United States Patent

Burger et al.

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[45] **Mar. 21, 1972**

[54] REPROGRAPHY MACHINE CONTROLLED BY INFORMATION ON MASTER

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[52] **U.S. Cl.**.....**101/45,** 101/2, 235/61.7, 101/132, 101/91, 235/61.11

[51] **Int. Cl.**.....**B41l 9/00,** G06k 17/00

[58] **Field of Search**.....101/132.5, 91, 144, 369, 247, 101/322, 45

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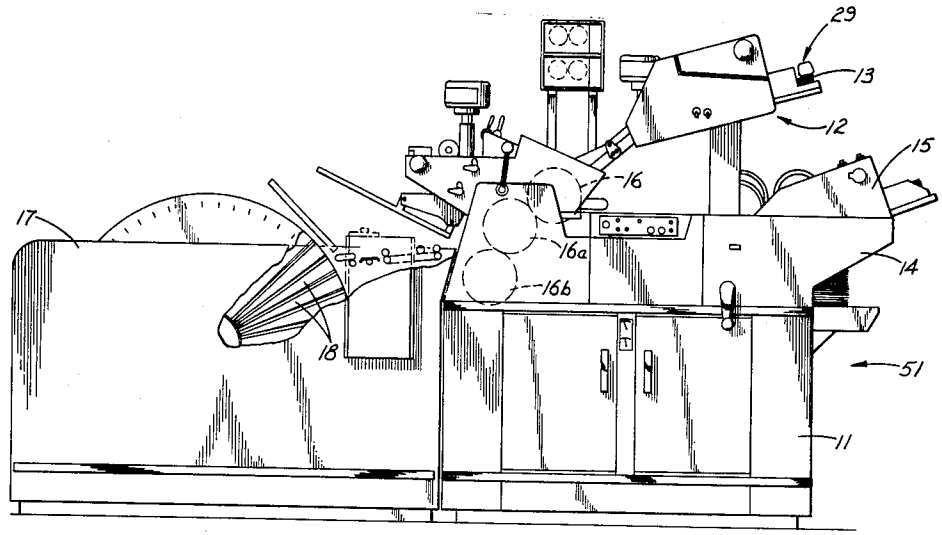
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[57] **ABSTRACT**

Automatic control of reproduction and sorting of reproduced copies is accomplished in a printing or duplicating machine, a reprography machine, of the type which utilizes masters or originals from which copies are made and which has a hopper, magazine, bunker or chamber for masters, with provision for feeding them in succession to a cylinder associated with inking, duplicating and cleaning mechanisms. Masters are employed which are formed with indicia or coded markings along one or two edges which provide signals for causing a desired number of copies of each successive master to be produced and for sorting the produced copies in a desired manner, for example according to the number of copies to be sent to each of a plurality of different destinations. A scanner is provided for examining the code marks to produce signals, and circuits responsive thereto serve to actuate parts of the duplicating machine. A digital memory device is utilized to store information supplied by the code of one master while reproduction from a previous master is going on.

