

PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.:—G 03 g 1/24

COMPLETE SPECIFICATION

Copy Counting

We, RANK XEROX LIMITED, of 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 to copy counting means for indicating the number of copies produced by a copying machine.

According to this invention there is provided copy counting means for indicating cumulatively the number of copies produced by a copying machine during successive reproducing runs, which means comprises a first counter for indicating cumulatively the total of a first predetermined number of copies of each reproducing run, a second counter for indicating cumulatively at least a second predetermined number of copies in excess of the first predetermined number of copies of each reproducing run, counter actuating means responsive to the production of each copy and switch means for causing the first counter to be actuated by the actuating means following production of each of the first predetermined number of copies of each reproducing run and for causing the second counter to be actuated following production of each of the second predetermined number of copies in excess of the first predetermined number of copies of each reproducing run.

In conventional copying machines that are utilised on a leased basis, it is common practice to charge customers at a set rate for the number of copies made. As a rule, the set rate is based on a minimum monthly charge for a predetermined number of copies and, then on a somewhat reduced rate for all copies in excess of the predetermined number made during a month. By this arrangement, a customer effectively pays the same rate a copy for all copies regardless of whether the customer uses the machine for single-copy runs or multi-

copy runs. In as much as the use of the machine for single or short copy runs results in increased wear of the machine over multi or long copy runs, it is preferred to adjust the charges for copies on a basis proportionate to the actual wear or usage imposed upon a machine. In the present invention, the first predetermined number of copies are counted on the first counter, and a second predetermined number in excess of the first predetermined number are counted on a second counter. It may be arranged that all the remaining copies are counted on the second counter. The total may also be counted on a third counter, in the case where only a fraction of the total possible number of copies made on each reproducing run are counted on the second counter for use in charging the user. A resettable counter in addition to other counters may be used to indicate the total number of copies made.

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

Fig. 1 is a right-hand perspective view of xerographic apparatus embodying the invention with parts of the desk covering broken away to show the arrangement of xerographic machine elements,

Fig. 2 is a left-hand perspective view of the xerographic apparatus with parts of the desk covering broken away to show the arrangement of the xerographic machine elements,

Fig. 3 is a view of the main control panel of the apparatus mounted on a super-structure of the desk,

Fig. 4 is a top view of the stepping switch used in the counting system of the apparatus of Fig. 1,

Fig. 5 is a front view of the stepping switch,

Fig. 6 is a view along line 6—6 of Fig. 5, and

Fig. 7 is a view along line 7—7 of Fig. 5.

A desk, generally designated 1, constructed in a conventional manner, has mounted on the top and in the right-hand corner thereof a main control panel for initiating operation of the machine and for selecting and indicating the number of reproductions to be made, and a collecting tray for finished reproductions, usually made on paper. Although the reproductions may be discharged from the copier-duplicator for collection at any point accessible externally of the machine, it is preferred that the discharge terminal of the reproduction or paper feed means be embodied in a super-structure 4 overhanging the rear portion of the desk top, said super-structure also housing the main control panel 3 of the apparatus. Thus, the document holder or copyboard 5 and its covering platen 6 can be left unobstructed at the front part of the desk over the knee space.

In the lower right-hand corner of the desk is a second control panel 7 for additional control circuits and for levers to control the length of scan, to control the tensions of the paper separator rollers on a stack of paper, to adjust for different paper weights, and for controlling the toner dispensing rate all of which is described in detail hereinafter.

Referring now to Figs. 1 and 2 there is shown the general arrangement of the xerographic apparatus within the desk 1. As shown, there is provided a frame for supporting the components of the apparatus formed by a base plate 10 to which are mounted front and rear plates 11 and 12, respectively, and partial plate 13. The plates are connected together and maintained rigidly in spaced relation to each other by suitable tie plates.

As shown in Fig. 1, the xerographic drum 20 is mounted on horizontal driven shaft SH6 and the drum is positioned on the exposed front face of front plate 11, with the major xerographic components of the machine mounted around the drum either on the exposed front face of plate 11 or between plate 11 and partial plate 13.

