted for rotation at the same angular speed as the xerographic drum, cam follower means engaging the cam and driving a second sector-shaped cam, a third sector-shaped cam mechanically linked for movement with the second cam by a flexible drive and operatively associated with the object mirror to oscillate the object mirror in synchronization with the angular velocity of the xerographic drum.

An example of the invention will now be described with reference to the accompanying drawings in which:—

Figure 1 illustrates schematically xerographic apparatus,

Figure 2 is a perspective view of the optical system of Figure 1,

Figure 3 is a right-hand view of the drum drive assembly with the xerographic drum of the apparatus removed,

Figure 4 is a front view of the drum drive mechanism,

Figure 5 is a front view of the drum drive mechanism with the front cover broken away to show the arrangement of the various drive elements,

Figure 6 is a top view of the drum drive mechanism with parts broken away to show the arrangement of the drive mechanism,

Figure 7 is a rear view of the drum drive mechanism with parts of the casing broken away to show the cam drive arrangement and

Figure 8 is a sectional view taken along line 10—10 of Figure 7.

As shown schematically in Figure 1, an automatic xerographic reproducing apparatus comprises a xerographic plate 20 including a photoconductive layer or light-receiving surface on a conductive backing and formed in the shape of a drum, which is mounted on a shaft journaled in a frame to rotate in the direction indicated by the arrow to cause the drum surface sequentially to pass a plurality of xerographic processing stations. In sequence, these stations include a charging station, an exposure station, a developing station, a transfer station and a drum cleaning and discharge station.

The charging station is preferably located, as indicated by reference character A. As shown, the charging arrangement includes a corona charging device 21 which includes a corona discharge array of one or more corona discharge electrodes that extend transversely across the drum surface and are energized from a high potential source and are substantially closed within a shielding member.

Next subsequent thereto in the path of motion of the xerographic drum is an exposure station B. An optical scanning or projection

[*Price 4s. 6d.*]

system is provided to project a flowing image onto the surface of the photoconductive drum from a stationary original.

The optical scanning or projection assembly comprises a stationary copyboard which consists of a transparent curved platen member 22 such as, for example, a glass plate or the like, positioned on the exterior of the cabinet, which is adapted to support a document to be reproduced, the document being uniformly illuminated and arranged in light projecting relation to the moving light-receiving surface of the xerographic drum. Uniform lighting is provided by banks of lamps LMPS arranged on opposite sides of the copyboard. Scanning of the document on the stationary copyboard is accomplished by means of a mirror assembly which is oscillated relative to the copyboard in timed relation to the movement of the xerographic drum.

The mirror assembly, which includes an object mirror 23, is mounted below the copyholder to reflect an image of the document through a lens 24 onto an image mirror 25 which, in turn, reflects the image onto the xerographic drum through a slot in a fixed light shield 26 positioned adjacent to the xerographic drum surface.

Adjacent to the exposure station is a developing station C in which there is positioned a developer apparatus 30 including a casing or housing having a lower or sump portion for accumulating developer material. A bucket type conveyor is used to carry the developing material to the upper part of the developer housing where it is cascaded over a hopper chute onto the xerographic drum to effect development. A toner dispenser is used to accurately meter toner to the developing material as toner particles are consumed during the developing operation.

Positioned next and adjacent to the developing station is the image transfer station D which includes a sheet feeding arrangement adapted to feed sheets of support material, such as paper or the like, successively to the xerographic drum in coordination with the presentation of the developed image on the drum surface at the transfer station.

The sheet feeding mechanism includes a sheet feed device 40 adapted by means of vacuum feeders to feed the top sheet of a stack of sheets on a tray 41, to a set of feed rollers 42 for advancement by the feed rollers to a paper transport 44 which, in turn, conveys the sheet to a sheet registration device 45 positioned adjacent to the xerographic drum. The sheet registration device arrests and aligns each individual sheet of material and then in timed relation to the movement of the xerographic drum advances the sheet material into contact with the xerographic drum in registration with a previously formed xerographic powder image on the drum.