9 Claims, 19 Drawing Figures



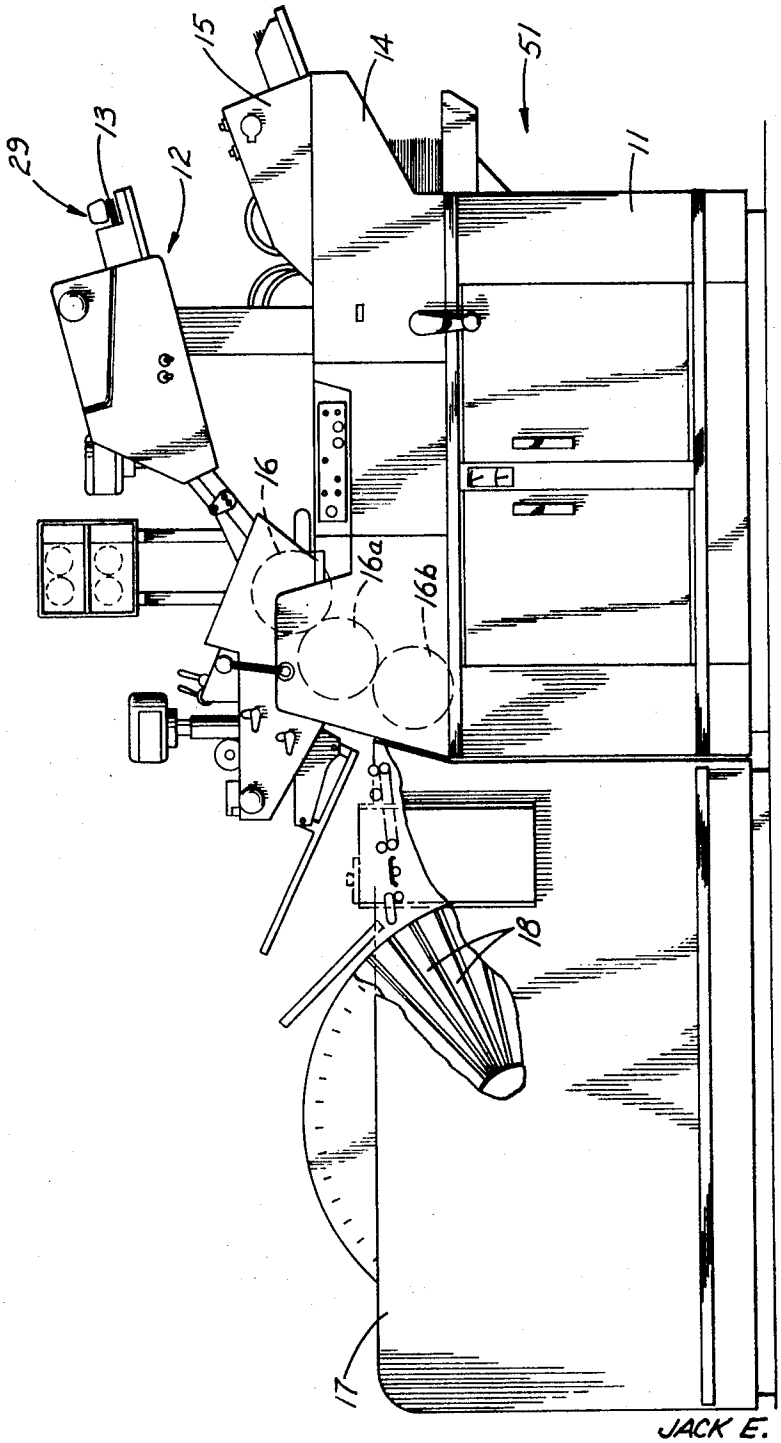


Fig. 1

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BY Russell L. Root