The main drive elements and controls for the xerographic components are mounted between front and rear plates 11 and 12, respectively, as shown in Fig. 2, and they include as major components thereof, a main drive motor MOT 1, a scan control mechanism 48 for operating the movable elements of the optical system 24, a programmer 50 for actuating the operation of the paper feed system 32 and paper pickoff mechanism 36, a clutch mechanism 52 for effecting alternate operation of the separator and feed rollers in the paper feed system, and a lever control system 54 for adjusting the length of scan, toner dispensing rate, and separator roller tension.

A platen cover 6 is hingedly mounted over a transparent platen 5 in the top skin of a desk 1. The original 18 to be copied is placed

face downwards on the platen 5 and the platen cover 6 is laid over the original to force it into intimate contact with the platen 5.

The xerographic drum 20 is mounted below the platen 5 for rotation anti-clockwise as seen in figure 1, so that points of the drum move past various processing stations in turn. The first station is the charging station comprising a corona discharge device 22 for uniformly charging the surface of the drum. At the exposure station, light reflected from the under surface of the original is focussed by the projection system 24 including a movable lens onto the drum through a slit in a light shield to discharge the surface of the drum in image configuration, leaving a latent electrostatic image. This latent electrostatic image is developed at the developer station comprising a developer housing 26 in which developer is cascaded over the image on the drum. At the transfer station a charge of opposite polarity to that of the charging station is applied by means of corona discharge device 34 so that paper fed to the surface of the drum along guide 32 from a paper stack receives the developer material in image configuration and then passes along conveyor 38 to the fuser 42 where the toner is fused into the paper.

The drum is rotated at a constant speed by a motor MOT-1 in synchronism with the movement in the scanning direction of the lens of the projection system 24, the paper feed to the guide 32 and the air puffer 36.

The paper bearing the fused image is passed up a conveyor 44 up the back of the machine to a paper tray 2 in the raised portion 4 of the cabinet 1. As the paper tends to adhere to the surface of the xerographic drum even after the application of charge from the device 34, the air puffer 36 is applied to the surface of the drum beyond the transfer station to lift the leading edge of the paper away from the drum. The drum is finally cleaned at the cleaning station by means of a rotating brush in a housing 46.

If more than one copy of the original is required the process is repeated. The number of copies to be made is controlled by setting the knob on the control panel shown in Fig. 3.

The exposure mechanism of the xerographic copier-duplicator of this invention is designed to use an optical scanning or projection assembly 24 to scan the object to be reproduced and to project a flowing image of said object on the rotating xerographic drum, the length of scan and the projection of the flowing image in synchronization with the rotation of the xerographic drum being controlled by the scan control mechanism, generally designated 48.

In this type of apparatus, the scanning of the object which is placed in stationary position on a fixed copy holder is accomplished by means of a movable lamp carriage, having

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fluorescent lights mounted thereon to provide uniform illumination of the object to be reproduced, and is moved relative to the copy holder in timed relation to a laterally movable lens system and the xerographic drum.

A fixed object mirror mounted below said fixed copy holder reflects an image from said original object through the lens of said lens system onto an image mirror which in turn reflects the image onto the xerographic drum to a slot in a fixed light shield positioned adjacent to the xerographic drum.

Because the photoconductive surface of the xerographic drum is curved, and in constant motion while the machine is in operation, the image of a copy cannot be projected in its entirety directly onto the photoconductive surface of the xerographic drum. In order to obtain a clear well-defined image on the xerographic drum, the lens is moved to project line images of the copy onto the xerographic drum, the movement of the lens being synchronised with the movement of said drum so that the line images are properly registered successively with each other on said drum to produce an actual scaled reproduction of the copy on said drum surface. To effect uniform illumination of the copy, a suitable light source is moved at a uniform rate across the copy as previously described, the motion of the light source being coordinated with the movement of said lens and said drum.

