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(54) IMPROVEMENTS IN AND RELATING TO ELECTROSTATIC COPYING APPARATUS

(71) We, AGFA-GEVAERT AKTIENGESELLSCHAFT, a body corporate recognised under the laws of the Federal Republic of Germany, of Leverkusen, Federal Republic of Germany, 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:—

The invention relates to electrostatic copying apparatus.

Electrostatic copying apparatus has previously been proposed in which the preselection of the number of copies to be produced is possible both by means of direct setting of a control wheel by an operator and, especially in the case of a small number of repeat copies, also by means of multiple actuation of an operating switch which initiates the copying operation. In apparatus of this kind, advancing and returning means for the control member are actuated by means of electromagnets. In addition, in these arrangements the number of copies set directly at the control wheel is in each case increased by one copy when the operating switch is actuated to initiate the copying operation. The operator must therefore take care to ensure that the number set directly at the control wheel does not indicate the total number of copies to be produced, but only the number of repeat copies following the first copy.

The invention provides electrostatic copying apparatus which includes a control member for controlling the number of copies of an original to be produced, which control member is arranged to move a predetermined distance on the production of each copy towards a position, the zero position, in which the copy production process is discontinued, advancing means capable of moving the control member away from the zero position, operating switch means arranged on actuation to initiate copy production and an actuating member movable to actuate the operating switch means and mechanically coupled to the advancing means so that movement of the actuating member can be transmitted by the advancing means to the control member to advance it.

It is possible for the apparatus of the invention to be simple and reliable in operation without the use of an electromagnet for advancing the control member in the relatively costly manner of previously proposed arrangements.

Advantageously, the advancing means comprises a toothed member and a projecting member arranged to engage the toothed member to move it in one direction, and the actuating member is mechanically coupled to the projecting member.

The arrangement is advantageously such that when the actuating member is moved to actuate the operating switch means it can advance the control member away from its zero position by a distance equal to that moved by the control member towards its zero position during the production of one copy. Preferably, after actuation of the operating switch means, the actuating member can be moved to advance the control member further, and, preferably, the actuating member is in the form of an operating key which can be depressed by an operator, the key, on each depression thereof, being capable of advancing the control member by a distance equal to that moved by the control member towards its zero position during the production of one copy.

The advancing means is advantageously so coupled to the control member as to allow relative movement between the two of an amount corresponding to the distance moved by the control member during the production of one copy. When the arrangement is such that the control member can be advanced directly by an operator in addition to indirect advancement on movement of the actuating member, the coupling between the advancing means and the control member is preferably such that, after direct advancement of the control member, on movement of the actuating member to actuate the operating switch means, the control member is not advanced by the advancing means. With this arrangement, on direct advancement of the

control member by an operator the advancing means remains one step behind in relation to the control member and this is only made up after the actuating member has been moved to actuate the operating switch means. With such arrangement it is possible for the number of copies set directly by the operator at the control member to indicate the total number of copies produced and the control member can thus always show the exact number of copies to be produced after the initiation of the copying operation, no matter whether the number is set directly at the control member or by movement of the actuating member. The advancing means may be coupled to the control member by means of a pin and slot coupling having free play of the distance moved by the control member during the production of one copy.

Advantageously, the control member is arranged to be movable away from its zero position by rotation in one direction and movable towards its zero position by rotation in the opposite direction. The advancing means preferably comprises a toothed wheel mounted co-axially with the control member.

The control member is advantageously arranged to actuate a switch to discontinue the copy production process when the control member reaches its zero position. Preferably, there is also provided means for ensuring that the control member, is advanced in steps each corresponding to the distance moved by the control member during the production of one copy.

