

[54] **ELECTRONIC CONTROLLER FOR
COPYING MACHINE**

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235/92 SB, 92 PE, 92 CA

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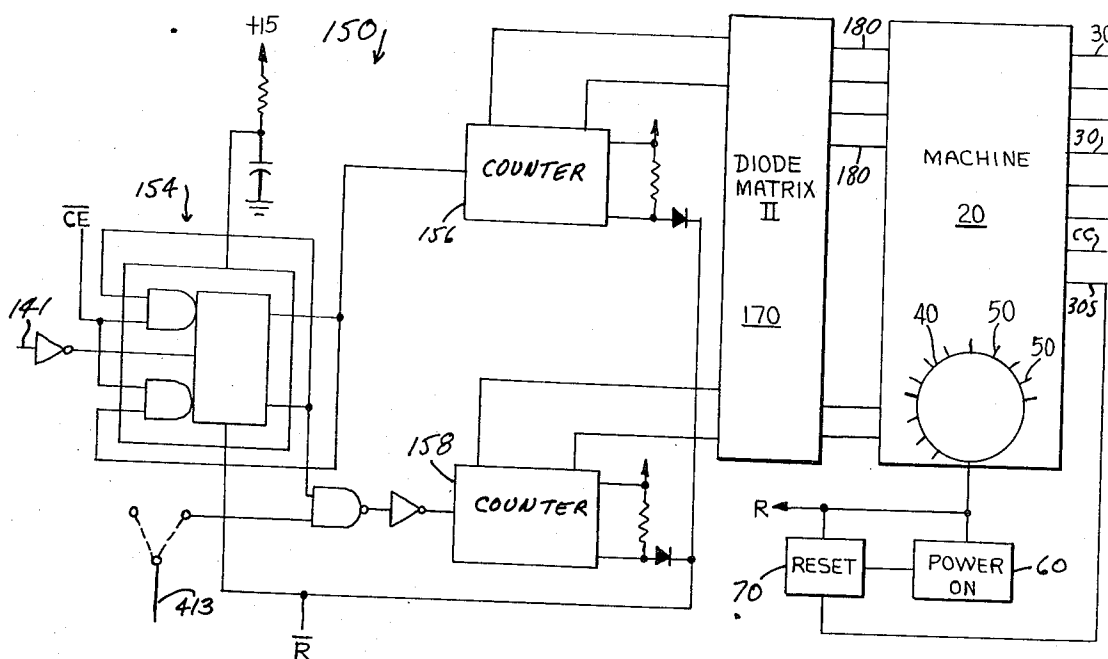
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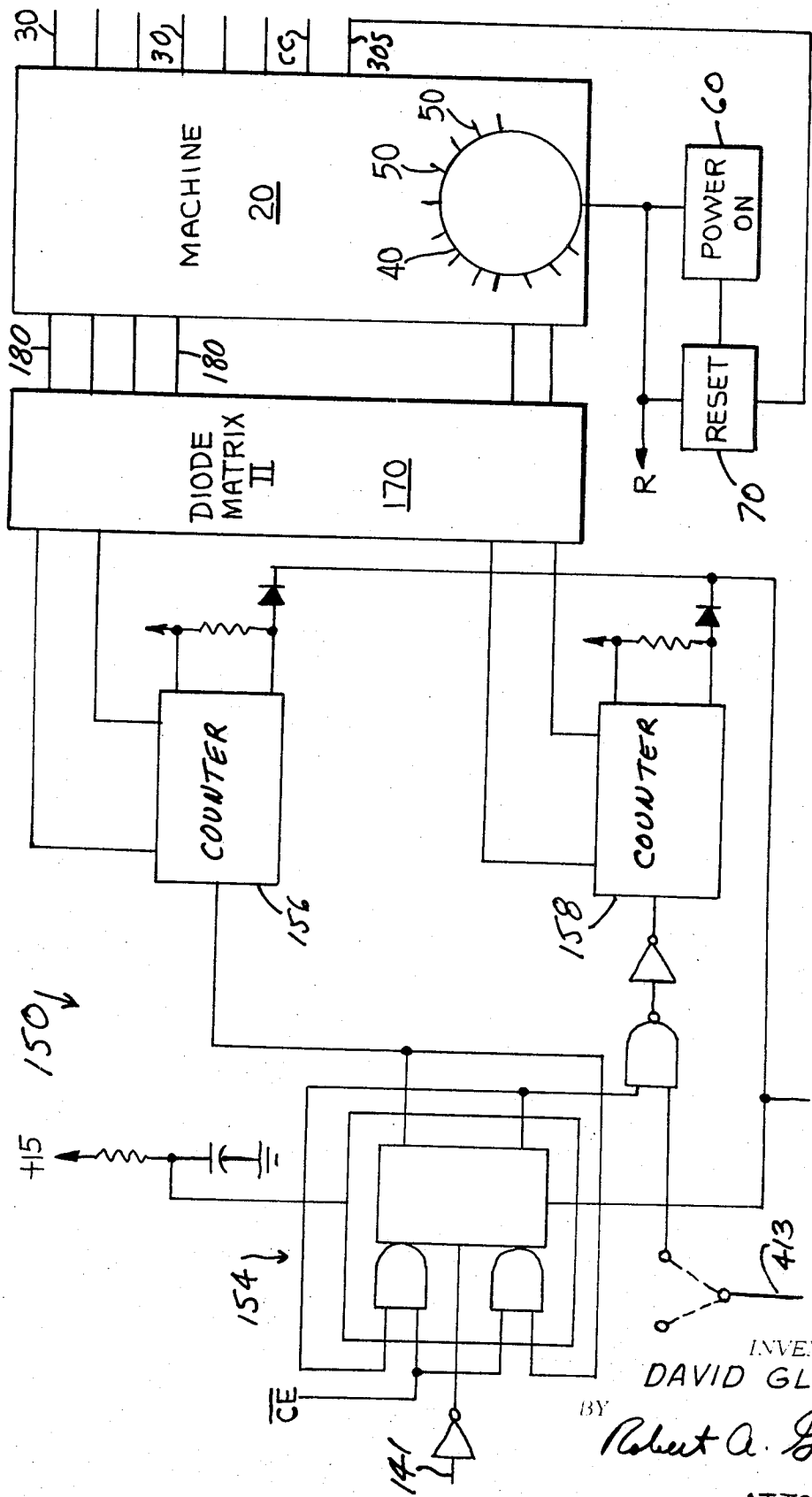
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[57] **ABSTRACT**