ATTORNEY

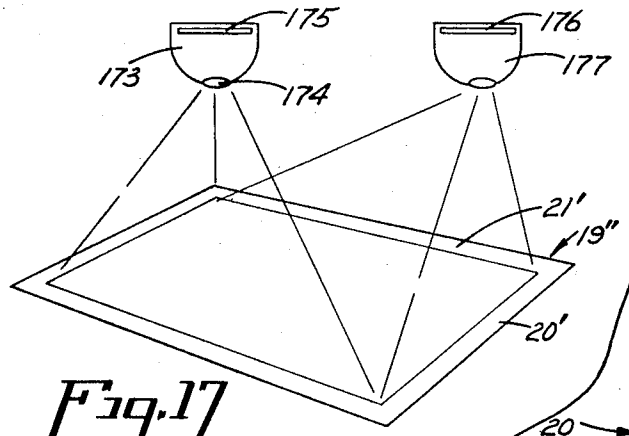


Fig. 1

Fig. 2

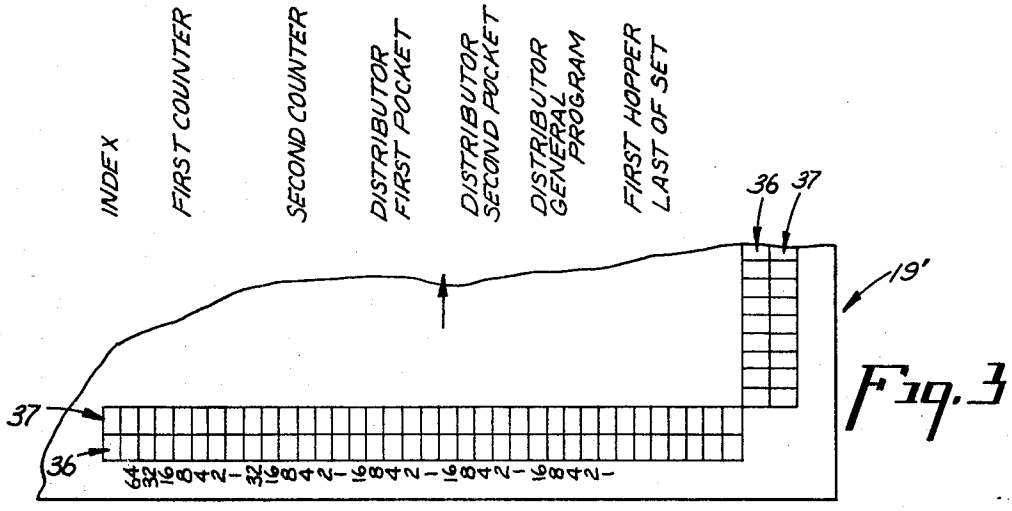


Fig. 3

