

[54] MEMORY AND COUNTING DEVICE

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[58] Field of Search 235/92 SB, 92 K, 92 PE, 92 J

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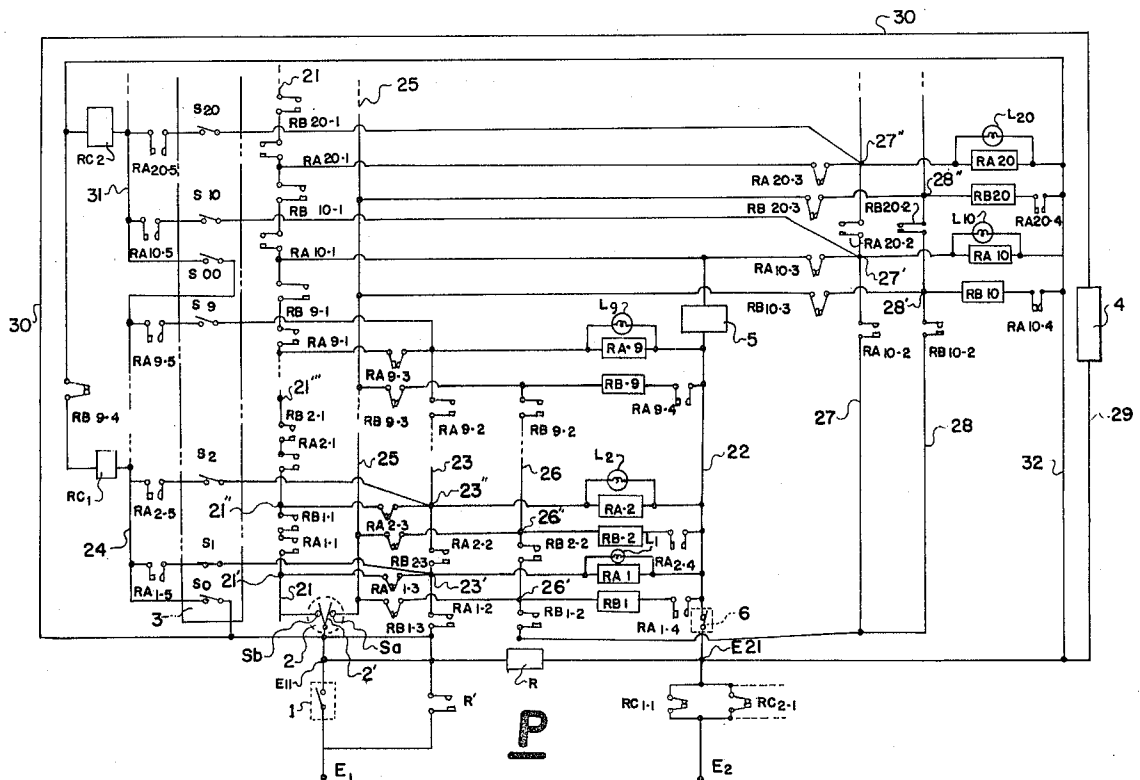
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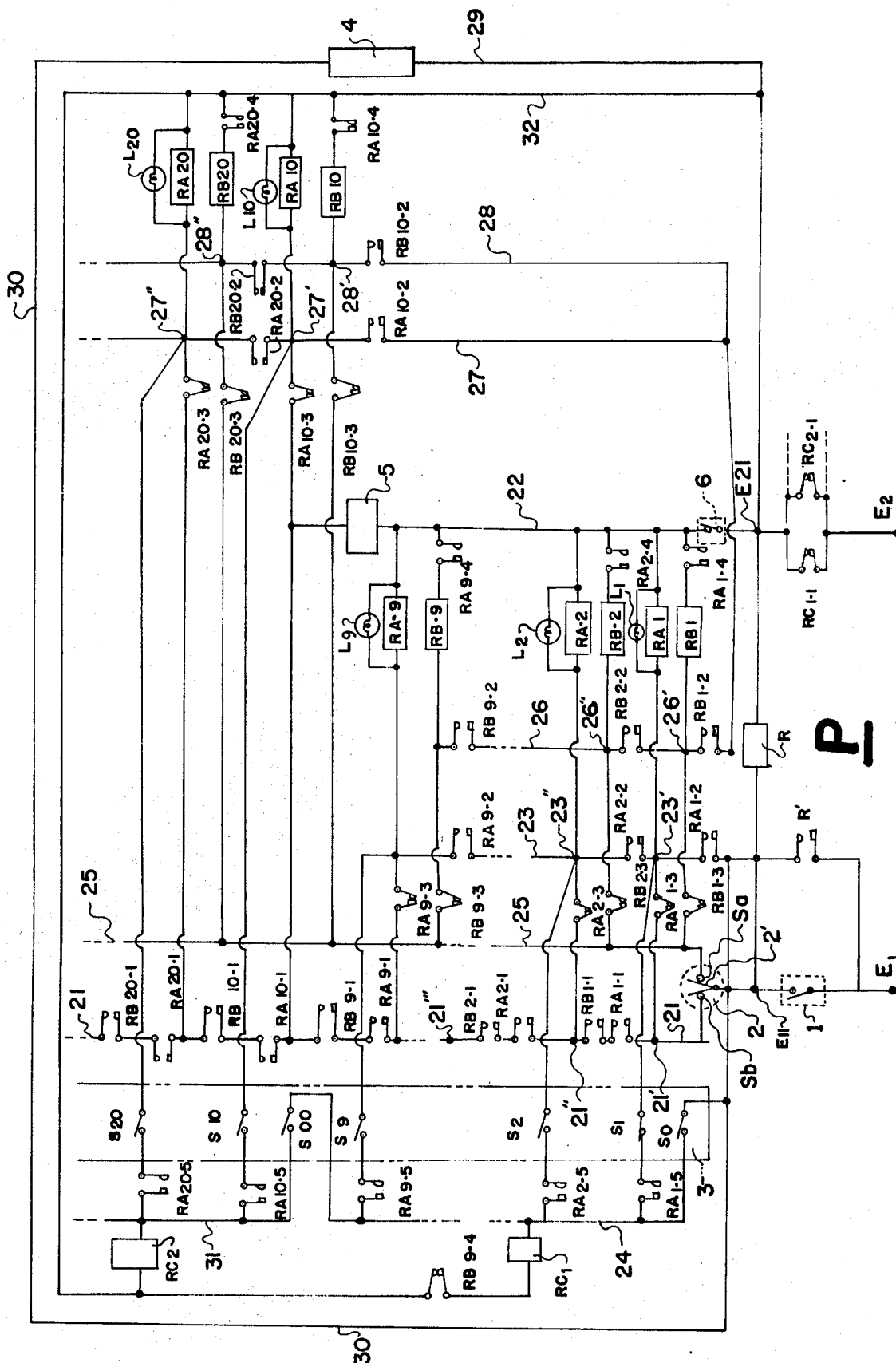
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[57] ABSTRACT

