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[54] PREDETERMINED COUNTER FOR ELECTROSTATIC COPYING APPARATUS

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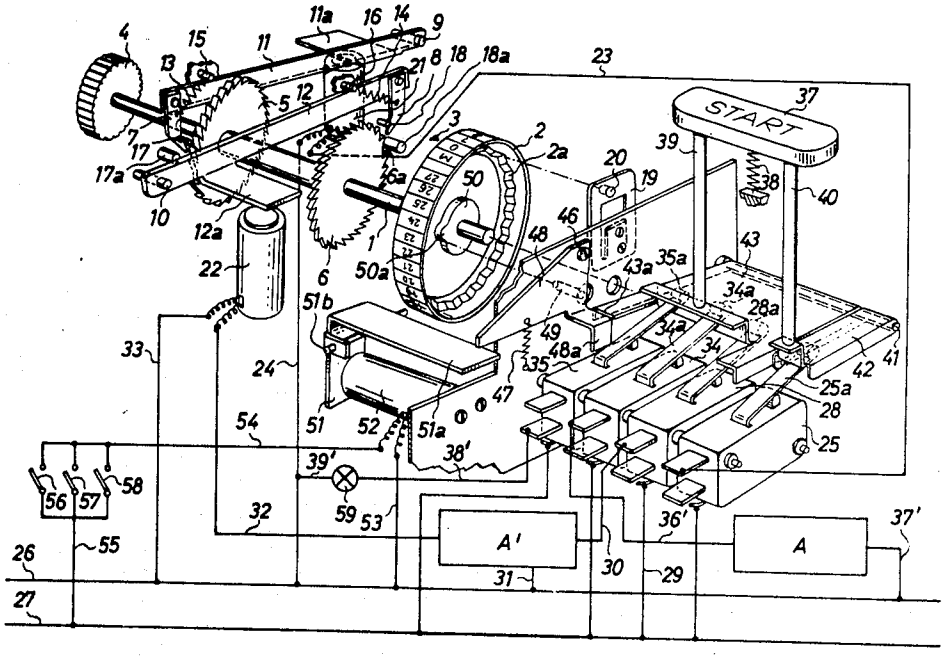
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[57] **ABSTRACT**

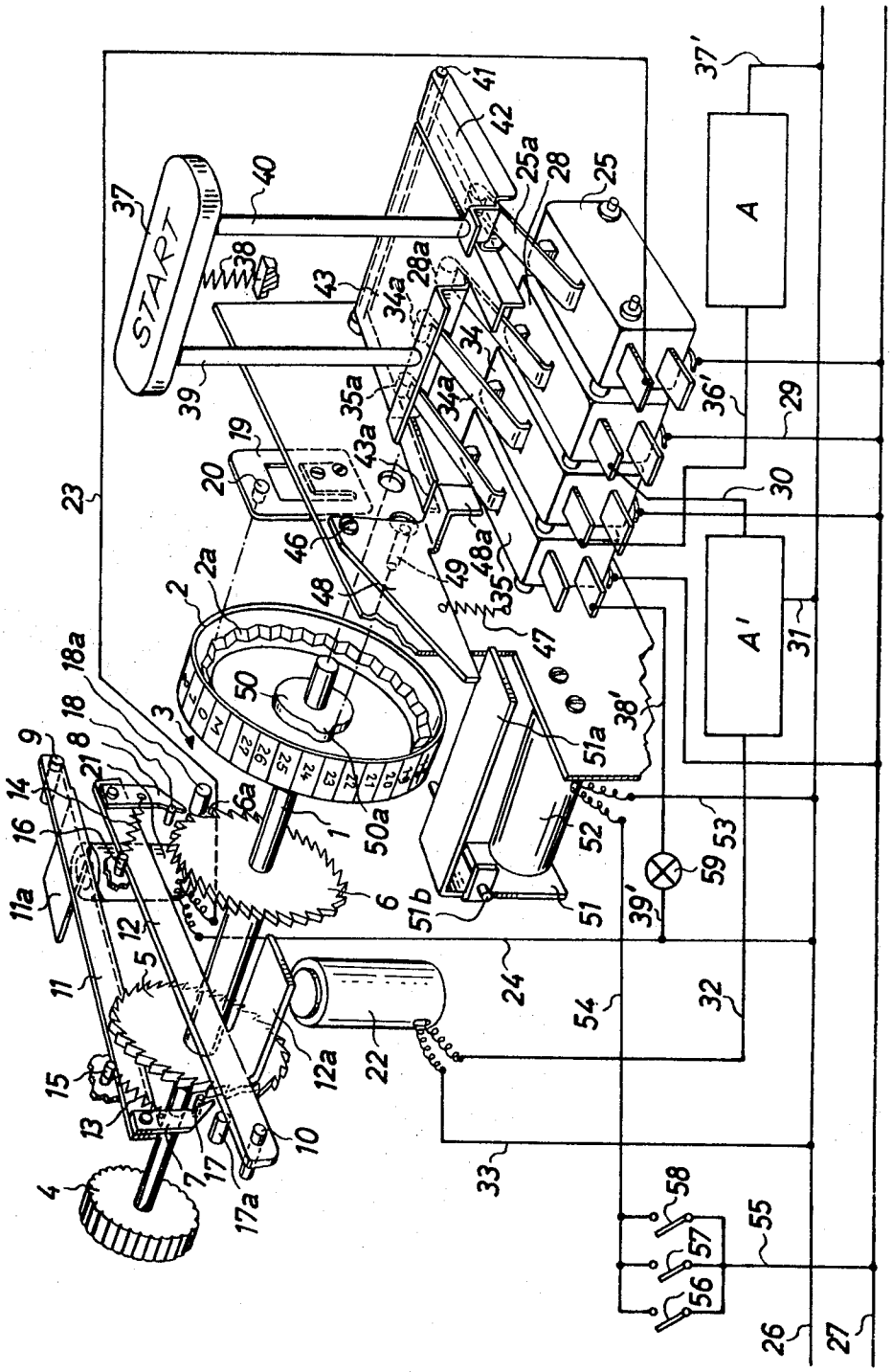
In an electrostatic copier a switch can be operated for initiating a copying sequence. A number wheel is mounted on the shaft and can be turned from a zero position to a plurality of operating positions in each of which it preselects a specific number of repetitions of the sequence. An externally accessible knob is provided for turning the shaft manually to place the number wheel in the desired operating position. A device is provided which incrementally returns the number wheel to zero position as each of the respective sequences is executed. An additional device is provided which is operated every time the switch is actuated and which causes the number wheel to move from its zero position to a respective operating position incrementally in dependence upon the number of times the switch is operated.