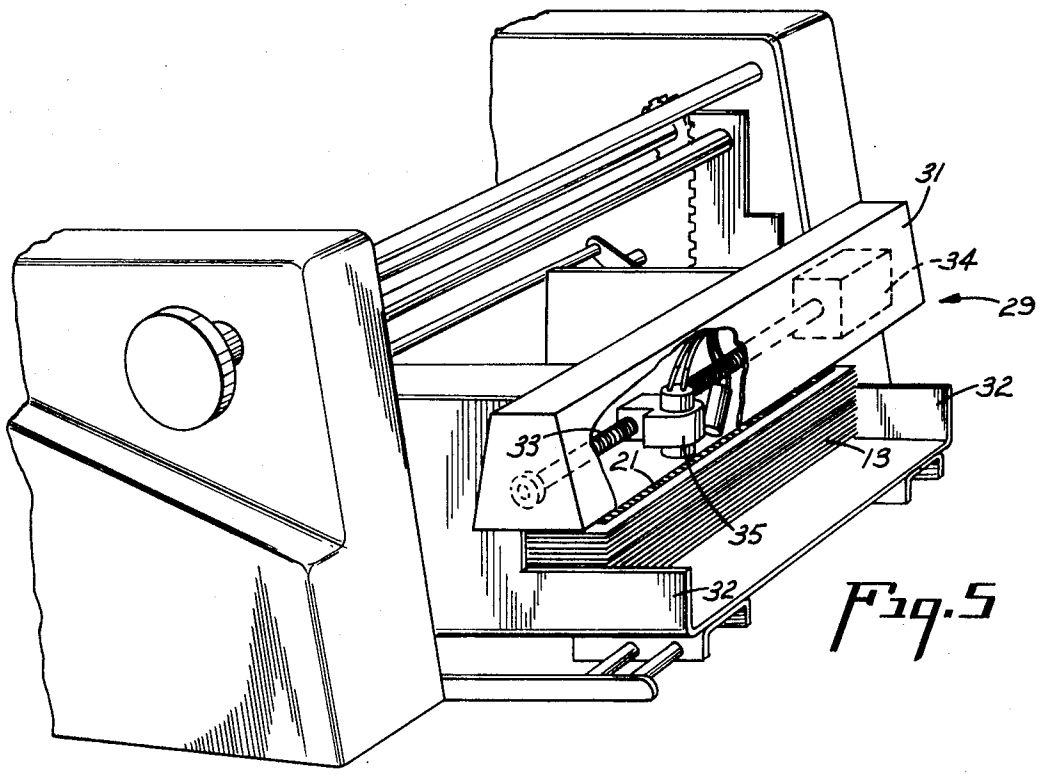


Fig. 5

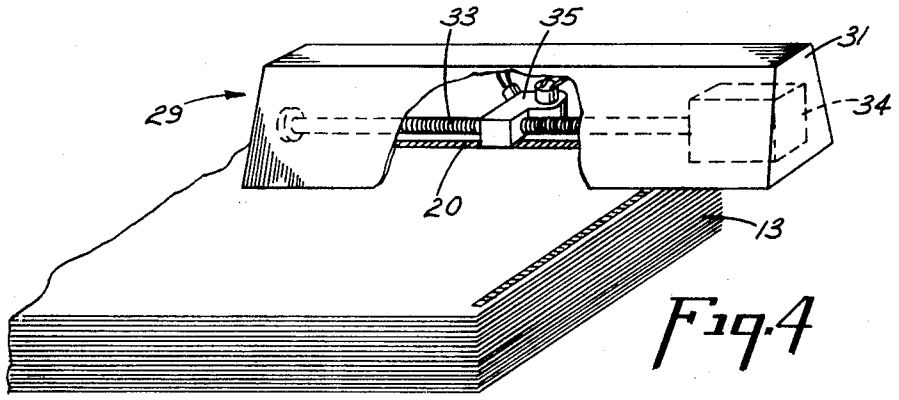


Fig. 4

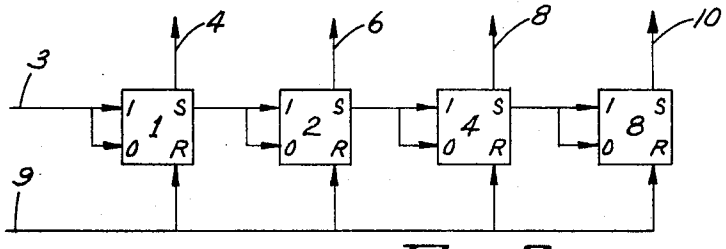


Fig. 8a