This invention relates to an electric relay circuit arrangement for counting a pre-selected number of copies to be made in an automatic copying machine and to store the number of copies made so that such number is progressively indicated as the machine continues to produce copies until the pre-selected number is completed. The counting is accomplished by relays which are progressively actuated by a copy actuated counting switch. The actuated relays remain energized in self-latching circuits until reaching of the pre-selected count restores all circuits to the starting position. Visual indicator means are connected in parallel to the counting relays.

9 Claims, 1 Drawing Figure





MEMORY AND COUNTING DEVICE

This application is a continuation-in-part application of my copending application, Ser. No. 720,637; filed Apr. 11, 1968.

BACKGROUND OF THE INVENTION

The present invention relates to a counting and count memory device for use in a copying machine. More specifically, the invention relates to an electric relay circuit arrangement for counting a pre-selected number of copies to be made on said copying machine.

U.S. Pat. No. 2,844,317 (R. H. Shillington) describes an impulse counting circuit comprising several relay stages. Indicator lamps are connected to the relay stages for indicating the instantaneous count. Preceding counts are not indicated because the preceding lamps are disconnected, thus a continuous total count indication is not intended.

U.S. Pat. No. 2,703,280 (L. B. Butterfield et al) discloses a counting circuit control for electro-photographic printers wherein stepping relays advance rotary switches in response to the presence of a light beam. The copying is stopped when the predetermined number of copies has been completed. However, there is no indication of the number of copies made as the copying machine keeps operating.

OBJECTS OF THE INVENTION

In view of the foregoing it is the aim of the invention to achieve the following objects:

- to overcome the disadvantages of the prior art;
- to count and store or memorize the number of pre-selected copies for progressively indicating the instantaneous number of copies made;
- to stop the copying operation when a pre-selected number of copies has been completed;
- to stop the copy feeding mechanism when a pre-selected number of copies has been completed;
- to provide a first relay circuit group which will count unit digits of a pre-selected number and further similar relay circuit groups, one group of which will count, for example, the tens digits of said pre-selected number, whereby the circuit groups are so interconnected with each other that a carry circuit is provided between adjacent groups;
- to employ a single-pole double-throw counting switch which is actuated by each sheet; and
- to restore the entire circuit arrangement to a zero count position.

SUMMARY OF THE INVENTION

According to the invention there is provided an electric relay circuit arrangement for counting a pre-selected number of copies to be made in an automatic copying machine wherein counting relays are connected to a relay actuating circuit through a counting switch. Each actuated relay prepares the actuating circuit for the next succeeding relay and each relay keeps itself energized in a self-latching circuit until, upon reaching of a count which has been pre-selected by adjusting a selector switch, the actuating circuit for all energized relays is interrupted. Visual indicating means, such as a bulb, is connected in parallel to each counting relay to continuously and progressively in-

dicating each copy, whereby at any time during the copying the presently completed number of copies may be ascertained at a glance.

The counting switch is preferably a single-pole double-throw switch, which on the one hand energizes said relay actuating circuit and on the other hand energizes an actuating circuit for memory relays one of which is provided for each counting relay and connected to a common return circuit conductor which is interrupted when said pre-selected count is reached.

In order that the invention may be clearly understood, it will now be described, by way of example, with reference to the single FIGURE of the accompanying drawing illustrating an electrical circuit diagram of a relay arrangement for counting a pre-selected number of copies to be made in an automatic copying machine.

A power supply circuit P having input terminals E1 and E2 is shown at the lower part of the circuit diagram. The input terminal E1 is connected through a switch 1 for actuating the present circuit arrangement including an automatic copy sheet feeding mechanism 4, to a first output terminal E11. A relay contact R' is connected in parallel to the actuator switch 1. The other input terminal E2 is connected to the other output terminal E21 through a group of normally closed relay contacts RC1-1; RC2-1; . . . which are connected in parallel with each other.

The power supply circuit P further comprises a relay R connected across the output terminals E11 and E21 for actuating its contact R' which is a normally open contact to keep the power supply circuit closed until resetting as will be described below. The term "normally open" defines a contact which is open whenever its respective relay is not energized and vice versa. The term "normally closed" designates a contact which is closed when its relay is not energized and open when its relay is energized.

The copy sheet feeding mechanism 4 is directly connected to the output terminals E11, E21 through conductors 29 and 30.

A counting switch, for example, in the form of a single-pole double-throw switch 2, has a throw arm 2' which is normally in contact with a contact Sa. The throw arm 2' is actuated by the feeding of a copy to move away from contact Sa and to contact contact Sb once for each sheet. When the feeding is completed the throw arm 2' returns to Sa. This movement of the movable throw arm 2' is possible, for example, through an operating lever and a microswitch, whereby the lever sticks out into a delivery channel for the copy sheets, so that when a copy sheet is fed into the copying machine, the leading edge of the copy sheet will push the operating lever to actuate the throw arm 2'. A spring, not shown, returns the throw arm to its home position on contact Sa.