The machine controller is adapted for use with a copying machine which is adapted to perform a plurality of functions including printing copies. The controller includes various machine synchronizing circuits and, in addition, a first counter for counting copies made, a second counter for registering copies to be made, and third counter, all of the counters being interrelated to control the making of copies, detecting when the desired number of copies have been made, and turning off the machine at the end of a copying cycle.

10 Claims, 7 Drawing Figures





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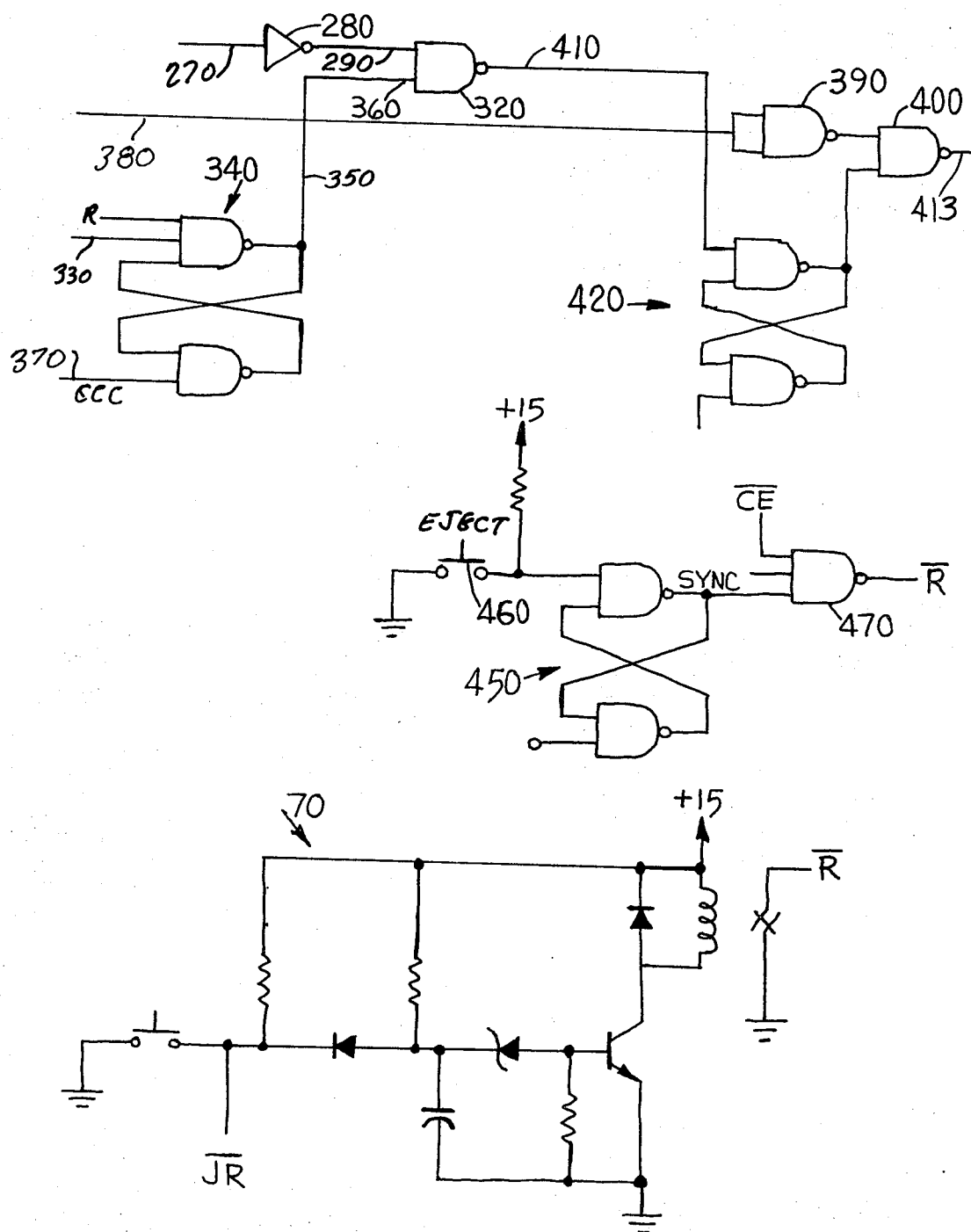
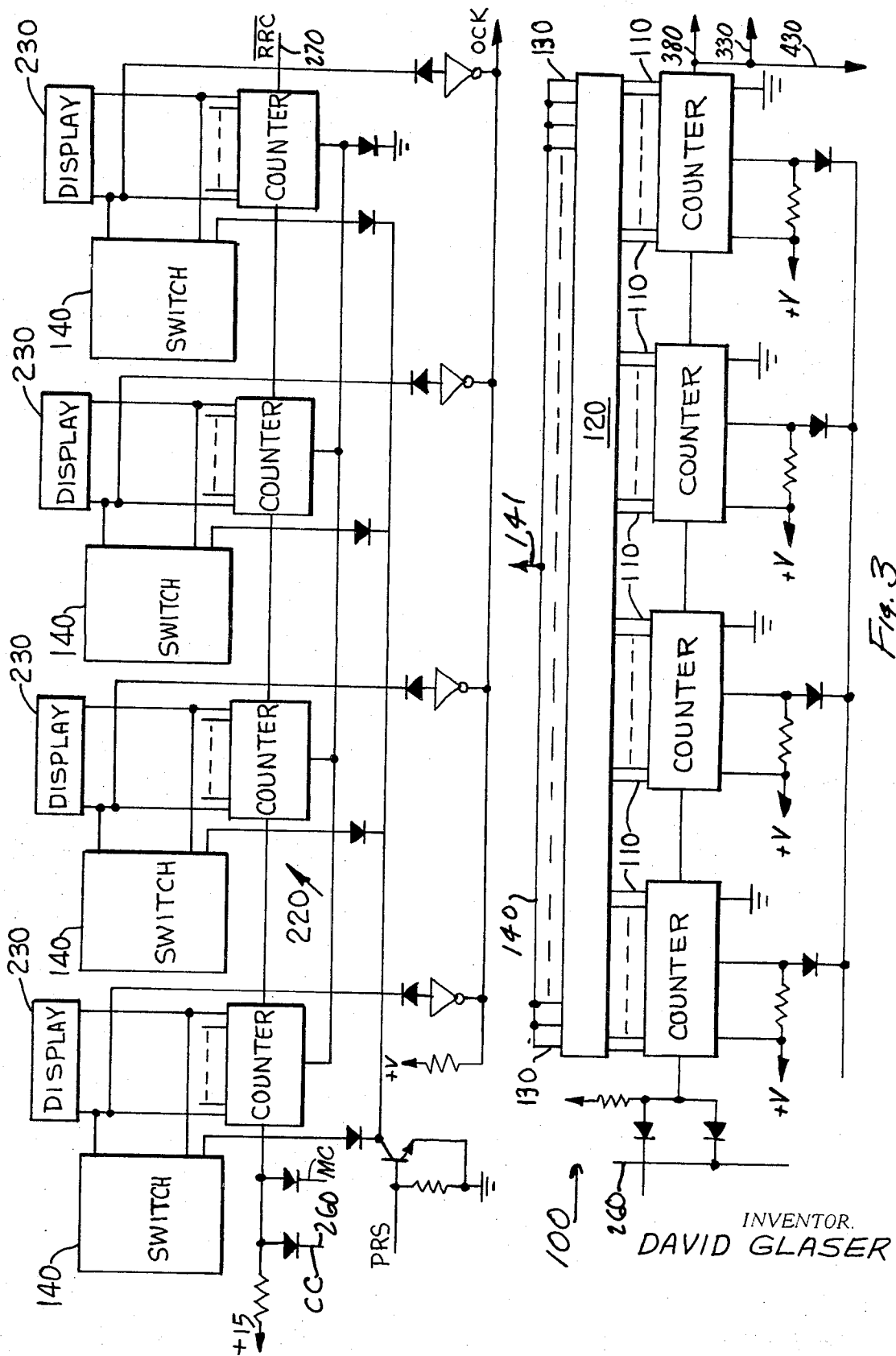