This synchronised and coordinated movement of the lens and light source to scan a copy in correlation with the movement of the xerographic drum is obtained by the scan control mechanism 48 which, in the preferred embodiment of the invention, is provided with means by which the length of scan may be varied to compensate for the length of various types of copy.

Actually, in operation, the lens and light source are moved from their respective starting positions in coordinated motion with the xerographic drum in one direction only, that is, their motion is coordinated with the movement of said drum during the actual scan cycle in which a latent image of the copy is formed on said drum, and then at the end of the scan cycle the lens and light source are rapidly returned to their original starting positions, this latter cycle being appropriately termed a return or retrace cycle. It is apparent that since no shutter system is employed with the lens, the xerographic drum is exposed during the return or retrace cycle, but since the drum is constantly in motion, the original exposed image on said drum is not obliterated during the retrace cycle since by this time the area of the drum carrying the previously formed latent image has passed from the exposure station to developing station. Unlike regular photographic film, the photoconductive surface

of the drum is reusable and consequently no harm is done to its surface during the retrace cycle.

In the image transfer station the powder images previously formed on the xerographic drum are electrostatically transferred to a sheet of transfer material, the electrostatic charge being applied to the transfer material by means of the corona transfer device 34. The electrostatic charge applied to the transfer material during the transfer process is sufficient to cause the transfer material to adhere to said drum even after the material has passed out of corona emission area. It is therefore apparent that there must be provided some means for removing the transfer material from said drum.

Although mechanical means, such as doctor blades common in the printing art, may be used to remove the transfer material from the drum, mechanical means of this type may injure the photoconductive surface of the drum or destroy the powder images on the transfer material. To prevent destruction of the powder images on the transfer material and to prevent damaging the drum, there is provided a pick-off mechanism 36.

COPY COUNTING SYSTEM

In conventional copying machines that are utilized on a leased basis, it is common practice to bill customers at a set rate for the number of copies made. In order to provide an advantageous arrangement for machine users who employ the machine primarily for making multiple copy runs, i.e., on the order of 10 to 25 copies per run, the invention includes a counting system whereby the first few copies of each run are totalized on one counter and the remaining copies of each run are totalized on a second counter. In this manner, it is possible to arrange for billing at a given rate for the first few copies of each run and at a lower rate for succeeding copies of each run. In the particular embodiment disclosed, the first three copies of each run are arranged to be totalized at the higher rate. However, the number of copies to be totalized in this manner may be arranged at will in accordance with the requirements of a particular application. A single original is copied in each run. In addition to providing separate counters to totalize different parts of each multiple copy run, the invention also may include a third counter arranged in convenient viewing location for the operator whereby the number of copies made on each run are indicated for visual inspection.

Conveniently, the counting system counters MC-1 and MC-2 are arranged as shown in Fig. 1 whereby the totals registered by the counter may be observed periodically by opening the access doors on the side of the machine. A "run total" counter MC-3 is arranged on control panel 3 as shown in Figs.

1, 2 and 3, whereby it is in convenient viewing position for the operator. Preferably, counter MC-3 is of the resettable type so that the operator may readily reset it for indicating the copies made from the time of resetting.

In order to operate each of the counting system counters MC-1, MC-2 and MC-3, means are provided operable under control of the programmer 50 to effect proper operation of the respective counters in timed relation to other functions of the machine such as copy-scanning, paper feeding, and sheet removal from the drum. For operating MC-1 and MC-2 the invention includes a stepping switch 5TR (see Figs. 4 to 7) similar to the copy-counting switch, described below, that is actuated under control of the programmer 50. MC-3 is operated once for each copy made by the machine.