The transfer of the xerographic powder image from the drum surface to the sheets of support material is effected by means of a corona transfer device 51 that is located at/or immediately after the line of contact between the support material and the rotating drum. In operation, the electrostatic field created by the corona transfer device is effective to tack the support material electrostatically to the drum surface, whereby the support material moves synchronously with the drum while in contact therewith. Simultaneously with the tacking action, the electrostatic field is effective to attract the toner particles comprising the xerographic powder image from the drum surface and cause them to adhere electrostatically to the surface of the support material.

Immediately subsequent to the image transfer station, there is positioned a stripping apparatus or paper pick-off mechanism 52 for removing the sheets of support material from the drum surface. This device includes a plurality of small diameter orifices supplied with pressurized aeriform fluid by a suitable pulsator or other device. The pulsator is adapted to force jets of pressurized aeriform fluid through the outlet orifices into contact with the surface of the xerographic drum slightly in advance of the sheet of support material to strip the leading edge of the sheet from the drum surface and to direct it onto an endless conveyor 55 whereby the sheet material is carried to a fixing device 60. At the fixing device, the transferred xerographic powder image on the sheet of supporting material is permanently fixed or fused thereto as by heat. After fusing, the finished copy is discharged from the apparatus at a suitable point for collection externally of the apparatus by means of the conveyor 65.

The next and final station in the device is a drum cleaning station E, having positioned therein a corona preclean device 66, similar to corona charging device 21, a drum cleaning device 70 adapted to remove any powder remaining on the xerographic drum after transfer by means of a rotating brush 71, and a discharge lamp LMP—1 adapted to flood the xerographic drum with light to cause dissipation of any residual electrical charge remaining on the xerographic drum.

To remove residual powder from the xerographic drum, there is disposed a cylindrical brush 71 rotatably mounted on an axle and driven by a motor, not shown. For collecting powder particles removed from the xerographic drum by the brush, there is provided a dust hood 73 that is formed to encompass approximately two-thirds of the brush area. To ensure thorough cleaning of the brush, a flicking bar 74 is secured to the interior of the dust hood adjacent the edge of the outlet duct 75 of the dust hood and in interfering

relation with the ends of the brush bristles whereby dust particles may be dislodged therefrom.

For removing dust particles from the brush and dust hood, an exhaust duct 76 is arranged to cover the outlet of the dust hood, the exhaust duct being connected at its other end to the wall of a filter box 77 attached to the dust hood. A filter bag 78 is secured within the filter box, with the mouth of the filter bag in communication with the exhaust duct. A motor fan unit MOT—6, connected to the filter box, produces a flow of air through the filter box drawing air through the area surrounding the xerographic drum and the dust hood, the air entraining powder particles removed from the drum by the brush as the air flows through the dust hood. Powder particles are separated from the air as it flows through the filter bag so that only clean air reaches the motor unit.

Suitable drive means are provided to drive the drum, rotating mirror and sheet feed mechanism at predetermined speeds relative to each other, and to effect operation of the bucket-type conveyor and toner dispenser mechanism.

Referring now to the drawings, there is provided a frame for supporting the components of the apparatus formed by a base plate 10 supported on legs 9. Vertical outboard and inboard frame plates 11 and 12, respectively, are secured to base plate 10 in spaced relation to each other.

The xerographic drum 20 is mounted on a horizontal driven shaft and the drum is positioned between frames 11 and 12, with the major xerographic components of the machine mounted around the drum.

Exposure Mechanism

Referring now to the subject matter of the invention, the exposure mechanism is used to scan the object to be reproduced and to project a flowing image thereof onto the rotating xerographic drum. In the embodiment of the invention shown, the scanning of the object, such as a document or book, placed on a copy platen is accomplished by means of an oscillating object mirror which reflects an image from the object through a lens onto an image mirror which, in turn, reflects the image through a slotted light shield onto the xerographic drum.