Fig. 2

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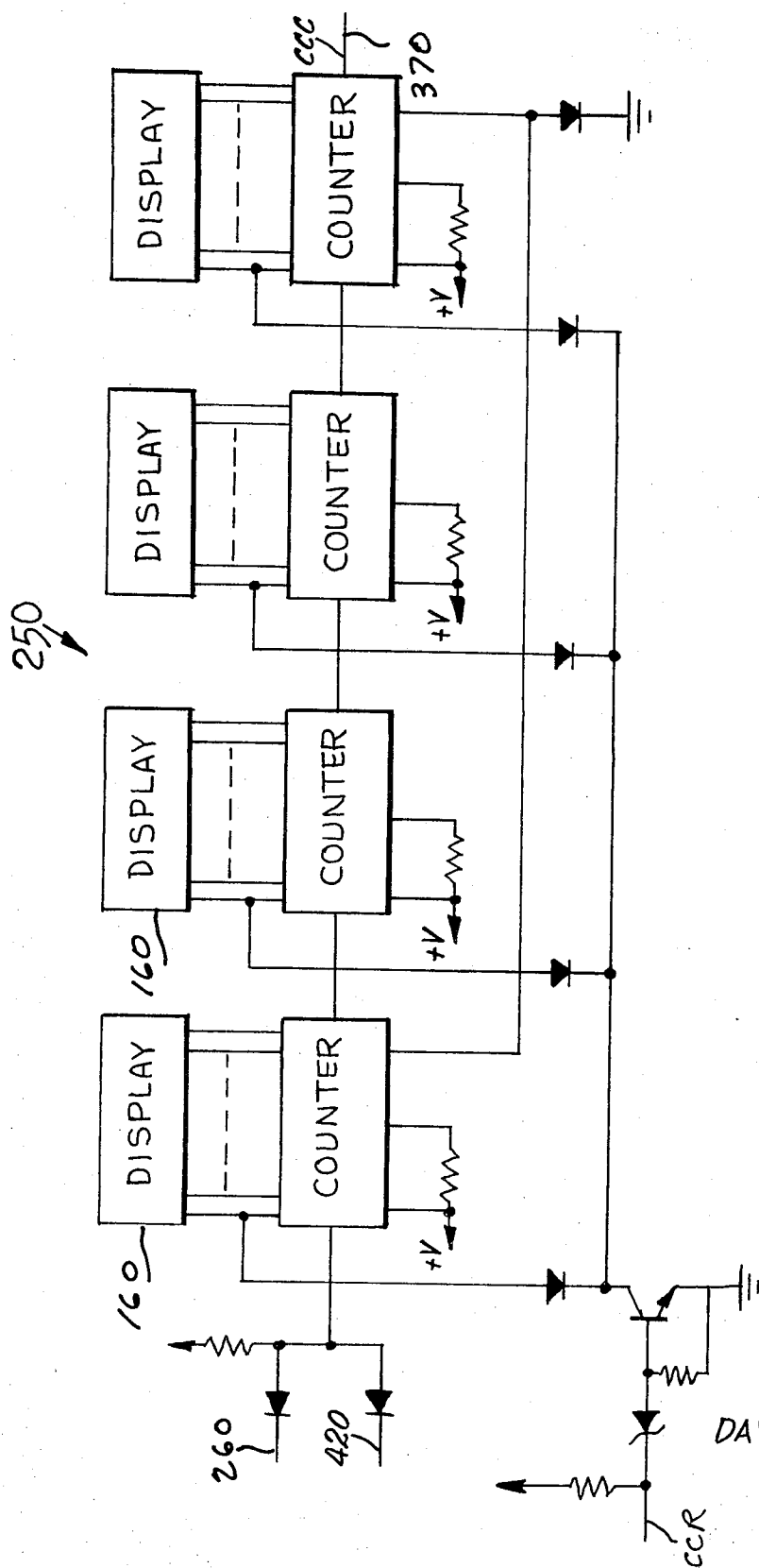