12 Claims, 1 Drawing Figure



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PREDETERMINED COUNTER FOR ELECTROSTATIC COPYING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates generally to copying apparatus, and more particularly to an electrostatic copier.

Electrostatic copiers are well enough known not to require a detailed description. For purposes of the present invention, be it pointed out, it is immaterial in what specific way they effect the production of a copy.

Various different types of electrostatic copiers are known. These differ in various respects from one another, but in each one it is necessary that—if a series of several copies of the same original is to be made—the number of copies which it is desired to make be preselected by setting manually a preselecting switch provided for this purpose. If, for instance, a relatively small number of copies is to be made, say four copies, then the effort required for setting the repeat switch or preselecting switch is out of keeping with the results which are to be obtained, in so far as the time required for setting the preselector is concerned.

Although it is clearly desirable that an improvement should be found concerning this problem, no such improvement heretofore has been forthcoming.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to provide such an improvement.

More particularly it is an object of the present invention to provide an electrostatic copier which is not possessed of the aforementioned drawback.

Still more specifically it is an object of the present invention to provide an electrostatic copier in which it is not necessary to preselect a number of copies to be made via the preselector, although this is still possible if and when desired.

At the same time it is an additional object of the invention to provide such an improved copier which is relatively simple and therefore reliable in its operation.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides, in an electrostatic copier, in a combination of first means operable for initiating a copying sequence and second means which is incrementally advanceable in a first direction from a zero position to a plurality of operating positions in each of which it preselects a specific number of repetitions of said sequence. Third means is provided for manually advancing the second means in the aforementioned first direction and fourth means is provided for incrementally returning the second means in a second direction opposite the first direction towards the zero position in response to execution of the respective copying sequence. Finally, there is also provided fifth means connected with the first and second means and being operative for incrementally advancing the second means in the aforementioned first direction in response to operation of the first means.