Selector switch means 3 comprising a plurality of switches S0, S1, S2, . . . S20 represent a memory switch group or groups for presetting or pre-selecting the desired number of copies. Switches S0, S1, S2, . . . S9, are for storing unit digit numerals. Switches S00, S10, S20, . . . are for storing tens digit numerals. Further switch groups may be provided for storing digits in other columns. Each switch in the unit digit group and in the tens digit group etc. is adapted, when in its closed

position, to open when any other of the switches in the same group is closed. For example, suppose 21 copies are desired, hence the contacts of switches S20 and S1 are closed, while all other contacts of the selector switches are open.

A first power supply conductor 21 comprising a plurality of junctions 21', 21'' 21''', . . . is connected to the contact Sb of the counting switch 2 and thus to terminal E11 when the throw arm 2' is in its dashed-line position.

A further power supply conductor which will be referred to as a return conductor 22 is connected through a normally closed reset contact 6 to the output terminal E21 of the power supply circuit P. A reset relay 5 for the reset contact 6 and opens this contact each time when the counting of unit digits has been completed as will be described more fully below.

A first group of unit digit counting relays RA1, RA2, . . . is connected on the one hand to the junctions 21', 22', of conductor 21 and on the other hand to the return conductor 22 so that these relays may be energized by the actuation of the counting switch 2 and de-energized by opening the reset contact 6.

Each counting relay RA1, . . . has normally open contacts RAn-1, RAn-2, RAn-4, RAn-5 and a normally closed contact RAn-3.

One of said normally open contacts of each counting relay, namely normally open contact RA1-1; RA2-1; is connected in series between said junctions 21', 21'', . . . whereby these normally open contacts successively prepare the energizing circuit for one counting relay after the other step by step.

Self-latching circuit means 23 including junctions 23', 23'', . . . are provided for the unit digit counting relays RA1, . . . normally open latching contacts RA1-2; RA2-2, . . . are connected in series between said junctions to complete a self-latching circuit for the counting relays between said output terminal E11 of the power supply circuit P and the return conduit 22, whereby the counting switch 2 is bypassed by said self-latching circuit 23.

The selector switch means S0, S1, . . . are connected between a common conductor 24 and to the respective one of said junctions 23', 23'' . . . in the self-latching circuit for the unit digit counting relays.

Further, there are provided power supply circuit interrupting relays RC1, RC2, . . . which are connected in series between the common conductor 24 and the output terminal E21 of the power supply circuit P, whereby the copy feeding mechanism will be stopped when the selected number of copies has been counted as will be described in more detail below. The relays RC1, RC2, . . . actuate said normally closed contacts RC1-, RC2-1, . . . in said power supply circuit P which are connected in parallel to each other between the contact 6 and the input terminal E2 for re-setting the apparatus to zero.

According to the invention visual indicator means L1, L2, . . . are connected in parallel directly with the respective counting relay RA1, . . . whereby the indicator means remain energized in the corresponding self-latching circuit 23 to progressively indicate the number of completed copies as will also be described in more detail below.

A group of memory relays RB1, RB2, . . . is also provided. Each of the memory relays has normally open contacts RBn-1, RBn-2, and a normally closed contact RBn-3. However, the last memory relay RB9 has two normally closed contacts RB9-3 and RB9-4.

As shown in the circuit diagram, one terminal of each memory relay RB is connected through its own normally closed contact RB1-3, . . . to a conductor 25 which is in contact with the fixed contact Sa of the counting switch 2. The other terminal of each RB relay is connected to the return conductor 22 and thus to contact 6 through a normally open contact RA1-4. The counting relays RA are connected to the fixed contact Sb through the normally closed contact RAn-3 and to the contact 6 also through return conductor 22.