As indicated schematically in Fig. 4, coil 5TR (count) is energized to attract the actuator 804. Coil 5TR (count) is energized once for each cycle of operation by the programmer 50. The actuator 804 is held in the inoperative position shown in Fig. 5 by a spring 812. When the actuator 804 is attracted by the coil 5TR (count), an actuator arm 814 engages the ratchet wheel 816 thereby stepping the stepping switch 5TR actuating the contact arm 832. The actuator arm 814 is pivoted on the actuator 804 about pivot point 818 and is held in the position shown in Fig. 4 by means of a spring 820 which is mounted by the bracket 822. As the actuator arm 814 is operated, the arm moves downward engaging the ratchet wheel 816 and moves along with the ratchet wheel until the actuator engages the top of the coil 5TR (count) and the pawl 824 drops behind the next tooth of the ratchet. When the coil 5TR (count) is released, the actuator arm is moved back into the position shown in Figs. 4 and 5 by means of the springs 820 and 812 ready to again step the stepping switch.

The pawl 824 is pivotally mounted on the bracket 822 by means of a shaft 826 which has a coil spring 828 mounted thereon for the purpose of engaging the pawl 824 with the notches of the ratchet 816.

The ratchet wheel 816 is connected by means of a shaft 830 which engages sliding contact arm 832 and contacts 833 mounted on insulated plate 834. Thus, the stepper may be actuated a specific number of times according to how many times the scanner operates thus actuating the coil 5TR (count) and actuates counters MC-1, or MC-2 and MC-3 accordingly. The operation of 12LS and 13LS which are mounted on plate 834 and actuator 804 is described below.

After a particular document has been copied the required number of times, the programmer actuates a coil 5TR (reset) which serves to reset the stepper in a manner to be described below. The resetting actuator arm 838

is held in the unoperative position as shown in Fig. 5 by a spring 840 in a similar manner to that of spring 812 which holds the actuator 804 in its inoperative position.

As the resetting actuator arm 838 is attached by coil 5TR (reset) the outer portion 842 of the arm 838 contacts the pawl 824 and pivots it about shaft 826 thereby releasing the ratchet 816. The ratchet 816 is returned to its starting position by means of return coil spring 844 which will serve to rotate the ratchet in the counterclockwise direction as shown in Fig. 7. As the outer portion 842 of the resetting actuator contacts the pawl 824, a dog 846 pivoted about a shaft 848 is moved in a counterclockwise direction as shown in Fig. 7 by means of a spring 850. The dog 846 serves to maintain the pawl 824 out of contact with the ratchet 816 until the ratchet can return completely and come to rest when protruding portion 851 on ratchet 816 contacts stopping means 852. When the actuator 804 is again operated, the actuator arm 814 will contact an extension 854 of dog 846 thereby releasing the pawl 824 and the resetting actuator arm 838 to their original positions.

During each scan, a pulse is applied to counter MC-1 or MC-2. The stepping switch 5TR is wired so that the first three copies are counted on MC-1 and the remainder of the copies made are counted on MC-2. When the stepping switch has been actuated 15 times, which is the number of contacts on the switch in this case, and 15 copies are counted, sliding contact arm 832 moves past the position shown in dotted lines in Fig. 6 to open switch 12LS mechanically which allows the counter to continue to count copies being made as described below. When the switch 12LS is opened by the sliding contact arm as 5TR (count) is actuated, switch 13LS is closed to keep the coil 5TR (count) energized. Switch 13LS will keep the coil of 5TR (count) energized until the power is cut off at end of the machine programme. This is done in order to assure that the 5TR switch is completely stepped into the fifteenth or last position. Thus, the machine can continue to operate in a continuous or multiple mode with the stepper in the last or fifteenth position and all counts going on to MC-2. A switch-over point between MC-1 and MC-2 can be controlled by selecting the electrical connection between the contacts on the stepper and the counters. A given switch over point is established by means of a connector which is pre-wired to give the desired switch-over between the counter MC-1 and MC-2.