Fig. 4

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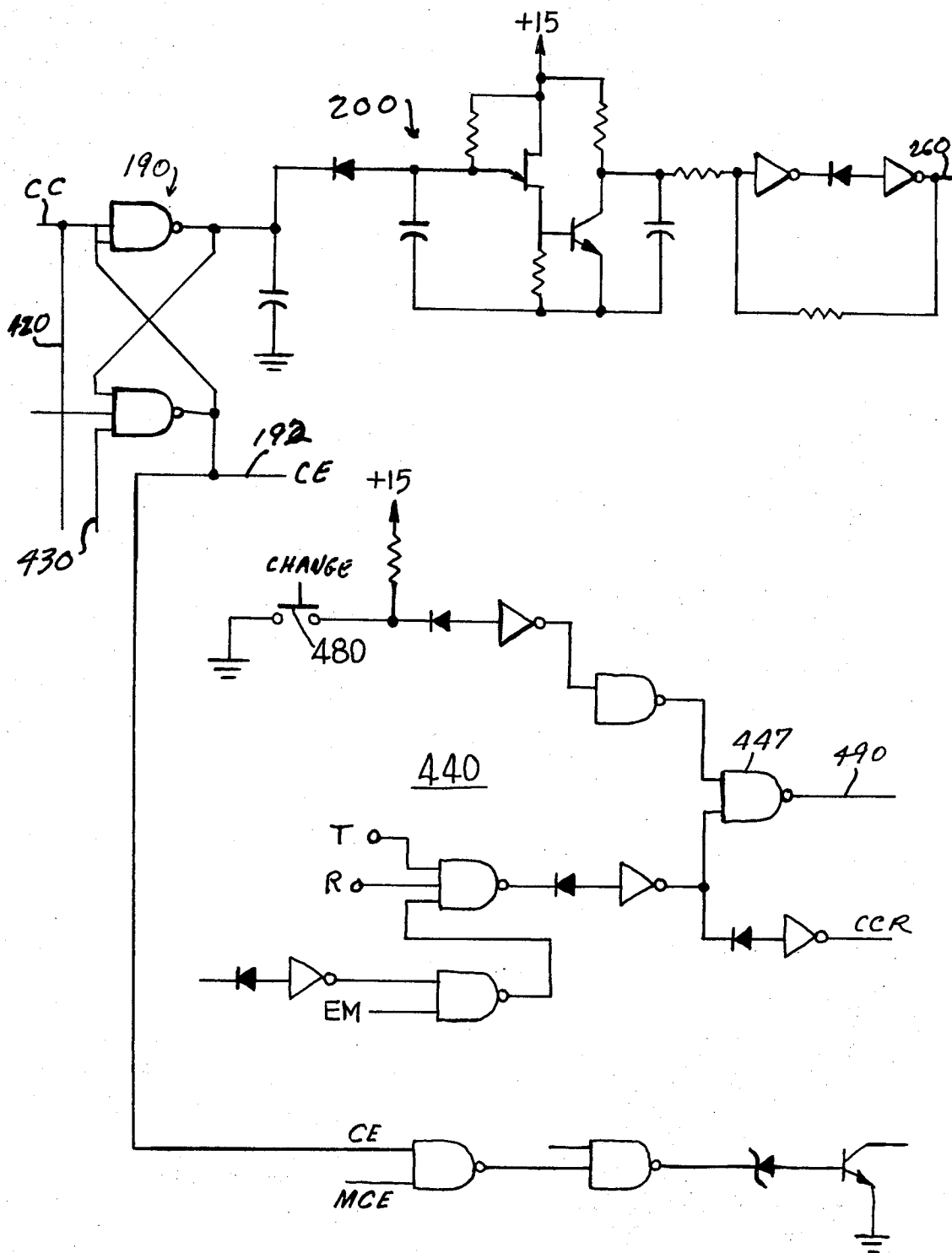
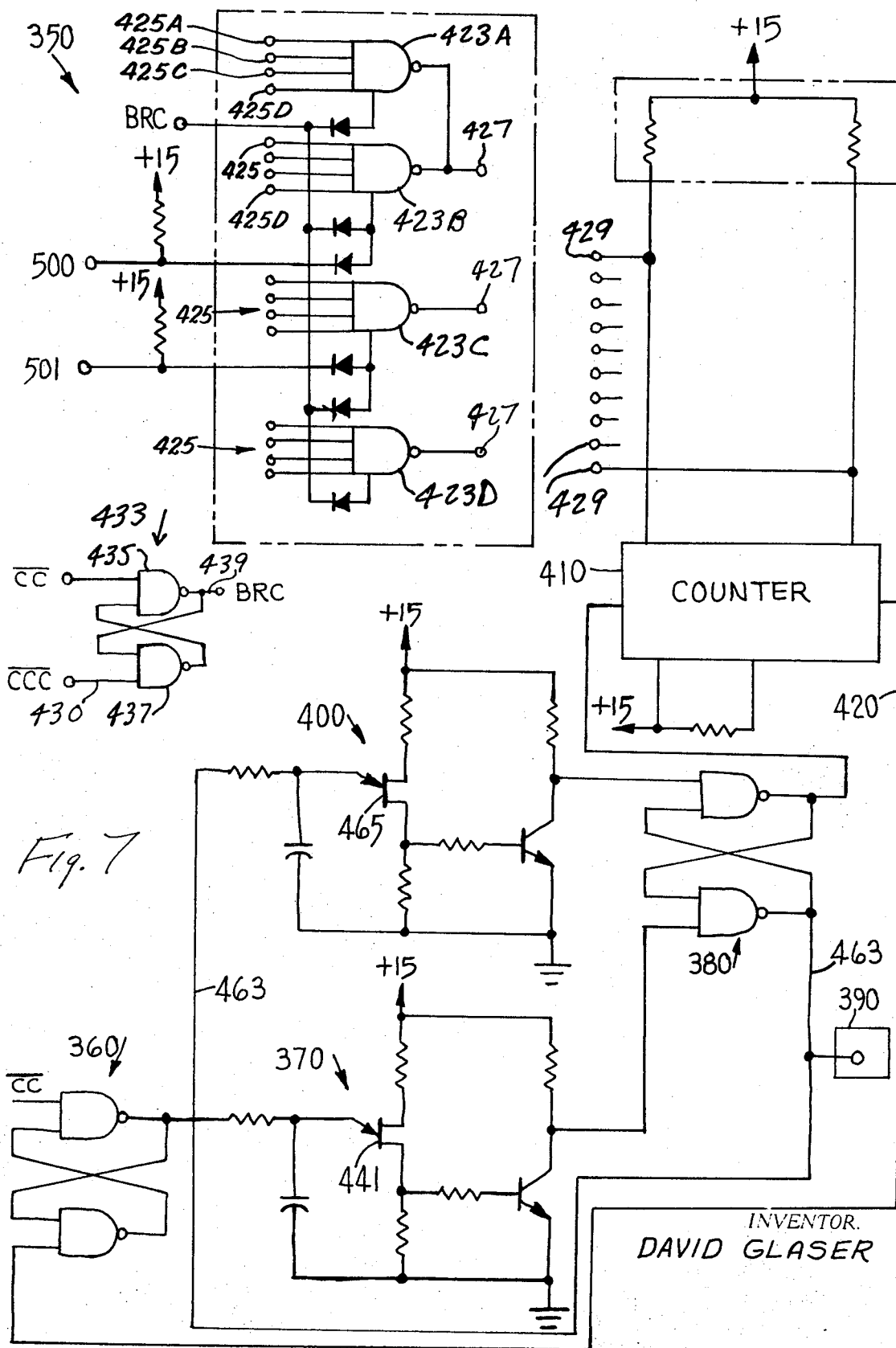