The exposure mechanism includes an optical frame 13 for supporting the object mirror, lens and image mirror. The optical frame 13 is supported at one end by support bar 14 secured to and extending between frames 11 and 12 and at its opposite end by pin support 15 secured to frame 12. Attached to the optical frame, adjacent to the object mirror, is a lamp holder frame assembly 16 which, in turn, supports a platen support frame assembly 17.

The platen 22, made of transparent material, such as glass, is suitably attached to the platen support frame assembly directly over the axis of rotation of the object mirror 23. Platen 22 is curved in the shape of an arc, with the radius thereof equal to the distance from the platen surface to the axis of rotation of the object mirror 23.

A document or other object to be reproduced placed on the curved platen 22 is uniformly illuminated by banks of lights, such as fluorescent lamps LMP—2, LMP—3, LMP—4, LMP—5, LMP—6, LMP—7, LMP—8, LMP—9, LMP—10, and LMP—11 mounted in conventional fluorescent lamp holders secured to the lamp holder frame assembly 16.

Object mirror 23 is supported by a suitable mirror support assembly fixed to mirror shaft 101 journaled by suitable bearings mounted in optical frame 13. A detailed description of the mirror support assembly is not deemed pertinent to a complete understanding of the invention, it being noted that this assembly positions the mirror in a flattened portion of the shaft so that the reflecting surface of the mirror is in a plane extending through the axis of shaft 101.

The shaft 101, and therefore the object mirror 23, are oscillated by means of a cam 102 secured to the inboard end of the shaft for movement therewith. Motion in one direction of the cam is effected by means of a tape 103 secured at one end to cam 102 and at its other end to a cam 104 driven in synchronization with the rotation of the xerographic drum, as described in detail hereinafter. Motion of cam 102 in the opposite direction, or the return motion of the cam, is effected by means of spring 105 connected at one end to pin 106 fixed to the cam and at its other end to pin 107 secured in optical frame 13.

Both the lens 24 and the image mirror 25 are secured in a suitable manner in fixed position on the optical frame 13 in the optical path from object mirror 23.

The light shield 26 is simply an open, elongated box having side walls, end walls and a bottom wall provided with a narrow slot 27 extending across the length of the light shield. Light shield 26 is secured to the optical frame and is positioned with its bottom wall in close proximity to the peripheral surface of the drum and with the center line of the slot parallel to the axis of rotation of the drum. In the embodiment shown, the light shield supports the corona charging device 21.

The xerographic drum 20 is mounted on horizontal driven shaft 111 that rotates in bearings 112 and 113 positioned in drum drive casing 114 secured to the outer face of inboard frame 12 with a portion of the drum drive casing extending through a suitable opening in frame 12 toward frame 11. The free end or outboard end of shaft 111 is threaded to receive thumb nut 115 to secure the inboard hub of the xerographic drum into driven engagement with the pin 108 of drive collar

109 secured to the shaft for rotation therewith. The openings in the drum drive casing to receive the shaft 111 are closed at one end by cover 116 and at the opposite end by bearing retaining cap 117 supporting seal 118 encircling the shaft.

The shaft 111 is operatively connected to the main drive motor MOT—3, of the apparatus by worm gear 121 on the end of the motor shaft engaging gear 122 which, in turn, drives gear 123 fixed to shaft 111 by key 124. The gear 123 is maintained in axial alignment thereon by washer 128 and by bearing nut 125 threaded onto the end of the shaft to force the washer 128 to contact bearing 113 which abuts against one side of the hub of gear 123, the opposite side of the gear being positioned against a shoulder formed on the shaft 111.

Gear 122 is fixed to one end of shaft 126 journaled in bearings 127 mounted in the drum drive casing. The opposite end of shaft 126 extends from the drum drive casing through seal 131 and bearing retaining cap 132 beyond the outboard face of inboard frame 12 and has fixed at the end thereof sprocket 133 for a purpose to be described.