Each RB relay also closes a self-latching circuit 26 through its normally open contact RBn-2 which are connected in series with each other between junction 26', 26'' . . . of the latching circuit 26 and to terminal E11, whereby the self-latching circuit 26 is successively extended as the counting switch arm 2' returns to its contact Sa after each count.

The selector switch S0 is connected between the common conductor 24 and the terminal E11. The other selector switches S1, S2, . . . are connected in series between said junctions 23', 23'' . . . and a normally open contact RAn-5 of the respective counting relay RA which in turn is connected to the common conductor 24.

The unit digit counting circuit so far described may be used for counting one to nine copies and to stop the sheet feeding device 4 when the pre-selected number of one to nine copies has been made.

For making more than nine copies a further group of counting relays RA10, RA20, . . . is provided which are connected in the same manner as the counting relays RA1 to RA9, namely on the one hand to the junctions along conductor 21 through respective normally closed contacts RA10-3, RA20-3, . . . and on the other hand to a further return conductor 32. A self-latching circuit 27 is provided for the tens digit counting relays which is connected in the same manner as the self-latching circuit 23 and which comprises normally open contacts RA10-2, RA20-2, . . . connected in series between terminal E11 and junctions 27', 27'', . . .

A second group of memory relays RB1, RB2, . . . , namely on the one hand to conductor 25 through respective normally closed contacts RBn-3, and on the other hand to the further return conductor 32 through normally open contacts RAn-4. A self-latching circuit 28 is also provided for the tens digit memory relays RB10, RB20, . . .

The circuit 28 is connected to terminal E11 and comprises normally open contacts RB10-2; RB20-2 . . . connected in series to progressively extend the circuit 28 as the counting continues, said contacts RB10-2, . . . being connected to respective junctions 28', 28'' . . . along the circuit 28.

The common conductor 24 to which the unit digit relays RA1 to RA9 are connected through the selector switches S1 to S9 and through normally open contacts RA1-5 to RA9-5, is connected in series with a similar common conductor 31 for the tens digit counting elements of the circuit, by means of a switch S00 which is part of the selector switch means 3. The two series con-

nected conductors 24 and 31 are connected to terminal E11 of the power supply circuit P through switch So which is also part of the selector switch means 3.

The operation of the present apparatus will now be described by illustrating how, for example, two copies are made. First the selector switch S2 and the switch Soo are manually closed. Then the switch 1 is momentarily closed, whereby the sheet feeding mechanism 4 is energized as well as the relay R whereby its contact R' establishes a self-latching circuit within the power supply circuit P.

When now the first sheet moves the throw arm 2' momentarily from its home position on contact Sa to its counting position on contact Sb an energizing circuit for relay RA1 is established or closed as follows:

—E11, 2', 21, 21', RA1-3, RA1, 22, 6, E21 —

whereby relay RA1 is energized, indicator L1 lights up, and a self-latching circuit for relay RA1 is established as follows by the closing of normally open contact RA1-2:

—E11, RA1-2, 23, 23', RA1, 22, 6, E21 —

Since contact S1 is open, reset relay RC1 will not be energized. However, as the throw arm 2' returns to Sa the memory relay RB1 will be energized in the following circuit:

—E11, 2', Sa, 25, RB1-3, 26', RB1, RA1-4, 22, 6, E21 —

whereby the memory relay RB1 establishes its own latching circuit by closing Rb1-2:

—E11, RB1-2, 26', RB1, RA1-4, 22, 6, E21 —

With the energizing of RA1 and RB1 completed as just described the contacts RA1-1 and RB1-1 are closed thus preparing the energizing circuit for the next counting relay RA2. When now the second sheet actuates arm 2', RA2 is energized as follows:

—E11, 2', 21, 21', RA1-1, RB1-1, 21'', RA2-3, 23', RA2, 22, 6, E21 —

A similar circuit is also established for the memory relay RB2. Furthermore, since S2 and Soo are closed the reset relays RC1 and RC2 will also be energized thereby opening contacts RC1-1 and RC2-1 simultaneously to reset the apparatus to zero after the completion of the second copy in this example.