Fig. 6

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ELECTRONIC CONTROLLER FOR COPYING MACHINE

BACKGROUND OF THE INVENTION

Although many different types of copying machines are available commercially and in the prior art, each is different, operates differently, and has different requirements of operation. The present invention satisfies the operating requirements of a copying machine not found in the prior art.

DESCRIPTION OF THE DRAWINGS

FIGS. 1 To 7 are schematic representations of separate portions of the system of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description of the electronic circuit of the invention and in the drawings, circuit features which would be obvious to those skilled in the art are omitted for purposes of simplifying the drawings and the description. Such elements include power supplies, ground connections, various resistors, inverters, buffers, amplifiers, or the like.

Referring to FIG. 1, the apparatus of the invention 10 comprises, essentially, an electronic system for operation with a copying machine represented schematically by block 20. The machine 20 is adapted to perform a plurality of functions including, for example, turning on motors, engaging clutches, setting a printing master in place, feeding paper, making copies, discharging copies made, etc., and in most cases, the performance of each of these functions is accompanied by the generation of an output pulse on selected leads 30. The machine includes, for this purpose, apparatus called a machine clock 40 which comprises, essentially, a rotating member such as a cog wheel or a rotating optical apparatus or the like adapted to energize portions of the machine or to deliver pulses to the electronic circuits at various ones of its angular positions as it rotates. The machine clock is represented schematically within the machine block 20, with tabs 50 representing its contact elements or apparatus-energizing elements.

Continuing with FIG. 1, the system 10 includes suitable means 60 for applying power to the system and its various component parts and thus turning them on. The circuit includes an inhibit or reset circuit represented by block 70 and shown in detail in FIG. 2, which is energized when power is turned on and which inhibits generation of pulses by the machine clock 40; however, it does not prevent rotation of the machine clock. The reset circuit 60 also resets all counters to zero condition representing the beginning of a machine cycle. Other operations may also be performed by this circuit, if required.

The leads 30 as noted represent output connections from each of the functional portions of the machine 20. For example, one may be coupled to apparatus for sensing the presence of a master to be printed; one may sense the physical orientation of the master; one may represent the condition of the printing mechanism; one may represent the making of a copy; one, 30S, may also represent the rotation of the machine clock 40 to a known starting position, at which time a synch pulse is

generated to permit a desired sequence of operations, including printing, to take place. In operation of the apparatus, the synch pulse through lead 30S is coupled to the reset circuit 60 to remove its inhibiting influence on the machine clock so that the machine clock can rotate and cause the desired sequence of events to occur.

Considering, first, the machine cycle portion of the system which prepares the machine for printing as the machine clock 40 rotates, it generates pulses which are fed by lead MC into a multiple-decade counter 100 (FIG. 3), the outputs of which are connected by leads 110 to a first diode matrix 120 in which they are decoded to produce output pulses which represent time intervals during which various operations are to be performed.