Advantageously, the apparatus includes means for returning the control member to its zero position, the returning means being coupled to a component of the apparatus that operates once during the production of each copy and being arranged to move the control member its uredetermined distance towards its zero position on the operation of the said component. In principle, this returning means, which preferably comprises a toothed member and a projecting member arranged to engage the toothed member to move it in one direction, could be driven by means of an electro-magnet controlled by the copying operation. However, a particular simplification of the apparatus and at the same time an improvement in the functioning of a scanning carriage for the original, which is necessary in book copying apparatus, can be produced if the returning means is driven by a pneumatic cylinder which is connected to a brake cylinder for the scanning carriage for the original being copied, which carriage is arranged to return to its initial position after each copy.

Advantageously, an auxiliary control member is also provided which can be set by means of the control member and/or the actuating member and which controls a switch to change over from a first copy counter to a second copy counter. This auxiliary control member is preferably connected to the control member by means of a resilient follower, and an adjustable stop provided to limit movement of the auxiliary control member. The adjustable stop is advantageously in the form of a deflecting cam for the follower which brings the resilient follower out of engagement, and the cam is preferably arranged on an interchangeable holder. In an arrangement in which the returning means comprises a toothed wheel and a projecting member arranged to engage the toothed member to move it in on direction, the auxiliary control member is preferably rotatably mounted coaxially with resepct to the toothed wheel, the adjustable stop being arranged to limit the angle of rotation of the auxiliary control member, and the projecting member is arranged to engage the said auxiliary control member in addition to the toothed wheel of the returning means.

By means of the auxiliary control member and the follower controlled by the deflecting cam, the result can be obtained, in a simple manner, that a further copy counter, as is required for example for separate counting of first copies and repeat copies, can be controlled without being influenced by any manipulations carried out by turning the control member backwards and forwards. On the other hand, the switching programme may be selected as required by exchanging the holder for another one with a different deflecting cam.

Apparatus constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a portion of the apparatus of the invention;

Figure 2 shows a perspective view of a further portion of a modified form of the apparatus shown in Figure 1; and

Figure 3 shows a block wiring diagram for the control of two copy counters of the apparatus shown in Figure 2.

Referring to the accompanying drawings, and especially to Figure 1, on a spindle 1 fixed to the apparatus a toothed wheel 2 is rotatably mounted. A main actuating member in the form of a lever, indicated generally by the reference numeral 6, which carries an operating key 7, is pivotably mounted on a spindle 5 fixed to the apparatus. A switching pawl 3 linked to the lever 6 is arranged to co-operate with the toothed wheel 2, the pawl being arranged to engage and rotate the toothed wheel in the direction of the arrow A by one step each time the lever 6 or operating key 7 is depressed by an operator from a position resting against a stop 47 to the position shown in Figure 1. A tension spring 4 secured to a pin 3*a* on

the pawl 3 and a pin 6*a* on the lever 6 urges the pawl into engagement with the toothed wheel 2. A return spring 45 secured at one end to the pin 6*a* on the lever 6 and at the other to a fixed pin 46 returns the lever 6 to its position against the stop 47 on release by the operator. The pawl 3 is formed with an inclined surface 3*b* which bears against a fixed stop 48 so that as the lever 6 returns to its position against the stop 47 the pawl 3 is lifted away from the toothed wheel 2.

A portion 6*b* of the lever 6 is arranged to engage an actuating member 8 of a micro-switch 9 on depression of the lever 6. The microswitch 9 represents the operating switch of the copying apparatus, the remainder of which is not shown, which switch initiates the copy production process in each case.

On the face of the toothed wheel 2, locking depressions 2*a* are formed in which a locking pin 11 arranged on a locking spring 10 engages. The pitch of the locking depressions 2*a* corresponds to the pitch of the saw-like teeth of the toothed wheel 2. The locking pin 11 and the locking depressions 2*a* ensure that each time the operating key 7 is actuated the toothed wheel 2 is carried along by one switching step in the direction of the arrow A.