The above mentioned reset relay 5 for the unit digit counting portion of the circuit arrangement is connected between the return conductor 22 and the normally closed contact RA10-3 of the first tens digit counting relay RA10.

The operation of the circuit will now be described by means of an example for preparing 21 copies. For this purpose switches S20 and S1 in the selector switch means 3 are closed, the electric current flows as described above in the first example to bypass the starting switch by closing contact R'.

The electric current flows through the automatic copy sheet feeding mechanism 4 and activates it to feed the copy sheets to the printing section of the copying machine. As a copy sheet starts its movement, the section of the copying machine. As a copy sheet starts its

movement, the electric current will continue to flow to the automatic copy sheet feeding mechanism 4, unless the contacts RC1-1 and RC2-1 are simultaneously opened. The first copy sheet thus delivered actuates throw arm 2' of the counting switch 2, whereby the energizing circuit for the first counting relay RA1 is established as described above. This also applies to the circuit for the memory relay RB1 with the relay RA1 energized, the first count will also be indicated by the indicator lamp L1 which is connected in parallel with RA1 to confirm the correct movement of the relays.

Since switch S1 is closed, the closing of the contact RA1-5 will establish a circuit for reset relay RC1 as follows:

—E11, RA1-2, 23', S1, RA1-5, RC1, RB9-4, 26, E21 —

whereby contact RC1-1 opens. However, no reset is accomplished because the contact RC2-1 connected in parallel to contact RC1-1 remains closed.

As the first copy sheet has passed through the counting switch 2 its throw arm 2' returns to the contact Sa. However, inasmuch as the contact RA1-4 remains in the closed position, the electric current flows from

—E11, Sa, RB1-3, RB1, RA1-4, 22, 6, E21 —

causing the relevant contacts RB1-1, RB1-2, of the diagram RB1 to close while opening RB1-3. Since RB1-2 is kept closed despite opening of RB1-3, flow of electricity to the memory relay RB1 is maintained, thus completing the memory and counting operations for the first copy.

The completion of the second copy establishes the same circuits as has been described above and the counting continues until the 10th copy is counted, whereby an energizing circuit is established for the unit digit reset relay 5 as follows:

—E11, 2', Sb, 21, (including the series connection of the now closed contacts RA1-1, RB1-1, to RA9-1 and RB9-1), 5, 22, 6, E21 —

The energization of relay 5 opens its contact 6, whereby all relays in the unit digit counting portion of the circuit arrangement are reset to their zero, not energized position, whereby the 11th to 19th copy may now be counted in the unit digit circuit portion of the arrangement.

The progress of these operations is always confirmable by a glance at the indicator lamps L1, L2, . . . which is an important advantage of the present invention. It should be noted here that the completion of the ninth copy causes the opening of the normally closed contact RB9-4, which is specially provided for the ninth copy, whereby the circuit

—E11, RA1-2, S1, RA1-5, 24, RC1, RB9-4 (now open), 26, E21,

which had been formed for the first copy is opened and the contact RC1-1 is closed, thus restoring to its original status.

When the 10th copy is counted the contact RA10-1 is kept in a closed position by virtue of the circuit

—E11, 27, 27', RA10, 26 E21 —,

which maintains RA10 energized. The memory relay RB10 is also energized by the return of the throw arm 2' to its Sa position, whereby the conductor 21 is extended by the closing of contact RB10-1 in preparation of the 11th count.

The counting of the 11th to 19th copy is now effected through the opening and closing movement of contacts, in the same manner as described for copies one to nine.