The outputs 130 of the diode matrix 120 (FIG. 3) are coupled to a bus 140 which is connected by lead 141 (FIG. 1) to a distributor circuit 150 which includes a flip-flop 154 and two decade counters 156 and 158 connected to operate in flip-flop fashion. The decade counters feed into a second diode matrix 170, the outputs 180 of which are connected to the various functioning elements of the machine 20 which must be cycled through before a printing operation takes place. Thus, each pulse generated by the machine clock produces an output from the diode matrix 120 (FIG. 3) which, in turn, acts through distributor 150 and the second diode matrix 170 to energize each component of the machine, in turn, for a specific period of time.

It is noted that the diode matrices 120 FIG. 3 and 170 FIG. 1 include the necessary inverters, buffers, amplifiers, etc., as required, although they are not shown.

As noted, one of the outputs 30CC from the machine 20 represents a copy made and includes apparatus, a portion of which is shown for producing an output pulse for each copy made. Referring to FIGS. 1 and 6, a lead CC from this apparatus is coupled through suitable circuitry to a flip-flop 190 and to a printing clock circuit 200 which, when turned on, runs freely and generates pulses until it is turned off. The printing clock circuit is designed to have a time delay from the time it receives a pulse from the flip-flop 190 to the time it begins to produce output pulses. A 0.5 usec. delay is suitable for purposes of the invention.

The flip-flop 190 (FIG. 6) includes a lead 192 which couples a disabling pulse CE to distributor 150 FIG. 1, as shown, to disable the distributor when it is desired to use the counter 100 for a second operation other than running through the machine cycle.

Referring to FIG. 3, The circuit of the invention includes a first multi-decade presettable counter 220 including a suitable display device 230 such as a NIXIE tube for each decade of the counter and suitable switches 140 for setting the counter. This counter is known as the CTBM or "copies to be made" counter. The system also includes a second counter 250 (FIG. 4) known as the CM or "copies made" counter which also includes four decades and associated display devices 160. The counter 100 is operated in conjunction with the counters 220 and 250 in the printing portion of the system and is known as a CB or "coincidence billing" counter, and it also includes four decades.

The counters 100, 220 and 250 are shown as including four decades each, and, in addition, the decades are

connected to provide a maximum count of 2000 since that is determined to be the maximum number of copies the machine is to be permitted to make from one master. Those skilled in the art will understand that counters can be connected to provide a different total count and that the system can be made to operate with any other total number of counts.

The output of the printing clock 200 (FIG. 6) is suitably coupled by lead 260 to the inputs of each of the three counters as shown.

The output of the CTBM counters 220 is coupled by a lead 270 (FIGS. 2 and 3) through an inverter 280 to one input 290 of a two-part AND gate 320. The output of the CB counter 100 is coupled by lead 330 to one side of a flip-flop 340, the output of which is coupled by lead 350 to the second input 360 of AND gate 320, and the output of the CM counter 250 is coupled by output line or lead 370 (CCC) FIGS. 2 and 4 to the second side of the flip-flop 340. The output of counter 100 is connected through lead 380 to both inputs of an AND gate 390, the output of which is coupled to AND gate 400. The output of AND gate 320 is coupled by lead 410 to one portion of flip-flop 420, and the output of flip-flop 420 is coupled to AND gate 400. The output of AND gate 400 is coupled by lead 413 to the distributor circuitry 150 (FIGS. 1 and 2) so that it can operate apparatus for turning off machine 20 to represent the end of a printing cycle.

The output of the CB counter 100 is also coupled by lead 430 (FIGS. 3 and 6) to the printing clock flip-flop 190, by which connection a carry pulse from the output of the CB counter 100 can be used to turn off the lock.

In operation of the system 10 as described thus far, the switches 140 in counter 220 (FIG. 3) are set to the number of copies to be made and power is turned on. The reset circuit 70 (FIG. 1) is operated to set all of the counters to zero position. At the same time, the machine clock rotates, but its output functions are inhibited by circuit 70. At some point in its rotation, the machine clock 40 generates a synch pulse is coupled on lead 305 and lead 443 through circuit 440 (FIG. 6) and gate 441 and lead 490 to switches 140 and counter 220 to cause the switch-set count to be transferred into the counter 220. Counter 220 is now set to the number of copies to be made. At another later time, the machine clock generates a pulse on line 30S (FIG. 1), and this removes the reset or inhibit circuit 70 from the machine clock which is thereby freed to operate (FIGS. 1, 5 and 6).

As the machine clock rotates, each pulse generated by it and its associated circuitry is fed into counter 100 on lead MC (FIGS. 3 and 5), and, as each position of the counter is energized, a pulse operates through the diode matrix 120 (FIG. 3), distributor 150, and diode matrix 170, to cause machine 20 to cycle through the various mechanical features of the machine which must be checked before a copying operation is carried out.

At a selected time, print paper is fed and a first print is made and a copy count pulse CC is generated in the machine on the appropriate lead 30CC (FIG. 1), and this pulse is applied to flip-flop 190 (FIG. 6) and thus to printing clock 200. When the pulse is applied to flip-flop 190, it operates to generate a pulse CE on line 192 which is applied to distributor 150 (FIG. 1) to disable it and to thus free counter 100 for use in the printing

operation. When copy count pulse CC is applied to the flip-flop 190, it is also applied through lead 420 to the input of the "copies made" counter 250 (FIG. 4) where one count is thus registered. After the required delay time of clock 200 (FIG. 6) has passed, the clock is set into operation and it generates a sufficient number of pulses to drive the counters 100 and 220 from one end to the other, in this case 2,000 pulses or counts, at which time a pulse appears at the output of counter 100 on output line 380 and is fed on line 430 therefrom to the flip-flop 190 (FIG. 6), which is thereby flipped and set to receive the next "copy count" pulse. This also turns off clock 200. An output also appears from counter 220 on output line or lead 270. However, it has no effect on the circuitry to which it is connected because the copies made do not yet equal in number the number of copies to be made.