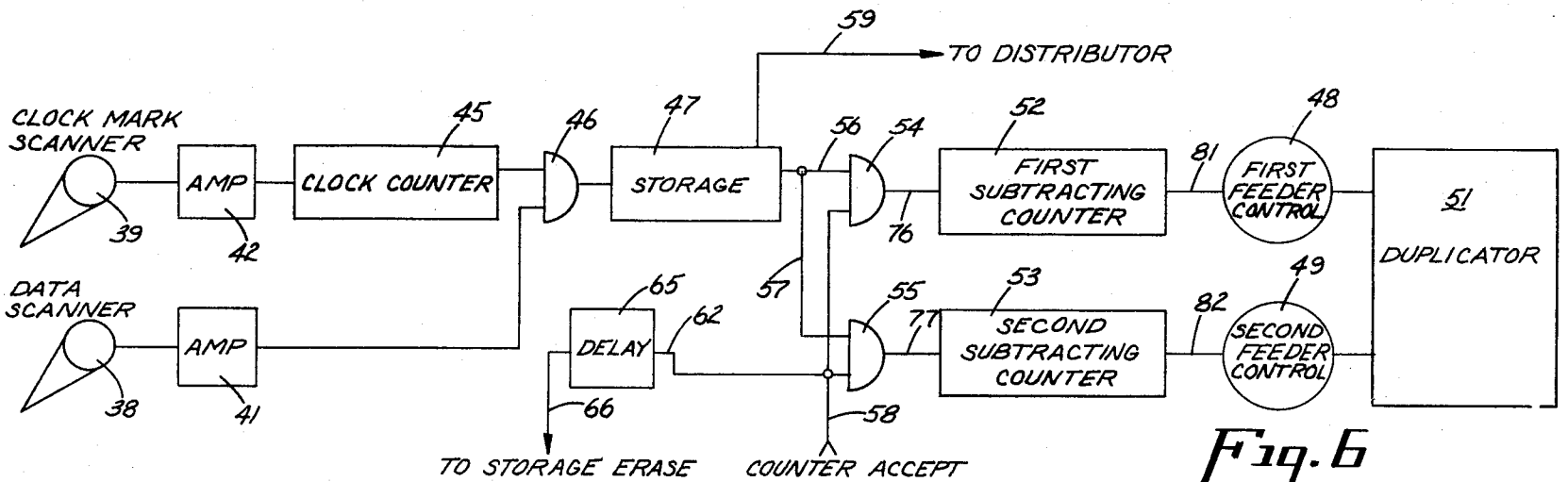


Fig. 6

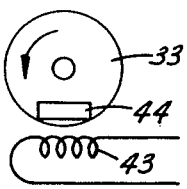


Fig. 6a

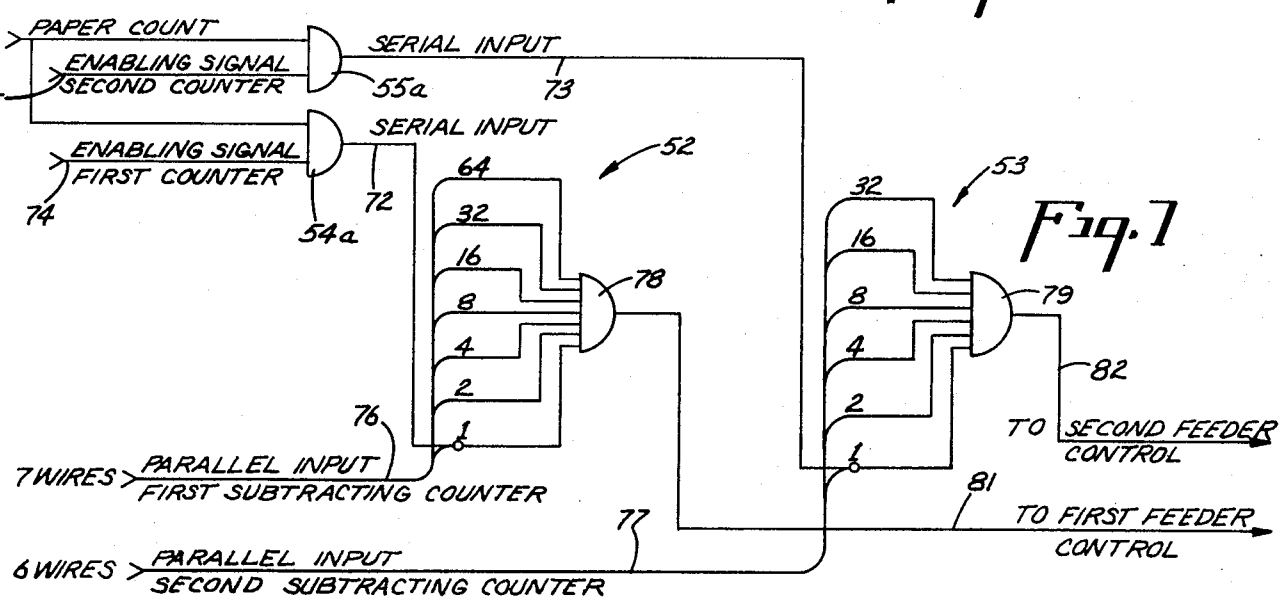