The 20th copy will be counted by relays RA20 because the contacts RA10-1 and RB10-1 will be kept closed to energize relay RA20, whereby the contact RA20-1 will be closed. The contacts RAn and RBn ($n=1, 2, \dots 9$) are released as described above with regard to the 10th copy. In this instance, the closing of the contact RA20-2 causes the current to flow in the circuit:

—E11, 27, RA10-2, 27', RA20-2, 27'', S20, RA20-5, RC2, 26, E21 —,

whereby reset relay RC2 is energized to open the contact RC2-1. However, the circuit for reset relay RC1 is already interrupted by this time by virtue of the release of RAn and RBn ($n=1, 2, \dots 9$), thus RC1-1 remains closed and the 21st count can proceed.

When the 21st copy is delivered, the related contacts RA1 make opening and closing movements in the same manner as has been described for the first copy, and by the closing of RA1-2, current flows in the circuit:

—E11, RA1-2, 23', S1, RA1-5, RC1, RB9-4, 26, E21 —,

whereby relay RC1 is energized to open the contact RC1-1. Since then the contact RC2-1 is simultaneously open, the current flow to the automatic copy sheet feeding mechanism 4 is interrupted and the sheet feeding operation is stopped and all circuits which had been maintained are also released.

The gist of the foregoing is that the first count did not cause a reset because the reset relay RC2 was not energized, whereas on completion of the twentieth count resetting still did not take place because relay RC1 was not energized. Stated differently, resetting could take place only by the simultaneous energizing of relays RC1 and RC2.

The circuit shown is capable of counting twenty-nine copies. The counting capacity may be extended to include the hundreds and further digits in a surprisingly simple manner by providing, as in the case of the tens digit, circuit corresponding to reset relay 5 and reset switch 6. Thus, by cascading such circuits as mentioned above, the memory and counting capacity is increased.

In addition, since closing of the contacts requires very little power for the relays, the durability of the relays is high and hardly any trouble is experienced with the present circuit.

Another advantage of the present invention is seen in its high efficiency in that simultaneous with the automatic prevention of the flow of current to the copy sheet feeding mechanism 4 upon the completion of the feeding operation of the preselected number of copies, zero restoration of the counting circuit is also automatically effected. Such resetting may also be accomplished

manually, if desired, by simultaneously closing switches So and Soo.

Another important advantage is seen in that the number of copies being counted is continuously and progressively indicated through indicator lamps Ln connected in parallel to the counting relays.

Another advantage of this invention is seen in that the parts, relays and microswitches used are in general use and no special parts are required. Therefore, the manufacturing costs can be reduced to a considerable extent.

Although specific examples have been described, it is to be understood that the invention includes all modifications and equivalents within the scope of the appended claims.

What I claim is:

1 An electric relay circuit arrangement for counting a pre-selected number of copies to be made in an automatic copying machine, comprising a power supply circuit including input and output terminals, copy feeding means connected to the output terminals of the power supply circuit, a copy actuated counting switch, a first power supply conductor including a plurality of junctions, said counting switch being connected in series between said first power supply conductor and one output terminal of said power supply circuit, a second power supply conductor connected to another output terminal of said power supply circuit, a group of unit digit counting relays connected between said first and second power supply conductors, said unit digit counting relays comprising normally open first contacts connected in series between said junctions in the first power supply conductor, each of said unit digit counting relays being connected to a respective one of said junctions whereby the normally open first contact of a preceding relay prepares the circuit for the next succeeding relay when the preceding relay is energized by the closing of said counting switch, self-latching circuit means including junctions for said unit digit counting relays including a series connection, between respective junctions, of second normally open latching contacts of said unit digit counting relays, said self-latching circuit means being connected to said one output terminal of said power supply circuit to bypass the counting switch, selector switch means including a common conductor for pre-selecting the desired number of copies, said selector switch means being connected between said common conductor and to said latching circuit means individually to the respective junction of said unit digit counting relays, power supply interrupting circuit means connected in series between said common conductor and another output terminal of said power supply circuit, whereby the copy feeding means is stopped when the selected number of copies has been counted, and visual indicator means connected in parallel to said counting relays, whereby said indicator means remain energized with their respective counting relay in the corresponding self-latching circuit means to progressively indicate the number of completed copies.