As mentioned above, alternative charging arrangements may be made by adjusting the connections of the stepper contacts and the counters. In one alternative arrangement, three counters are provided in place of MC-1 and MC-2 described above, the first counter being

actuated by every copy made on each reproducing run by connecting the counter to the contact arm 832. A second counter is connected to the first five contacts contacted by the arm 832 moving from its reset position and a third counter is connected to the second five contacts, that is the sixth to tenth contacts contacted by the arm 832. In this arrangement, the first counter counts all the copies made, the second counter counts the first five copies made in each reproducing run, and the third counter counts the second five copies made in each reproducing run. If the first and third counter are charged at a penny per number recorded and the second counter is charged at twopence per number recorded, the rate of charging is equivalent to threepence per copy for the first five copies, twopence per copy for the second five copies and a penny per copy for each copy above ten in each reproducing run. The contact arm 832 is reset to its first position at the end of a printing cycle, or to avoid abuse of the system, can be arranged to be reset also when the platen cover 6 is lifted from the platen to change an original to be copied. For example, the platen handle may be connected to a mercury switch which is tilted to break electrical connection between its contacts when the platen cover is lifted.

WHAT WE CLAIM IS:—

1. Copy counting means for indicating cumulatively the number of copies produced by a copying machine during successive reproducing runs comprising a first counter for indicating cumulatively the total of a first predetermined number of copies of each reproducing run, a second counter for indicating cumulatively at least a second predetermined number of copies in excess of the first predetermined number of copies of each reproducing run, counter actuating means responsive to the production of each copy and switch means for causing the first counter to be actuated by the actuating means following the production of each of the first predetermined number of copies of each reproducing run and for causing the second counter to be actuated following production of each of the second predetermined number of copies in excess of the first predetermined number of copies of each reproducing run.

2. Counting means as claimed in claim 1 wherein the switch means is adjustable to adjust the predetermined numbers.

3. Counting means as claimed in claim 1 or 2 further comprising a third counter responsive to the actuating means for indicating cumulatively each copy of each reproducing run.

4. Counting means as claimed in any one of claims 1 to 3 further comprising a further counter in addition to the previously men-

tioned counters and responsive to the actuating means for indicating cumulatively each copy of each reproducing run, the further counter being resettable.

5. Copy counting means substantially as herein described with reference to and as illustrated in the accompanying drawings.

6. In a xerographic reproducing machine including the combination of a xerographic drum journaled for rotation, charging means positioned to place a uniform electrostatic charge on said xerographic drum, a copyboard for supporting copy substantially in a plane, an optical scanning means having a light source and a movable lens positioned to project a light image from copy on said copyboard onto said xerographic drum, developing means positioned to effect development of an electrostatic latent image formed on said xerographic drum, a source of sheet material, paper feed means positioned to feed single sheets of sheet material seriatim from said source of sheet material into contact with said xerographic drum, transfer means positioned to effect transfer of a developed electrostatic image from said xerographic drum onto sheet material, pick-off means positioned adjacent to said transfer means, said pick-off means being adapted to pick off sheet material from said xerographic drum, drive means connected to said xerographic drum to rotate said drum at a constant speed, scan control means for reciprocating said movable lens to scan a copy on said copyboard, the movement of said movable lens in one direction being synchronised with the movement of said xerographic drum by said scan control means, programmer means controlled by said scan control means for effecting operation of said paper feed means in timed relation to the position of a developed electrostatic image on said xerographic drum and to effect operation of said pick-off means to pick off said material from said xerographic drum, and means settable to condition the machine to produce single or multiple copy reproductions of copy placed on the copyboard, the improvement comprising copy counting means responsive to the programmer means for indicating cumulatively the number of copies of sheet material produced by the machine during successive reproducing runs, said copy counting means including a first counter for indicating cumulatively the total of a first predetermined number of copies of each reproducing run, a second counter for indicating cumulatively the total of all copies in excess of the first predetermined number of copies of each reproducing run, and switching means actuated under control of the programmer for causing said first counter to be actuated upon the production of each of the first predetermined number of copies of reproducing run and for causing said second counter to be ac-