To effect a scanning cycle of the object mirror 23, there is fixed to the gear 123 on drum shaft 111 a cam 134 having in the embodiment shown, three cam lobes, that is, three rise portions and three fall portions. The mirror actuating cam 102, as previously described, has one end of tape 103 secured thereto. The tape extends over tape guide 136 fixed to frame 12 and is secured at its opposite end to a second cam 104 fixed to one end of shaft 141.

The opposite end of shaft 141 is provided with a cam arm 142, fixed thereon, which carries a cam follower 143 adapted to engage cam 134. Shaft 141 is journaled by bearings 144 mounted in the drum drive housing in spaced apart relation by cylindrical spacers 137 and 138 and secured therein by seal bearing retaining cap 145 provided with seal 147 and bearing retaining nut 146 and washer 148.

With this arrangement, the object mirror is oscillated three times to scan an image during each revolution of the drum and in synchronization with the rotation therewith, since it is driven during the scanning cycle directly from the drum shaft as the cam follower 143 follows the rise portion on cam 134 secured to the drum shaft. Return motion of the mirror to its start-of-scan position is effected by the biasing action of spring 105 and this return motion is effected rapidly because of the shape of the fall portion of cam 134, it being apparent that the spring 105 will always bias cam follower 143 into cooperative engagement with cam 134.

The two cams 102 and 104 have equal radii and this makes the angular velocity of the cam arm 142 equal to the angular velocity of the rotating object mirror 23. The cam 134 and the drum 20 are mounted on the same shaft making their angular velocity equal. Since the angular velocity of the cam 134 and the drum are equal, any deviation from constant angular velocity of the drum shaft will not be a factor in the synchronization of the optical system, because any deviation of the angular velocity of the drum would be synchronized with a proportionate deviation in the angular velocity of the scanning mirror, that is, object mirror 23, through the drum shaft, cams, and the interconnecting tape.

The construction and operation of other parts of the xerographic machine illustrated in the accompanying drawings is described in co-pending applications 11364/67 (Serial No. 1,089,537) and 11365/67 (Serial No. 1,089,538) divided from the present application.

WHAT WE CLAIM IS:—

1. Xerographic apparatus comprising a support for an original to be copied, illuminating means for illuminating the original, a rotatable xerographic drum, an optical system for transmitting to the xerographic drum light reflected from the original, the optical system including an oscillatable object mirror receiving light reflected from the original, a cam mounted for rotation at the same angular speed as the xerographic drum, cam follower means engaging the cam and driving a second sector-shaped cam, a third sector-shaped cam mechanically linked for movement with the second cam by a flexible drive and operatively associated with the object mirror to oscillate the object mirror in synchronization with the angular velocity of the xerographic drum.

2. Apparatus as claimed in claim 1 wherein the support comprises a curved copy board secured to a frame for supporting the original, and the xerographic drum is mounted on a horizontal driven shaft for rotation therewith, and the optical system comprises a light shield interposed in the optical path between the copy board and the xerographic drum, a slot aperture in the light shield adjacent the xerographic drum and extending transversely to the path of rotation of the drum.

3. The apparatus of claim 2 including biasing means to effect oscillatory movement of said third cam in one direction and to bias said cam follower means into engagement with said first cam.

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3. The apparatus of claim 2 including biasing means to effect oscillatory movement of said third cam in one direction and to bias said cam follower means into engagement with said first cam.

* C L M S *

4. Xerographic apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

For the Applicants:—
A. POOLE & CO.,
Chartered Patent Agents.

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from which copies may be obtained.

ERRATA

SPECIFICATION No. 1,089,536

Page 2, line 100, *for* "supporting" *read* "support"
Page 3, line 27, *for* "mchanism" *read* "mechanism"

THE PATENT OFFICE
4th December 1967