The second means comprises a number wheel which is mounted on a turnable shaft which can be turned manually by means of the third means to thereby preselect the number of copies which it is desired to make. At the same time, however, the present invention provides for gears mounted on this shaft and cooperating with electromagnetically operated pawls which, when they are actuated, either advance the shaft in a sense moving it from zero position to a respective operating position, or in a sense returning it from the respective operating position towards the zero position. With this arrangement a relatively large number of copies can be preselected by setting the second means to the desired operating position via the third means, just as before. On the other hand, a smaller number of copies need not be preselected in this manner, but can instead be preselected by rapidly operating the first means—which is usually the start switch of the copier—for a number of times corresponding to the number of copies it is desired to make. This can be done so rapidly and so conveniently that it is actually faster—as related to the total time required for preselection and waiting until the copies are completed—than if this relatively small number of copies were preselected in the usual manner by manually setting the second means via the third means. On the other hand, of course, it is entirely up to the machine operator or user, at what point he wishes to make use of one or the other possibilities. Thus, some persons may find it convenient to preselect fifteen or twenty copies by rapidly operating the first means a corresponding number of times, and will use the third means for manually preselecting the number of copies via the second means only from 16 or 21 copies on, simply to name an example. Other persons may have a different preference.

According to the invention it is further advantageous if the electromagnetic device which operates the fourth means for returning the second means to its zero position is connected in circuit with an electrically operable component which is periodically energized whenever a copying sequence takes place, that is whenever a single copy is being made. Such a component may for instance be the electromagnetic coupling of the illuminating carriage conventionally employed in such copying devices. Furthermore, the invention also advantageously provides for a single operating switch which, when operated, in turn actuates a switch energizing the electromagnetic device of the fifth means, a switch which energizes the aforementioned electrically operable component, and if desired additional switches which energize electrically operable components of the copying apparatus which are continuously energized for the duration of a multi-copy sequence. Such additional devices may include signal devices such as signal lamps or the like.

It is also advantageous for the second means to control a retaining arrangement which, when the main switch has been depressed and in turn has energized the various other switches, will retain those switches which control the periodically energized component and the permanently energized components, to closed energizing position. In this manner the main switch of the apparatus controls in the simplest possible way all periodic and non-periodic operating functions of the copier which are required for the multi-copying process, and deactivates the entire copier after the last or final copy of a multi-copying process is completed.

This retaining device may also cooperate with an additional electromagnetic device which is connected in circuit with safety switches intended to operate in a circuit-deactivating manner if malfunctions for instance occur in the transport arrangement for the copying paper, in the transport arrangement for the copying-drum cleaning device, or when the housing of the electrostatic copier is opened. In this manner a once selected multi-copy process is immediately interrupted if malfunctions occur or if the housing of the electrostatic copier is opened, this being an important safety factor.

It is further advantageous in accordance with the present invention if the second means is so constructed that it has a position or setting in which it permits continuous copying, rather than a preselected number of copies. According to the invention the construction is such that when the second means is placed in this continuous-copying position, the operation of the fourth means which normally would incrementally return the second means towards its zero position, is defeated by a defeat arrangement provided for this purpose. In a very simple manner the defeat arrangement may be in form of a cut-out provided in the gear which cooperates with the pawl activated by the fourth means, and which cut-out will be opposite the pawl—and therefore prevent engagement of the same with the teeth of the gear—when the second means is moved to the continuous-copying position. In this case the copier will be stopped only by manually returning the second means to zero position via the third means. The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will

be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a perspective view, combined with a circuit diagram, of an apparatus embodying the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before discussing the FIGURE in detail it is emphasized that only those components of an electrostatic copier have been illustrated which are provided in accordance with the present invention, or which are of importance for an understanding of the present invention. All other components have been omitted for the sake of clarity and it is emphasized that all such components which are not shown may be entirely conventional and are well known to those skilled in the art.

With this in mind, and now discussing the FIGURE in detail, it is pointed out that a shaft is identified with reference numeral **1** and is turnable about its longitudinal axis, being mounted in suitable manner for this purpose. Secured on the shaft **1** for rotation therewith is a number wheel or preselector wheel **2** whose circumferential edge face is provided with a plurality of setting-indicating or position-indicating indicia each of which indicates the number of repeat copies which has been preselected. In the illustrated embodiment the number wheel has 27 operating-position settings, a zero position setting, and a multi-copy or continuous-copy setting M. An index indicator **3** shows to which particular position the wheel **2** has been set. Accessible at the exterior of the copier is a knob **4** which permits turning of the shaft **1** manually until the desired setting (indicating the number of copies which are intended to be produced) is located opposite the mark **3**.