Fig. 7

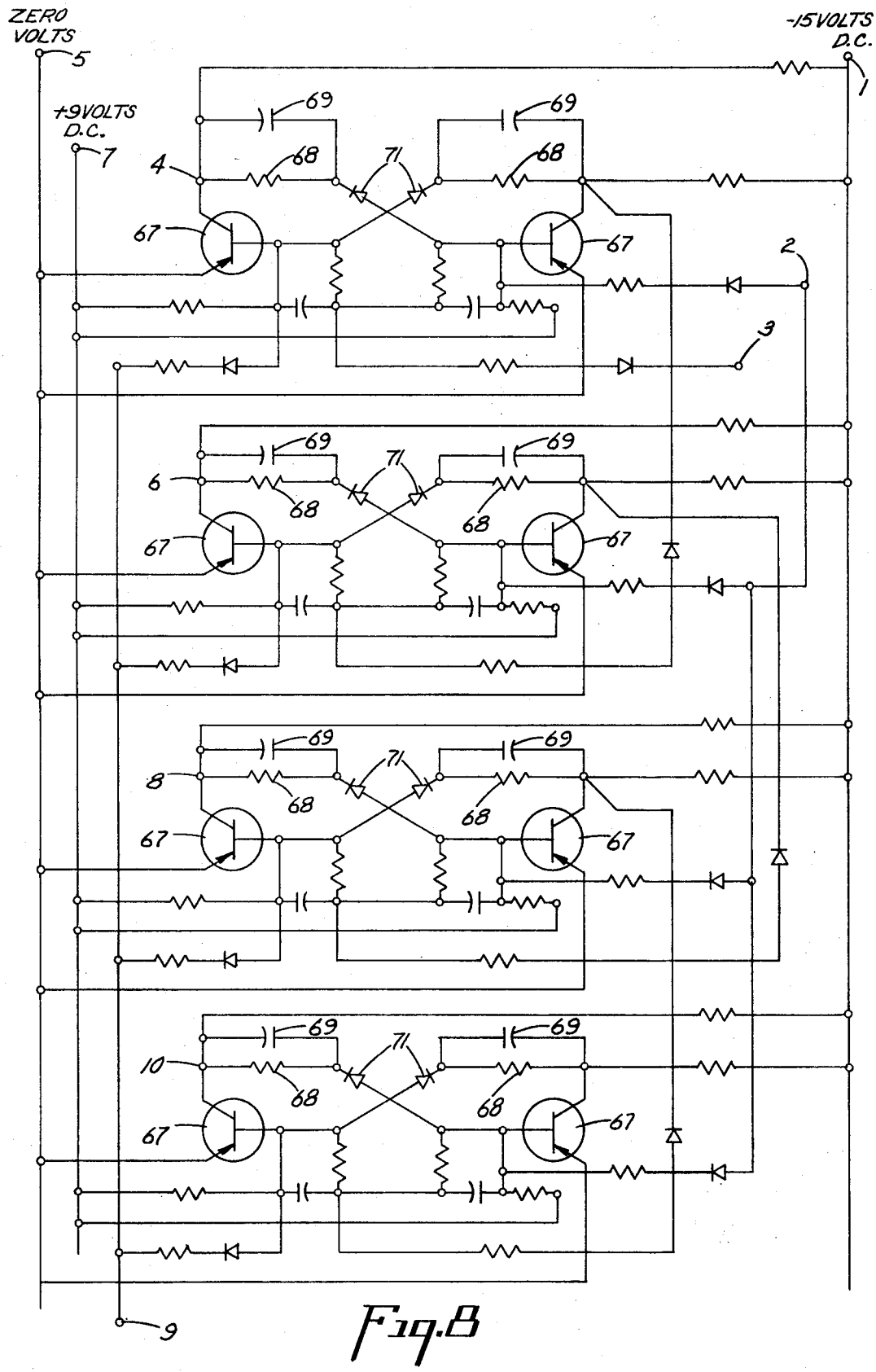
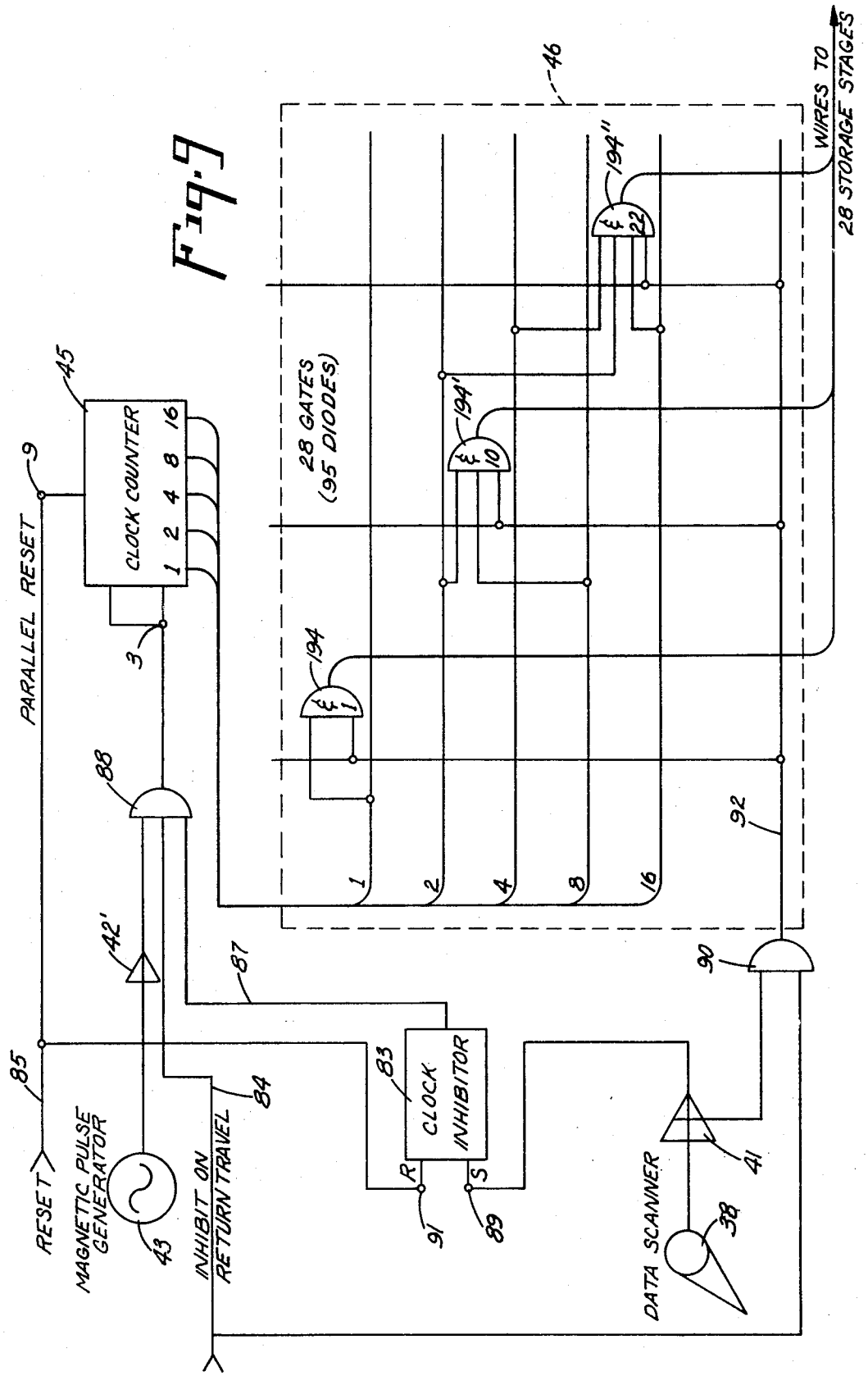
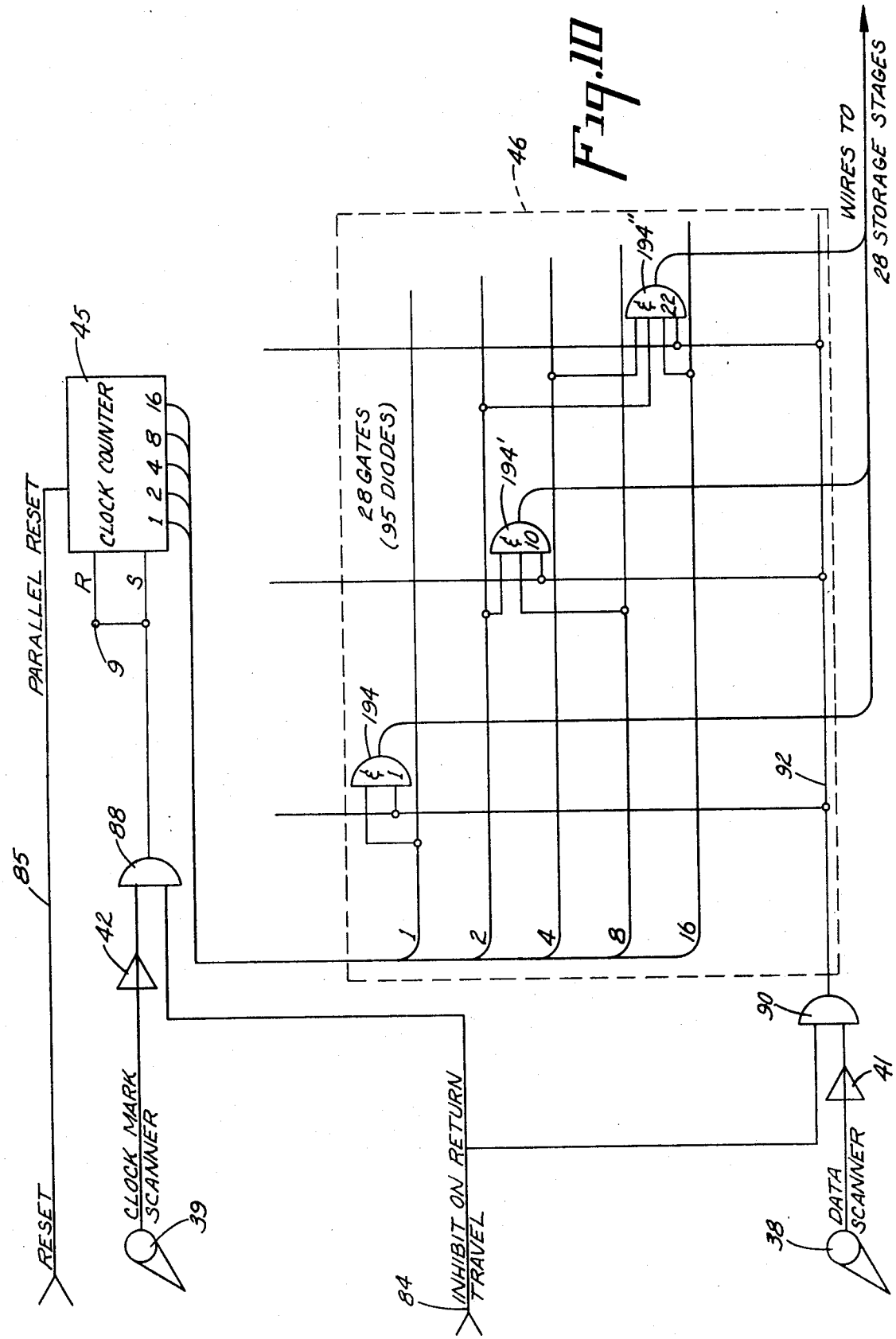