The toothed wheel 2 and the pawl 3 together form advancing means for a control member or pre-select wheel 12 also rotatably mounted on the spindle 1. The pre-select wheel 12 has on its periphery a series of numbers, beginning at zero, which corresponds to the number of copies set and is indicated in the drawing by 12*a*. The series of numbers can be read off from outside through an aperture 13*a* provided in an upper cover plate 13 of the apparatus in its position opposite to an index mark 13*b*. Through the aperture 13*a* there also projects a knurled rim 12*b* provided on the periphery of the pre-select wheel 12 by means of which the pre-select wheel 12 can be set manually by the operator.

Also attached to the pre-select wheel 12 there is a bush 14 which is also supported on the spindle 1 and which carries a return wheel 15. The return wheel 15 co-operates with a return pawl 17 which is linked to a pivot lever 16 and is arranged to operate in a similar manner to the switching pawl 3. On the face of the return wheel 15 which cannot be seen in the drawing, as in the case of the toothed wheel 2, locking depressions 15*a* are provided in which a locking pin 20 attached to a locking spring 19 engages.

The locking lever 16 rests under the action of a return spring 44 against a piston-rod 21 of a pneumatic cylinder 22 which is connected by means of an air hose 23 to a brake cylinder (not shown) for the return of an optical scanning carriage (not shown) of the apparatus. The pneumatic cylinder 22 thus receives after each return of the scanning carriage a pulse which actuates the return pawl 17 causing it to move forward and a tension spring 18 brings it into, and maintains it in, engagement with the return wheel 15 so that it turns the return wheel 15 and hence the pre-select wheel 12 back by one switching step in the direction of the arrow B. Afterwards, the locking lever 16 and hence the pawl 17 is returned to its original position under the action of the return spring 44, a pin (not shown) similar to the pin 48 causing the pawl 17 to come out of engagement with the return wheel 15.

On the toothed wheel 2 a follower pin 24 is arranged which engages between two follower lugs 25 and 26 attached to the pre-select wheel 12. The distance between the lugs 25 and 26 engaging round the follower pin 24 is such that the toothed wheel 2 can rotate by exactly one switching step in relation to the pre-select wheel 12.

The pre-select wheel 12 also carries a switch pin 27 which engages with an actuating member 28 of a micro-switch 29. The micro-switch 29 represents a switch of the copying apparatus which terminates the current copying operation.

The method of operation of the apparatus shown in Figure 1 is as follows:

At the end of the previous copying operation, both the pre-select wheel 12 and the toothed wheel 2 are in the zero posititon shown in Figure 1. The switch pin 27 thereby actuates the end switch 29, which brings the apparatus to a standstill. If the operating key 7 is now depressed, the pawl 3 moves the toothed wheel 3 by one switching step in the direction of the arrow A. The pre-select wheel 12 is advanced by one switching step in the direction of the arrow A by means of the pin and slot connection 24 to 26. The series of numbers 12*a* shows opposite to the index 13*b* the setting for the making of one copy. The switch pin 27 liberates the end switch 29. At the same time, by means of the arm 6*b* of the pivot lever 6 the start switch 9 is actuated and thus the single copying operation set at the pre-select wheel 12 is initiated.

After this single copying operation has been carried out, or after the return of the copying carriage, the pneumatic cylinder 22 receives a pulse which actuates the setting-back pawl 17 once and thus moves the return wheel 15 and hence the pre-select wheel 12 back by one switching step. The arrangement thereby returns to its original zero position which is shown in the drawing and in which the end switch 29 terminating the copying operation is actuated.

If instead of being actuated once the operating key 7 is actuated several times, the

switching pawl 3 advances the toothed wheel 2 and hence the pre-select wheel 12 by an equal number of switching steps in the direction of the arrow A. The copying operation is then not interrupted by the end switch 29 until the return pawl 17 has moved the return wheel 15 and hence the pre-select wheel 12 back by an equal number of switching steps. The number of copies produced also corresponds in this case exactly to the number read off at the index 13*b*. Over-rotation of the toothed wheels 2 and 15 is excluded in each case by means of a gap in the teeth of these wheels.