As the drawing shows, the wheel **2** is not the only component mounted for turning movement on the shaft **1**. There is further provided a gear **5** which is mounted on the shaft **1** for rotation therewith and which serves for advancing the number wheel **2** from zero position towards one of its operating positions **1–27** or M. An additional gear **6** is similarly mounted on the shaft **1** turnable therewith, and this serves for returning the number wheel **2** in opposite direction from the position M or from one of its operating positions **1–27** to the zero position. The gear **5** cooperates with a pawl **7** carried by an arm **11** which is secured to a stationary portion of the copier, for instance the frame, for movement about a pivot **9**. Similarly, the gear **6** cooperates with a pawl **8** which is mounted on a shaft **12**, the latter in turn being secured to a stationary component of the copier for swinging movement about the pivot **10**. As shown, the pawls **7** and **8** are located on opposite lateral sides of the shaft **1**. A tension spring **13** is connected with the pawl **7** at one of its ends, and with the other end the spring **13** is connected to a retaining pin **17** which is also mounted on a stationary portion of the copying device. Similarly, a tension spring **14** is connected to the pawl **8** and a stationary pin **18**. The springs **13** and **14** draw the pawls **7** and **8** towards the respectively associated pins **17** and **18**, and at the same time they draw the arms **11** and **12** against stationary abutment pins **15** and **16**, respectively.

The drawing clearly indicates that the pins **17** and **18** have the function of maintaining the pawls **7** and **8** remote from their respectively associated gears **5** and **6**, when the pivotable arms **11** and **12** are in rest position. In this case the number wheel **2** can be turned freely in both directions, with a pin **20** which is here shown as mounted on a leaf spring **19**, biasingly engaging in respective depressions **2a** of the number wheel **2** in order to prevent the latter from accidental movement out of the once-selected position.

There are further provided pins **17*a*** and **18*a*** which are also mounted stationarily on a stationary part of the copier, and which in operating position press the respectively associated pawls **7** and **8** into engagement with the gears **5** and **6**, respectively, so that they cooperate with the pawls **7** and **8**.

The arm **11** is provided with a projection **11*a*** and similarly the arm **12** is provided with a projection **12*a***. Each of these projections constitutes an armature cooperating with an electromagnetic device **21** and **22**, respectively. The device **21** together with the projection **11*a*** serves for operating the pawl **7** in a sense advancing the number wheel **2** from zero position to one of its operating positions. It is connected via conductors **23** and **24** to the electric supply lines **26** and **27**; with a micro-switch **25** being interposed in the conductor **23**. Additional conductors **29**, **30** and **31** cooperate with a micro-switch **28** to connect a device A′ with the current supply conductors **26** and **27**. The device A′ is diagrammatically illustrated and represents those components of the device which become energized periodically, whenever the copying sequence involving the production of a single copy takes place. In other words, every time a copy is made, the components of the device A′ are energized and subsequently again deenergized. Such components may be a magnetic coupling which couples the illuminating carriage or the optical scanning device of the electrostatic copying apparatus with the main drive motor, a heating device which may be switched on when a new copy sheet moves into position, a control device which scans the guidance of the copying paper or the like. It is of no particular consequence for the purposes of the present invention what specific components are incorporated within the definition of the device A′, as long as it is understood that all of these components are energized, every time a copy is made. Conductors **32** and **33** connect the device A′ with the electromagnetic device **22** so that the latter becomes energized every time a copy is made, that is every time a copying sequence is executed. Thus, whenever a copy is made, the electromagnetic device **22** acts upon the pawl **8** in a sense turning the gear **6** and thereby the shaft **1** and the number wheel **2** incrementally—that is by one step—from the operating position which the number wheel **2** assumes at the time, back towards the zero position.

A second device A is also diagrammaticaly illustrated and is representative of any or all such components which are continuously energized throughout the copying sequences, that is which will remain energized until the last of a plurality of copying sequences has been completed. Again it is of no importance precisely what components are included in the definition of the device A, but it is pointed out that they may for instance include the current supply for the main drive motor, various lights required for the copying process, the corona discharge device or the like. The device A is connected with micro-switches **34** and **35** via conductors **36′** and **37′**, and via conductors **38′** and **39′** these micro-switches are also connected with a signal lamp **59** which becomes energized when the machine is in operation to indicate that copying is going on.

A main switch or first means is provided and is identified with reference numeral **37**, this being the start switch or start button. A return spring **38** tends to move it to inactivated position as shown in the FIGURE. The start switch **37** is provided with two actuating rods **39** and **40** which each act upon a plate member **42** and **43**, respectively, pivotably mounted for movement about the pivot **41** which is in turn mounted on a stationary part of the copier. It is clear from the drawing that when the switch **37** is depressed, the plates **42** and **43** are pivoted in counterclockwise direction. In so doing they act upon the actuating arms **25*a***, **28*a***, **34*a*** and **35*a*** of the micro-switches **25**, **28**, **34** and **35**, respectively, thus simultaneously closing these switches and placing them in operative position.