Fig. 8


Fig. 9
46
WIRES TO 28 STORAGE STAGES
28 GATES (95 DIODES)
194
194'
194''
45
CLOCK COUNTER
1 2 4 8 16
9
PARALLEL RESET
3
88
42'
87
85
RESET
MAGNETIC PULSE GENERATOR
43
INHIBIT ON RETURN TRAVEL
84
83
CLOCK INHIBITOR
R
S
91
89
92
90
41
DATA SCANNER
38
1
2
4
8
16


Fig. 10
46
45
CLOCK COUNTER
1 2 4 8 16
R
S
9
PARALLEL RESET
85
88
42
CLOCK MARK SCANNER
39
RESET
28 GATES (95 DIODES)
194
194'
194"
1
10
22
1
2
4
8
16
92
WIRES TO 28 STORAGE STAGES
90
41
DATA SCANNER
38
84
INHIBIT ON RETURN TRAVEL

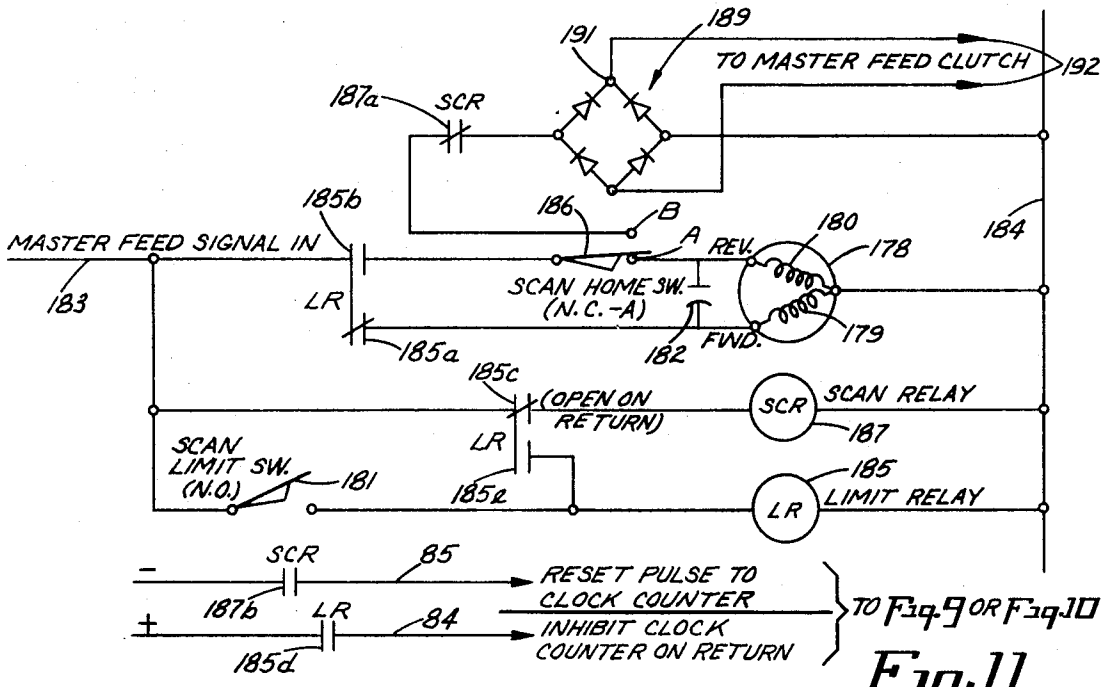


Fig.11

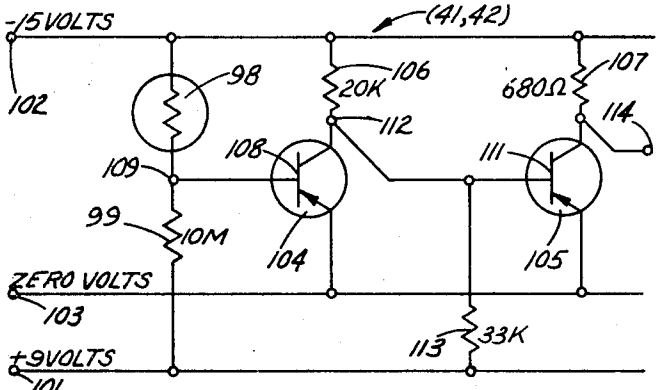


Fig.12

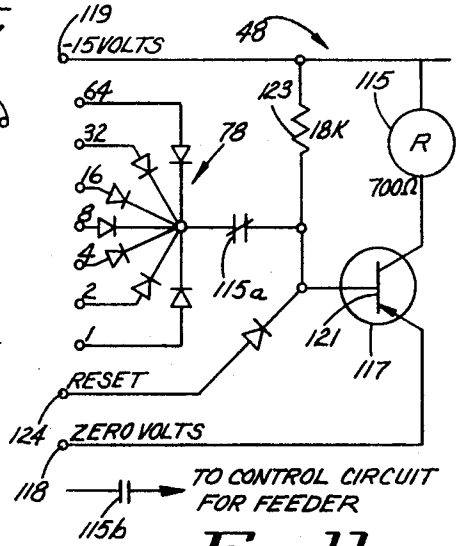


Fig.13

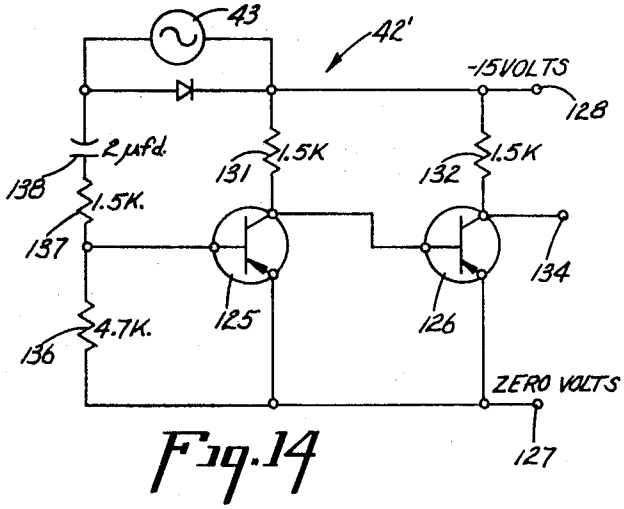


Fig.14

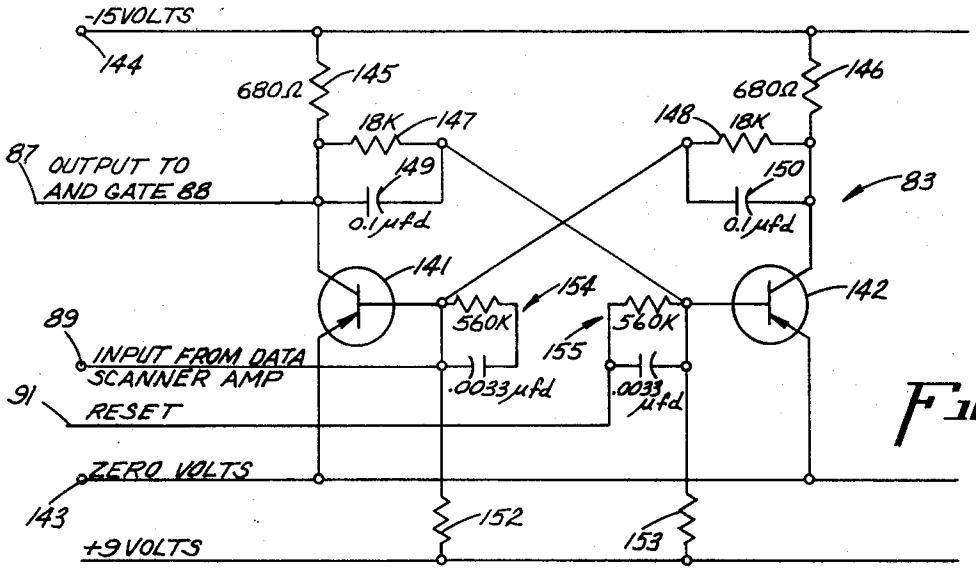

-15VOLTS
144
680Ω
145
680Ω
146
18K
147
18K
148
87 OUTPUT TO AND GATE 88
149
150
83
0.1 μfd
0.1 μfd
141
142
154
560K
560K
155
89 INPUT FROM DATA SCANNER AMP
.0033 μfd
.0033 μfd
91 RESET
ZERO VOLTS
143
+9 VOLTS
152
153