If, right from the start, the pre-select wheel 12 is pre-set manually to a particular number of copies by means of the knurled rim 12*b*, because of the free play of one switching step in the pin and slot connection 24 to 26 the toothed wheel 2 remains exactly one switching step behind. When the operating key 7 is actuated as required in order to initiate the copying operation set, this switching step is made up, the pre-select wheel 12 not being moved further by this actuation. To move the pre-select wheel 12 back to the zero position in which it actuates the end switch 29, therefore, the number of return steps required is exactly the number which can be read off at the index 13*b*.

According to Figure 2, an auxiliary control member or further switching segment 30 is rotatably supported on the spindle 1 in addition to the pre-select wheel 12 and the return wheel 15. This switching segment 30 carries a switch pin 41 which engages with the actuating member 42 of a further microswitch 43. The return pawl 17 is in this case made so wide that it engages both the return wheel 15 and the switching segment 30.

In addition, the return wheel 15 carries a projection 31 having a surface 31*a* arranged to engage a follower pin 32 which is attached to a leaf spring 33 carried by the segment 30. The projection 31 also has a ramp surface 31*b*. Arranged in the path of the follower pin 32 indicated by the arrow A are a deflecting cam 34*a* and a stop surface 34*b* which are formed on a holder 34. The holder 34 is attached by means of screws 35 and 36 to the apparatus frame (not shown), and the holder is thus easily interchanged.

As can be seen from Figure 3, the switch 43 lying in a lead-in line 37 and a lead-out line 38 for counting pulses going to two counters 39 and 40 effects the changeover of the counting pulses from the counter 39 to the counter 40 and vice versa. A changeover of this type is of particular importance if, as is frequently the case with rented apparatus, subsequent copies are to be charged for at a cheaper rate than first copies, starting from a certain base number.

The method of operation of this supplementary device is as follows:

When the pre-select wheel 12 is set to one of the numbers 12*a*, the switching segment 30 is carried along in the direction of the arrow A until the follower pin 32 meets the deflecting cam 34*a* and is raised by it in the direction of the arrow D, out of reach of the surface 31*a*. From there onwards the switching segment 30 remains stationary and the pre-select wheel 12 moves alone as far as the number set in each case. This means that the switching segment 30, independently of any further rotation of the pre-select wheel 12, only requires the number of return steps determined by the position of the deflecting cam 34*a* or the stop surface 34*b* in order to return to a switching position in which it actuates the changeover switch 29. By suitable selection of this deflecting cam it is therefore possible to determine which copies are to be counted on the counter 39 and which copies are to be counted on the counter 40.

When the follower pin 32 has run onto the cam 34*a*, the switching segment 30 can only be influenced then by means of the return pawl. If the pre-select wheel 12 has undergone more extensive rotation than the switching segment 30, the follower pin 32, as the pre-select wheel 12 returns to its zero position, rises over the ramp surface 31*b* of the projection 31 and engages again behind the surface 31*a*.

WHAT WE CLAIM IS:—

1. Electrostatic copying apparatus which includes a control member for controlling the number of copies of an original to be produced, which control member is arranged to move a predetermined distance on the production of each copy towards a position, the zero position, in which the copy production process is discontinued, advancing means capable of moving the control member away from the zero position, operating switch means arranged on actuation to initiate copy production and an actuating member movable to actuate the operating switch means and mechanically coupled to the advancing means so that movement of the actuating member can be transmitted by the advancing means to the control member to advance it.

2. Electrostatic copying apparatus as claimed in claim 1, wherein the advancing means comprises a toothed member and a projecting member arranged to engage the toothed member to move it in one direction, and the actuating member is mechanically coupled to the projecting member.