After the switch **37** has been depressed and is released, it immediately returns to its illustrated inactive position under the influence of the spring **38**. Simultaneously, the plate **42** is also immediately returned to its inactive position by the biasing action exerted upon it by the actuating lever **25*a*** of the micro-switch **35**; this means that the micro-switch **25** removes at once to open circuit-interrupting position.

Matters are different with the plate **43**. When the plate **43** is displaced in counterclockwise direction as pointed out before, a projection **48*a***—provided on an arm **48** which is pivoted at

46 to a stationary portion of the copying apparatus and which is under the influence of a tension spring 47—engages behind a cooperating projection 43*a* of the plate 43. Thus, the plate 43 is incapable of returning to its upper rest position when the switch 37 is released. A pin 49 of the arm 48 cooperates with a cam 50 provided on the shaft 1 or on the wheel 2 and having a projection 50*a* which, when the wheel 2 is in its zero position, abuts the projection 48*a* and lifts it away from the projection 43*a* of the plate 43, enabling the latter to move upwardly to its rest position and permitting the micro-switches 28, 34 and 35 to return to their normally open circuit-interrupting position.

In addition there is provided an electromagnet 52 which is connected via conductors 53, 54 and 55 and via switches 56, 57 and 58, with the current supply conductors 26 and 27. An arm 51a is provided on the armature 51 of the magnet 52 and the armature 51 is pivoted at 51*b* to a stationary portion of the copier. The switch 56 may for instance close in non-illustrated but well known manner when a feeler which engages the supply stack of copying paper (not illustrated) indicates that the paper supply becomes to low. Similarly, this switch 57 may close, also in known manner, when the supply of copying paper becomes interrupted. The switch 58, finally, may for instance close when the housing of the electromagnetic copier is opened, for instance by removal of a side wall thereof. None of these features are illustrated because in themselves they do not form a part of the present invention, but it will be appreciated that the switches 56, 57 and 58 are safety switches which operate in case of a malfunction or in case of opening of the housing to protect the device and the users from possible harm. When the switches 56–58 should close, the components in the devices A and A′ are immediately de-energized as an automatic response. At the same time, however, the electromagnetic device 52 becomes de-energized in such a case.

In operation of the illustrated electrostatic copier, and assuming that it is intended to make a relatively small number of copies—say 10 of them—the switch 37 is depressed rapidly as many times as copies are desired to be made, that is in this particular example 10 times. Every time the switch 37 is so depressed, the microswitch 25 is momentarily closed and the magnet 21 energized. This causes the pawl 7 to act upon the gear 5 in a sense turning the shaft 1 and thereby the number wheel 2 by one increment from its zero position. In other words, the first time the switch 37 is so depressed, the number wheel 2 will be turned from its zero position to the operating position 1 in which the making of one copy is preselected. The first time the switch 37 is so depressed, the projection 50a of the cam 50 moves out of engagement with the arm 48 so that the portion 48*a* thereof can engage the portion 43*a* of the plate 43, retaining the latter in its lower position and thus preventing the micro-switches 28, 34 and 35 from returning to open position, so that the components in the devices A, A′ and the signal lamp 59 remain energized. As the copier begins the copying sequence in well known non-illustrated manner, the device A′ supplies a current pulse to the electromagnet 22 whenever a copying sequence takes place, that is with every copy that is being made. With each such current pulse the magnet 22 acts upon the pawl 8 in a sense returning the number wheel 2 by one increment towards its zero position, and this continues until the zero position is reached. As the number wheel 2 moves from the operating position 1 to the zero position, the projection 50*a* disengages the arm 48 from the plate 43, permitting the same to move to upper position and permitting the switches 28, 34 and 35 to return to open position to thereby interrupt current supply to all components of the devices A and A′, as well as to the signal lamp 59.

If a larger number of copies is desired, where the preselecting by means of the switch 37 would take more time than the manual setting of the number wheel 2, then the number wheel 2 is set to the desired operating position by turning the knob 4. The number of copies so set increases by one when subsequently the switch 37 is depressed; of course, if the switch 37 is depressed more than once then the number of times the switch is depressed must be added to the preselected setting of the number wheel 2 and together these two figures will indicate the numbers of copies which will be made. If the number wheel 2 has been set with the knob 4 in the manner such as discussed, the operation of the copying sequence is of course the same as described before.