It is to be noted that the counters are all connected for a maximum count of 2,000 pulses which is set as the maximum number of copies to be made from one master. However, any other total number could be used. The next print made generates a CC pulse which causes the machine and circuit to execute the same cycle, with a second increment being entered in the CM counter 250. When the machine has printed the desired number of copies set into the preset CTBM counter 220, the carry pulses which appear on output leads 270 (FIG. 3) 370 (FIG. 4), and 380 (FIG. 3) appear simultaneously, electrically, and operate the various flip-flops and AND gates 320 and 400 (FIG. 2) to produce an output pulse at AND gate 400, and this is used on lead 410 to operate the distributor 150 and associated apparatus (FIG. 1) which now run the machine through its shut-down cycle.

The system also includes two arrangements for stopping the printing operation at any desired time. One arrangement includes the eject circuit 450, shown in FIG. 2, Which is operated by pressing of the eject button 460 which, in turn, causes the emission of a pulse at AND gate 470. This pulse is applied to reset circuit 70 to disable the machine.

In another arrangement, circuit 440 (FIG. 6) is used as follows. If, for example, 200 copies were set into the switches 140 (FIG. 3) originally and 150 copies have been made and it is decided to stop at 150, then the operator sets 150 or any smaller number into the switches, presses change button 480, and a shift pulse appears on line 490 which shifts the new number into counter 220. Then, when the next 2,000 pulses are applied to the counters, the carry output from the CM counter and the carry output from the CTBM counter operate as described above to disable the machine. With this arrangement of the counters, that is with CTBM counter set at a number equal to or smaller than the number set into the CM counter, the carry pulse from the counter 250 energizes AND gate 320 and maintains this state until the carry output from the CTBM counter 220 arrives and the coincidence state exists and the machine is shut down as described above.

The system is also provided with a billing circuit 350 (FIG. 7) which includes a flip-flop 360 having an input coupled to the copy count line 30 CC from machine 20 (FIG. 1). The flip-flop 360 is coupled to a first switching circuit 370 which in turn is coupled to a second flip-flop 380. The second flip-flop circuit 380 is

coupled (1) to a pulse counter 390 for counting billing counts, (2) to a second switching circuit 400, the output of which is coupled to the flip-flop 380, and (3) to the input of a presettable decade counter 410 having a carry output line 420 which is coupled to the input flip-flop 360. The decade counter 410 can be set to begin its count at any one of its ten positions so that the operator can vary the number of counts received before a carry pulse appears on output lead 420.

The billing circuit also includes a plurality of AND gates 423 (A,B,C,D), each having four input terminals 425 (A,B,C,D) by means of which each can be coupled to the decades of counter 100 so that each can sense a predetermined number of counts fed into counter 100. The counters have outputs 427 which can be connected to different positions in decade counter 410 through terminals 429 to cause the billing count to begin at the selected position and terminate at the last position in the decade counter. The number of counts thus fed into the decade counter, in effect, represents a billing rate, and it can be changed as desired by the coupling of a selected AND gate 425 to the counter 100 and to the counter 410.

The billing circuit 350 also includes a flip-flop 433 which includes two two-part AND gates 435 and 437 connected as shown and including a connection from the copy count pulse (CC) generating circuit to one input of gate 435 and a connection (CCC) representing copy count carry from lead 370, the carry output lead from copies made counter 250. The flip-flop 433 has an output lead 439 (BRC) which is connected to a common input line to all of the billing rate AND gates 423.

When a copy is made and a copy count comes in to the billing circuit 350, it sets billing flip-flop 360 and UJT 441 is turned on, and the circuit 370 generates an output pulse which sets billing rate flip-flop 380, and the output of 380 goes through lead 463 to an electro-mechanical counter 390 and to UJT 465 which is turned on, and circuit 400 then generates a pulse which resets flip-flop 380. The set and reset of flip-flop 380 enter one count in counter 390 and in counter 410. This operation continues until a carry pulse from counter 410 on line 420 turns off the billing flip-flop 360. Thus, each copy count input to flip-flop 360 sets the circuit in operation, and it shuts off after the counter 410 has reached its last position and produces a carry output.

If the billing counter 410 is set to a starting position other than its first position, for example position eight, then the entry of two counts into the counter would bring it to the end and would produce the turn-off carry output. Similarly, other settings of the counter may be made to vary the number of pulses required to turn off the billing counter, with each setting representing a different billing rate.

The billing rate may be changed automatically by connecting the billing gates 423 to different number positions in the counter 100, and the rate changes automatically in the counter 410 as copies are made by the machine. With this arrangement, AND gate 423A is set to enter the largest billing rate, and the rate decreases automatically as the other gates 423 B,C,D operate, each being connected to a different successively lower count position in the counter 100. Thus, for example, if AND gate 423 sets the highest rate of 10 counts for,

say, the first three copies made, then its terminals 425 are connected to the number 1997 in counter 100, and its output terminal 427 is connected to the first position in counter 410. Thus, for the first three copies made, each time counter 100 reaches count 1997, AND gate 423 is energized, and the billing circuit 350 is operated with ten counts entered in counter 410 for each copy.

AND gate 423B might have its terminals 425 connected to the number 1990, AND gate 423 might have its terminals 425 connected to the number 1970, etc. with their respective outputs connected to a different starting position in counter 410. However, in this case, control circuit 433 is required to make certain that, as each new lower rate comes into play, the proper AND gate 423 controls the billing operation, and the higher rate gates which follow it are prevented from operating. This is achieved by having a copy count pulse CC, generated when a copy is made, open the flip-flop gate 433 and thus energizes the gates 423 through lead 439. Then, when a low rate gate 423, which is set to a position in counter 120, is energized, the billing operation is carried out, and at the same time but with some delay, a pulse CCC from counter 250 turns the gate 433 off and thus prevents operation of any subsequent gates 423 as the counter 100 completes its counting cycle. Appropriate time delay is built into the circuit to permit the billing operation to be carried out before the gate 433 is closed.