3. Electrostatic copying apparatus as claimed in claim 1 or claim 2, wherein the arrangement is such that when the actuating member is moved to actuate the operating

switching pawl 3 advances the toothed wheel 2 and hence the pre-select wheel 12 by an equal number of switching steps in the direction of the arrow A. The copying operation is then not interrupted by the end switch 29 until the return pawl 17 has moved the return wheel 15 and hence the pre-select wheel 12 back by an equal number of switching steps. The number of copies produced also corresponds in this case exactly to the number read off at the index 13*b*. Over-rotation of the toothed wheels 2 and 15 is excluded in each case by means of a gap in the teeth of these wheels.

If, right from the start, the pre-select wheel 12 is pre-set manually to a particular number of copies by means of the knurled rim 12*b*, because of the free play of one switching step in the pin and slot connection 24 to 26 the toothed wheel 2 remains exactly one switching step behind. When the operating key 7 is actuated as required in order to initiate the copying operation set, this switching step is made up, the pre-select wheel 12 not being moved further by this actuation. To move the pre-select wheel 12 back to the zero position in which it actuates the end switch 29, therefore, the number of return steps required is exactly the number which can be read off at the index 13*b*.

According to Figure 2, an auxiliary control member or further switching segment 30 is rotatably supported on the spindle 1 in addition to the pre-select wheel 12 and the return wheel 15. This switching segment 30 carries a switch pin 41 which engages with the actuating member 42 of a further microswitch 43. The return pawl 17 is in this case made so wide that it engages both the return wheel 15 and the switching segment 30.

In addition, the return wheel 15 carries a projection 31 having a surface 31*a* arranged to engage a follower pin 32 which is attached to a leaf spring 33 carried by the segment 30. The projection 31 also has a ramp surface 31*b*. Arranged in the path of the follower pin 32 indicated by the arrow A are a deflecting cam 34*a* and a stop surface 34*b* which are formed on a holder 34. The holder 34 is attached by means of screws 35 and 36 to the apparatus frame (not shown), and the holder is thus easily interchanged.

As can be seen from Figure 3, the switch 43 lying in a lead-in line 37 and a lead-out line 38 for counting pulses going to two counters 39 and 40 effects the changeover of the counting pulses from the counter 39 to the counter 40 and vice versa. A changeover of this type is of particular importance if, as is frequently the case with rented apparatus, subsequent copies are to be charged for at a cheaper rate than first copies, starting from a certain base number.

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When the follower pin 32 has run onto the cam 34*a*, the switching segment 30 can only be influenced then by means of the return pawl. If the pre-select wheel 12 has undergone more extensive rotation than the switching segment 30, the follower pin 32, as the pre-select wheel 12 returns to its zero position, rises over the ramp surface 31*b* of the projection 31 and engages again behind the surface 31*a*.

WHAT WE CLAIM IS:—

1. Electrostatic copying apparatus which includes a control member for controlling the number of copies of an original to be produced, which control member is arranged to move a predetermined distance on the production of each copy towards a position, the zero position, in which the copy production process is discontinued, advancing means capable of moving the control member away from the zero position, operating switch means arranged on actuation to initiate copy production and an actuating member movable to actuate the operating switch means and mechanically coupled to the advancing means so that movement of the actuating member can be transmitted by the advancing means to the control member to advance it.

2. Electrostatic copying apparatus as claimed in claim 1, wherein the advancing means comprises a toothed member and a projecting member arranged to engage the toothed member to move it in one direction, and the actuating member is mechanically coupled to the projecting member.

3. Electrostatic copying apparatus as claimed in claim 1 or claim 2, wherein the arrangement is such that when the actuating member is moved to actuate the operating

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switch means it can advance the control member away from its zero position by a distance equal to that moved by the control member towards its zero position during the production of one copy.

4. Electrostatic copying apparatus as claimed in claim 3, wherein, after actuation of the operating switch means, the actuating member can be moved to advance the control member further.

5. Electrostatic copying apparatus as claimed in claim 4, wherein the actuating member is in the form of an operating key which can be depressed by an operator, the key, on each depression thereof, being capable of advancing the control member by a distance equal to that moved by the control member towards its zero position during the production of one copy.