If it is desired to obtain a number of copies which is greater than that for which provision is made on the number wheel 2, that is for instance if 28 or 30 copies are to be provided (the settings on the number wheel 2 only go up to 27), then the number wheel 2 is turned with the knob 4 until its setting M—indicating multi-copying—is in registry with the marker 3. In this case a cut-out 6*a* provided for this purpose in the gear 6 is located opposite the pawl 8, so that despite the energization of the magnet 22 and movement of the pawl 8, during each individual copying sequence, the pawl 8 is incapable of advancing the gear 6 and therefore cannot return the number wheel 2 towards its zero position. In this case the copying device continues to operate until such time as it is de-activated manually, meaning normally until the desired number of copies—which can be supervised by a suitable counter provided for this purpose (not illustrated) has been reached. At that time the number wheel 2 is returned to its zero position with the knob 4.

It will be seen that by resorting to the present invention the ease of operation of a copying apparatus of the type under discussion is considerably improved and that, similarly, the versatility of the apparatus is improved in terms of making the apparatus more responsive to the individual preferences of different operators.

It will be understood that each of the elements described above, or two or more together, may also be useful in other applications differing from those described above.

While the invention has been illustrated and described as embodied in an electrostatic copier, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. In an electrostatic copier, in combination, first means operable for initiating a copying sequence; second means incrementally advanceable in a first direction from a zero position to a plurality of operating positions in each of which it preselects a specific number of repetitions of said sequence; third means for manually advancing said second means in said first direction; fourth means for incrementally returning said second means in a second direction towards said zero position in response to execution of the respective sequence; and fifth means connected with said first and second means and operative for incrementally advancing said second means in said first direction in response to operation of said first means.

2. In a copier as defined in claim 1, said second means comprising a rotatable shaft and a number wheel mounted on said shaft for rotation therewith.

3. In a copier as defined in claim 2, said fourth means comprising one gear fast with said shaft, one pawl engageable with said gear in a sense turning said shaft in said second direction, and one electromagnetic device operable for engaging said pawl with said gear; and wherein said fifth means comprises another gear fast with said shaft, another pawl engageable with said another gear in a sense turning said shaft in said first direction, and another electromagnetic device operable for engaging said another pawl with said another gear.

4. In a copier as defined in claim 3; further comprising an electrically operated component arranged to be energized

during each copying sequence; and wherein said one electromagnetic device is connected in circuit with said component.

5. In a copier as defined in claim 4, said first means comprising a main switch, and said fifth means further comprising an auxiliary switch in circuit with said another electromagnetic device and operable for energizing the same in automatic response to operation of said main switch; and at least one additional switch in circuit with said component and also operable in a sense energizing said component in automatic response to operation of said main switch.

6. In a copier as defined in claim 5, said auxiliary switch and said additional switch being normally open; and further comprising retaining means operable in response to operation of said main switch and cooperating with said additional switch for maintaining the same in closed position while said second means is in a position other than said zero position.

7. In a copier as defined in claim 6; further comprising at least one additional electrically operated component arranged to be energized during each copying sequence; and at least one other normally open additional switch in circuit with said additional component and cooperating with said retaining means so as to be maintained thereby in closed position while said second means is in a position other than said zero position.

8. In a copier as defined in claim 7; and an actuating element operatively connected with said main switch and said one and said other additional switches for displacing both of the latter from said normally open to said closed positions in response to operation of said main switch, and for operating said retaining means.

9. In a copier as defined in claim 6; further comprising cam means on said number wheel and operative for releasing said retaining means in a sense permitting return of said auxiliary and said additional switches to said normally open position in automatic response to said number wheel returning to said zero position.

10. In a copier as defined in claim 6; further comprising at least one safety switch operable in automatic response to occurrence of a predetermined safety hazard; and a further electromagnetic device in circuit with said safety switch and acting upon said retaining means in a sense effecting release of said auxiliary and said additional switches in response to operation of said safety switch.

11. In a copier as defined in claim 3, said second means being advanceable to a continuous-copying position via said third means; and further comprising defeat means for defeating operation of said fourth means when said second means is in said continuous-copying position.

12. In a copier as defined in claim 11, said defeat means comprising a cut-out provided in said one gear and located opposite said one pawl when said second means is in said continuous-copying position, to thereby preclude engagement of said one pawl with said one gear.

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