2 The electric relay circuit arrangement according to claim 1, wherein said power supply circuit comprises an actuator switch connected in series between an input terminal and said one output terminal, a latching relay connected across said output terminals of the

power supply circuit and including a normally open relay contact connected in parallel to said actuator switch for activating the power supply circuit, said power supply interrupting circuit means comprising relay means and normally closed contact means connected in series between an input terminal and the other output terminal of the power supply circuit.

3 The electric relay circuit arrangement according to claim 1, wherein said unit digit counting relays comprise normally closed third contacts connected in an initial energizing circuit in series between said self-latching circuit means and said first power supply conductor, whereby said initial energizing circuit is interrupted when a self-latching circuit is established for each unit digit counting relay.

4 The electric relay circuit arrangement according to claim 1, wherein said unit digit counting relays comprise normally open fourth contacts connected in series between said common conductor and the respective one of said selector switch means.

5 The electric relay circuit arrangement according to claim 1, further comprising a plurality of memory relays, said copy actuated counting switch comprising a single pole double throw switch connected with its single pole to said one output terminal of the power supply circuit, said counting switch further comprising two throw contacts, a throw arm, and means for returning the throw arm to a home position on one of said throw contacts when the throw arm has been actuated by a copy to contact the other throw contact which is connected to said first power supply conductor, a third power supply conductor connected to said one throw contact, said memory relays being connected between the second and third power supply conductors to form relay pairs with said unit digit counting relays which comprise normally open fifth contacts connected in series with a respective one of said memory relays between the second and third power supply conductors, whereby an energizing circuit is prepared for a memory relay when the respective counting relay is energized by said counting switch and the memory relay is energized when the throw arm of the counting switch is returned to said home position.

6 The electric relay circuit arrangement according to claim 5, wherein said memory relays comprise normally open first contacts connected in series with said first counting relay contacts in said first power supply conductor, whereby there are arranged two of said normally open first contacts in series between adjacent ones of said junctions; normally open second contacts

connected in series to form a further self-latching circuit for said memory relays connected to said one output terminal of the power supply circuit, and normally closed third contacts connected in series in said energizing circuit for the respective memory relay, whereby said energizing circuit is opened as soon as the corresponding normally open second contact has closed the self-latching circuit for the respective memory relay.

7 The electric relay circuit arrangement according to claim 1, further comprising a group of tens digit counting relays connected between a fourth power supply conductor and said first power supply conductor, said tens digit counting relays comprising the same contacts as said unit counting relays, release means comprising a normally closed release switch connected in series between the second power supply conductor and the other output terminal of the power supply circuit, actuating means for said release switch connected in series between the end of the second power supply conductor and a junction in said first power supply conductor between the normally open first contact of the last unit digit counting relay and the normally open first contact of the first tens digit counting relay which is also connected to the just mentioned junction, whereby actuation of the counting switch for the last unit digit count energizes said actuating means to temporarily open said release switch for returning all contacts of the unit digit counting relays to their normal position, thus preparing the group of unit digit counting relays for a further series of counts after the counting of a tens digit, and self-latching circuit means for said tens digit counting relays to bypass said counting switch.

8. The electric relay circuit arrangement according to claim 7, wherein said selector switch means comprise switches for each of said tens digit counting relays including a first tens digit selector switch connected in series between the common conductor of said selector switches for selecting unit digits and a further common conductor of said tens digit selector switches.

9 The electric relay circuit arrangement according to claim 8, comprising further power supply interrupting means for said tens digit counting relays, said further interrupting means being connected in series between the other output terminal of the power supply circuit and said further common conductor, said further power supply interrupting means comprising a normally closed contact connected in series between an input terminal and the other output terminal of said power supply circuit.

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