6. Electrostatic copying apparatus as claimed in any one of claims 1 to 5, wherein the advancing means is so coupled to the control member as to allow relative movement between the two of an amount corresponding to the distance moved by the control member during the production of one copy.

7. Electrostatic copying apparatus as claimed in claim 4, wherein the control member can be advanced directly by an operator, and the coupling between the advancing means and the control member is such that, after direct advancement of the control member, on movement of the actuating member to actuate the operative switch means, the control member is not advanced by the advancing means.

8. Electrostatic copying apparatus as claimed in claim 6 or claim 7, wherein the advancing means is coupled to the control member by means of a pin and slot coupling.

9. Electrostatic copying apparatus as claimed in any one of claims 1 to 8, wherein the control member is arranged to be movable away from its zero position by rotation in one direction and movable towards its zero position by rotation in the opposite direction.

10. Electrostatic copying apparatus as claimed in claim 9, wherein the advancing means comprises a toothed wheel mounted co-axially with the control member.

11. Electrostatic copying apparatus as claimed in any one of claims 1 to 10, which comprises a switch which on actuation discontinues the copy production process and the control member is arranged to actuate the said switch when it reaches its zero position.

12. Electrostatic copying apparatus as claimed in any one of claims 1 to 11, wherein there is provided means for ensuring that the control member is advanced in steps each corresponding to the distance moved by the control member during the production of one copy.

13. Electrostatic copying apparatus as claimed in any one of claims 1 to 12, which includes means for returning the control member to its zero position, the returning means being coupled to a component of the apparatus that operates once during the production of each copy and being arranged to move the control member its predetermined distance towards its zero position on the operation of the said component.

14. Electrostatic copying apparatus as claimed in claim 13, which includes a scanning carriage for an original being copied which is arranged to return to its initial position after the production of each copy, the scanning carriage having a brake cylinder, and wherein the returning means is arranged to be moved by means of a pneumatic cylinder coupled to the brake cylinder.

15. Electrostatic copying apparatus as claimed in claim 13 or claim 14, wherein the returning means comprises a toothed member and a projecting member arranged to engage the toothed member to move it in one direction.

16. Electrostatic copying apparatus as claimed in any one of claims 1 to 15, which comprises first and second counters for counting the number of copies produced, and an auxiliary control member arranged to move a predetermined distance on the production of each of an initial predetermined number of copies in each copy production process towards a switching position, the arrangement being such that the auxiliary control member can be advanced from the switching position by the control member and/or the actuating member by a distance not exceeding the total distance it moves on the production of the said predetermined number of copies and that the first counter is arranged to operate until the auxiliary control member reaches the switching position in which it causes the second counter to come into operation.

17. Electrostatic copying apparatus as claimed in claim 16, wherein the auxiliary control member is coupled to the control member by means of a resilient follower and a stop is provided to limit movement of the auxiliary control member.

18. Electrostatic copying apparatus as claimed in claim 17, wherein the stop is adjustable.

19. Electrostatic copying apparatus as claimed in claim 17 or claim 18, wherein the stop is in the form of a deflecting cam for the resilient follower which causes the follower to come out of engagement.

20. Electrostatic copying apparatus as claimed in claim 19, wherein the deflecting cam is arranged to be removable.

21. Electrostatic copying apparatus as

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claimed in any one of claims 16 to 20, when dependent on claim 13, wherein the auxiliary control member is coupled to the returning means so as to move towards its switching position as the returning means moves the control member towards its zero position.

22. Electrostatic copying apparatus as claimed in claim 21, wherein the returning means comprises a toothed wheel and a projecting member arranged to engage the toothed member to move it in one direction, and the auxiliary control member is rotatably mounted co-axially with the toothed wheel and the projecting member is arranged to engage and move the said auxiliary control member in addition to the toothed wheel of the returning means.

23. Electrostatic copying apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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