The terminals 500 and 501 can be used after a large number of copies have been made and it is desired to set the billing rate to a minimal level. The AND gates 423 and their connections may all be mounted on a removable billing board which can be specially designed for each customer, and, if the card is removed from the system, then the counter 410 automatically requires 10 counts to produce a carry output.

What is claimed is:

1. A copy-making machine and control system therefor including

a plurality of operating mechanisms in said machine for performing a variety of functions including a copy-printing function,

a copy-printing means for performing said copy-printing function and including copy count electronic means for generating a copy count pulse for each copy made,

a copy count clock coupled to and turned on by each pulse from said copy count electronic means, said copy count clock being free-running when turned on,

first, second, and third counters,

said copy count electronic means being coupled to said third counter for entering therein a count for every copy made,

said copy count clock being coupled into said first, second and third counters,

said second counter being adapted to have a count preset therein representing copies to be made and including means for generating an output pulse when a number of copy count pulses corresponding to the copies to be made are entered therein,

the output of said first counter being coupled to said copy count clock to turn it off when an output pulse is generated thereby, and

an AND gate coupled to the outputs of said second and third counters whereby, when the counts in said second and third counters are equal or the count in said third counter is larger than that in said second counter, then the outputs of said second and third counters operate said AND gate and transmit a signal to said machine to turn it off.

2. The system defined in claim 1 and including a billing circuit having a decade counter coupled to means for generating one or more pulses in response to a copy printed, the decade counter being settable to receive a selected number of pulses before it produces a carry output, said number of pulses representing a billing rate.

3. The system defined in claim 1 wherein said counters are connected to have a selected maximum count capacity, said first counter being adapted to have a preset count entered therein, said first counter producing an output carry pulse when the number of copies made equals said preset count, said second counter entering a count for each copy made, and said third counter not accumulating counts but receiving in each cycle the maximum number of counts it can contain from said clock before it generates an output pulse on its carry line to turn off said clock.

4. The system defined in claim 1 and including a billing circuit comprising

a plurality of AND gates each having input means selectively couplable to various counting positions of said first counter whereby each can be operated at a different counting position therein,

a settable billing counter having its input coupled through circuit means to said copy count electronic means whereby each copy count pulse enters one count therein,

each of said AND gates having an output couplable to any one of the positions of said billing counter to set the counter's count-starting position, said count-starting position determining the billing rate for said system.

5. The system defined in claim 1 and including a billing circuit comprising,

a plurality of AND gates each having input means selectively couplable to various counting positions of said first counter, and

a settable billing counter having an input and an output and having its input coupled through circuit means to said copy count electronic means whereby each copy count pulse energizes said circuit means and drives said counter from a starting position to the end to produce an output signal at the output of said billing counter, said output signal de-energizing said circuit means,

each of said AND gates having an output couplable to any one of the positions of said billing counter to select a count-starting position, said count-starting position determining the billing rate for said system.

6. The system defined in claim 1 and including a billing circuit comprising

a plurality of AND gates each having input means selectively couplable to various counting positions of said first counter,

a settable billing counter having an input and an output,

a pulse generating circuit having its input coupled to said copy count electronic means and having its output coupled to the input of said billing counter, each said copy count pulse turning on said pulse generating circuit and causing it to drive said counter from a starting position to the end to produce an output signal at the output of said billing counter, said output signal de-energizing said pulse generating circuit, and

each of said AND gates having an output couplable to any one of the positions of said billing counter to select its count-starting position, said count-starting position determining the billing rate of said system.

7. The circuit defined in claim 6 wherein said pulse generating circuit comprises a first flip-flop having one input coupled to said copy count electronic means and adapted to receive a copy count pulse to change its state and having its output coupled through a first pulse generator to a second flip-flop which has its output connected to a mechanical counter and to the input of said settable billing counter, the output of said second flip-flop also being connected through a second pulse generator to the input of said second flip-flop,

the output of said settable billing counter being coupled to said first flip-flop for returning said first flip-flop to the condition it has before it receives a copy count pulse.

8. A printing machine including

a plurality of operating mechanisms,

means in said machine for generating a start pulse to initiate a cycle of operation thereof and of its operating mechanisms,

a machine clock associated with said machine for generating pulses and adapted to be energized by said start pulse,

said machine clock being coupled to a circuit including cycling means including a first counter coupled to each of said operating mechanisms of said machine whereby each pulse from said machine clock causes each of said mechanisms to operate in turn,

a copy printing means comprising one of said mechanisms and including copy count electronic means for generating a copy count pulse when a copy is made of a master print inserted in said machine,

a copy count clock coupled to and turned on by each pulse from said electronic means of said copy printing means, said copy count clock being free-running when turned on,

second and third counters, said second counter being a presettable counter and adapted to have a count entered therein representing copies to be made, said third counter being adapted to enter a count representative of copies made and thus coupled to said copy count electronic means,

said second counter generating an output pulse when a number of copying pulses corresponding to the copies to be made is entered therein,

the output of said copy count clock being coupled to said first, second, and third counters,

the output of said first counter being coupled to said copy count clock to turn it off when an output pulse is generated thereby, and

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an AND gate coupled to the outputs of said second, and third counters whereby, when simultaneous outputs are generated by said second and third counters when the desired number of copies have been made, said AND gate is operated to couple a signal to said machine to turn it off.

9. The machine defined in claim 8 wherein said

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cycling means includes said first counter coupled to a diode matrix distributor which cycles each of said operating mechanisms in turn.

10. The machine defined in claim 8 wherein said first counter has a count capacity equal to the total number of copies to be made from a single master.

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