actuated by every copy made on each reproducing run by connecting the counter to the contact arm 832. A second counter is connected to the first five contacts contacted by the arm 832 moving from its reset position and a third counter is connected to the second five contacts, that is the sixth to tenth contacts contacted by the arm 832. In this arrangement, the first counter counts all the copies made, the second counter counts the first five copies made in each reproducing run, and the third counter counts the second five copies made in each reproducing run. If the first and third counter are charged at a penny per number recorded and the second counter is charged at twopence per number recorded, the rate of charging is equivalent to threepence per copy for the first five copies, twopence per copy for the second five copies and a penny per copy for each copy above ten in each reproducing run. The contact arm 832 is reset to its first position at the end of a printing cycle, or to avoid abuse of the system, can be arranged to be reset also when the platen cover 6 is lifted from the platen to change an original to be copied. For example, the platen handle may be connected to a mercury switch which is tilted to break electrical connection between its contacts when the platen cover is lifted.

WHAT WE CLAIM IS:—

1. Copy counting means for indicating cumulatively the number of copies produced by a copying machine during successive reproducing runs comprising a first counter for indicating cumulatively the total of a first predetermined number of copies of each reproducing run, a second counter for indicating cumulatively at least a second predetermined number of copies in excess of the first predetermined number of copies of each reproducing run, counter actuating means responsive to the production of each copy and switch means for causing the first counter to be actuated by the actuating means following the production of each of the first predetermined number of copies of each reproducing run and for causing the second counter to be actuated following production of each of the second predetermined number of copies in excess of the first predetermined number of copies of each reproducing run.

2. Counting means as claimed in claim 1 wherein the switch means is adjustable to adjust the predetermined numbers.

3. Counting means as claimed in claim 1 or 2 further comprising a third counter responsive to the actuating means for indicating cumulatively each copy of each reproducing run.

4. Counting means as claimed in any one of claims 1 to 3 further comprising a further counter in addition to the previously men-

tioned counters and responsive to the actuating means for indicating cumulatively each copy of each reproducing run, the further counter being resettable.

5. Copy counting means substantially as herein described with reference to and as illustrated in the accompanying drawings.

6. In a xerographic reproducing machine including the combination of a xerographic drum journaled for rotation, charging means positioned to place a uniform electrostatic charge on said xerographic drum, a copyboard for supporting copy substantially in a plane, an optical scanning means having a light source and a movable lens positioned to project a light image from copy on said copyboard onto said xerographic drum, developing means positioned to effect development of an electrostatic latent image formed on said xerographic drum, a source of sheet material, paper feed means positioned to feed single sheets of sheet material serially from said source of sheet material into contact with said xerographic drum, transfer means positioned to effect transfer of a developed electrostatic image from said xerographic drum onto sheet material, pick-off means positioned adjacent to said transfer means, said pick-off means being adapted to pick off sheet material from said xerographic drum, drive means connected to said xerographic drum to rotate said drum at a constant speed, scan control means for reciprocating said movable lens to scan a copy on said copyboard, the movement of said movable lens in one direction being synchronised with the movement of said xerographic drum by said scan control means, programmer means controlled by said scan control means for effecting operation of said paper feed means in timed relation to the position of a developed electrostatic image on said xerographic drum and to effect operation of said pick-off means to pick off said material from said xerographic drum, and means settable to condition the machine to produce single or multiple copy reproductions of copy placed on the copyboard, the improvement comprising copy counting means responsive to the programmer means for indicating cumulatively the number of copies of sheet material produced by the machine during successive reproducing runs, said copy counting means including a first counter for indicating cumulatively the total of a first predetermined number of copies of each reproducing run, a second counter for indicating cumulatively the total of all copies in excess of the first predetermined number of copies of each reproducing run, and switching means actuated under control of the programmer for causing said first counter to be actuated upon the production of each of the first predetermined number of copies of reproducing run and for causing said second counter to be ac-



tuated upon the production of each copy in excess of the first predetermined number of copies of each reproducing run.

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ERRATUM

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Page 3, line 17, for "entirely" read "entirety"

THE PATENT OFFICE
4th December 1967



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