Fig. 15

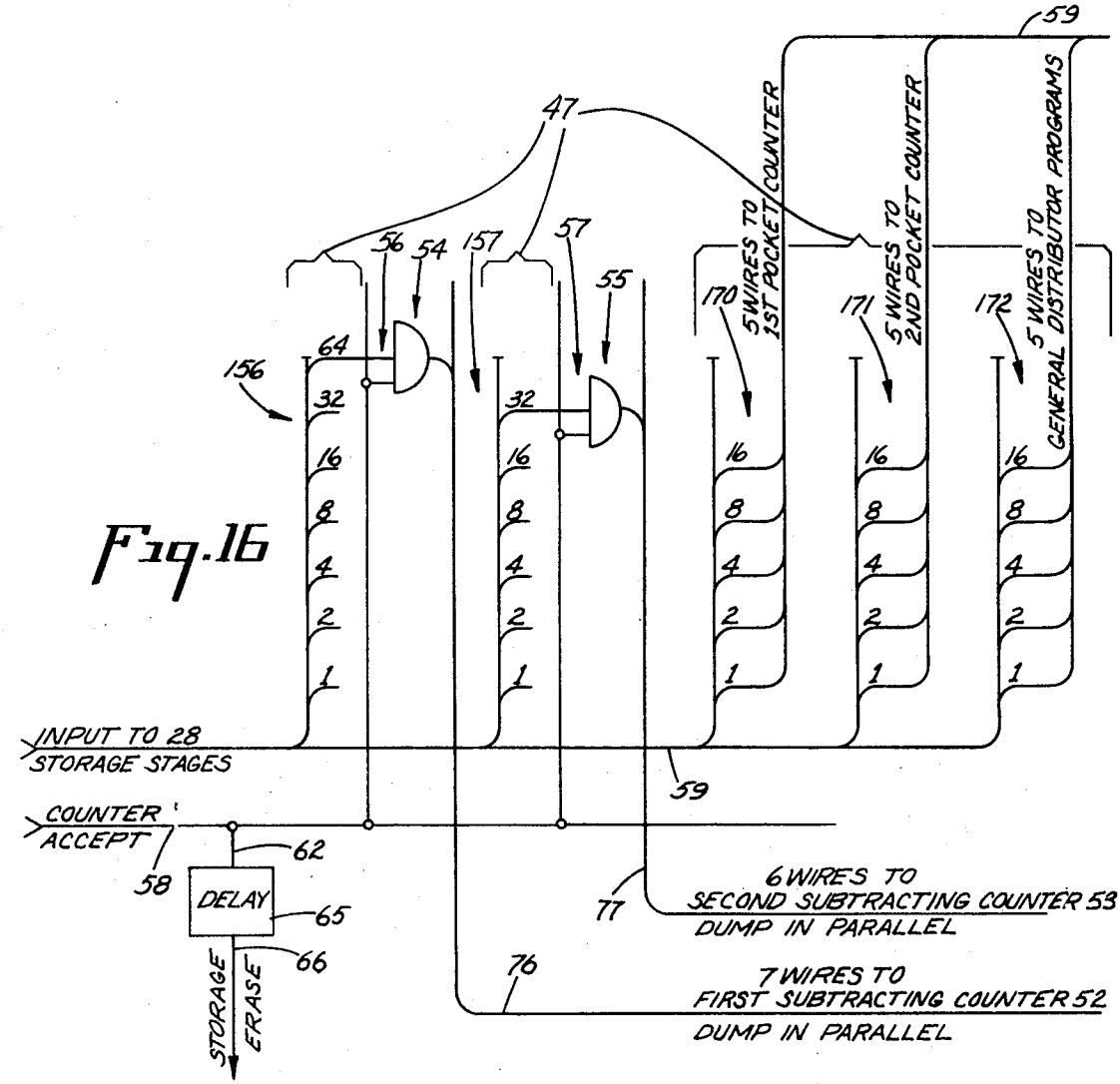

59
47
5 WIRES TO 1ST POCKET COUNTER
5 WIRES TO 2ND POCKET COUNTER
5 WIRES TO GENERAL DISTRIBUTOR PROGRAMS
56
54
157
57
55
170
171
172
156
64
32
16
8
4
2
1
INPUT TO 28 STORAGE STAGES
59
COUNTER ACCEPT
58
62
DELAY
65
66
STORAGE ERASE
77
6 WIRES TO SECOND SUBTRACTING COUNTER 53 DUMP IN PARALLEL
76
7 WIRES TO FIRST SUBTRACTING COUNTER 52 DUMP IN PARALLEL

Fig. 16

REPROGRAPHY MACHINE CONTROLLED BY INFORMATION ON MASTER

PRELIMINARY DESCRIPTION

An object of the invention is to make it unnecessary in reprography for the operator to stop the machine after the number of copies desired for any master has been run and to reset the machine for the number of copies desired for the next master. It is thus an object of the invention to obviate the need for manually set counters and to provide counting mechanism which is wholly responsive to the encoded master.

Another object of the invention is to provide for automatic distribution of the copies with any desired number of copies distributed to each of the plurality of different destinations.

Other and further objects, advantages and features will become apparent as the description proceeds.

In carrying out the invention in accordance with a preferred form thereof in conjunction with a printing or duplicating machine such as a "Multilith 2750" manufactured by Addressograph Multigraph Corporation, masters are employed similar to those ordinarily used with such machines except for the fact that the master is formed with a code along at least one edge, preferably two adjacent edges which contain instructions as to the number of copies to be made from each master and the manner in which the copies are to be distributed. A computer apparatus is provided responsive to the code for carrying out the instructions.

A scanner is provided with a carriage so constructed that the scanner will move along either the side or the end of the master and receive the coded instructions. In one embodiment of the invention, the master is provided also with a set of clock marks along the instruction code marks for synchronizing the computer. In another embodiment of the invention, the clock signals are produced in response to rotation of the shaft of the carriage for the scanner.

A memory or storage device is provided for storing the instructions received from one master in order that the instructions provided from the previous master may be carried out by the machine while a new set of instructions is being obtained by the scanning of the next master. A subtracting counter is provided for response to the storage information which saturates when the desired number of copies has been produced and stops a paper feeder. When the invention is employed with a type of duplicator such as "Multilith 2750" there is a magazine for masters.

Bistable circuits are employed for the clock and paper counters.

In the embodiment of the invention illustrated, the encoding on the masters is in the form of black marks which may be "read" by a scanner or reader provided with a lamp and photoresponsive detectors. The invention is not limited thereto, however, and does not exclude the use of other types of encoding and sensing means such as magnetic markings and magnetic responsive scanner equipment, or punched holes with scanning equipment responsive thereto or any other indicia which provides control data and which can be read. By reading is meant not merely traversing the indicia with a scanner, or moving the master with its indicia with respect to a reading head or scanner, but also utilizing a bank of pickup devices such as photoelectric cells to view separate parts of the indicia simultaneously for reading information in parallel as arrayed on the master. The invention relates to any type of machine which makes copies of some original, a process generally referred to as "reprography." Although specially prepared masters may be employed in reprography the invention is not limited thereto. The invention encompasses a procedure whereby the item inserted into the machine for copying is not such a printing master but is merely an original document carrying the appropriate control data, referred to herein as "indicia." This document, upon being fed into the machine has its control data read, and then proceeds to have some sort of copies made from it either by direct repetitive photography, or by first making a special master by some sort of photographic process and then printing copies from the special master. The term "master" as employed herein when used in its broadest sense, is intended to include such an original document with indicia marked thereon carrying control data as well as specially prepared duplicating masters.

A better understanding of the invention will be afforded by the following detailed description considered in conjunction with the accompanying in which:

In the drawings:

FIG. **1** is a side elevation of a printing apparatus in which the scanning apparatus and computer circuits of FIGS. **4–7**, **9–12**, and **14–16** are employed in conjunction with coded masters;

FIG. **2** is a view of a master employed in carrying out the invention;

FIG. **3** is a diagram of a coded master similar to that shown in FIG. **2**, but in which clock marks as well as control data information are coded;

FIG. **4** is a perspective view of the scanner carriage and mounting therefor arranged for scanning marks on the side of the master in the hopper;

FIG. **5** is a perspective view corresponding somewhat to FIG. **4** with the scanning head turned for scanning marks on the end of the master, and illustrating further how the scanning carriage and its mounting are related to the master hopper and its supporting structure;

FIG. **6** is a block diagram of the system employed for automatic control of a duplicator function such as the copy paper feed;

FIG. **6***a* is a detail diagram of a magnetic pulse generator which may serve as an alternate source of clock signals;

FIG. **7** is a logic diagram of two subtracting binary paper counters employed in carrying out the invention;

FIG. **8** is a circuit diagram of the type of bistable circuit illustrative of the clock counter but due to space limitations, showing **4** binary stages instead of **6**;

FIG. **8***a* is a logic diagram indicating the functions performed by the counter circuit of FIG. **8**;

FIG. **9** is a logic diagram of the binary scanning apparatus and clocking device in which the clocking impulses are produced by rotation of the scanner carriage shaft utilizing magnetic pulses produced by magnetic or magnetizable material mounted on the shaft;

FIG. **10** is a logic diagram corresponding somewhat to FIG. **9**, but showing an embodiment of the invention in which there are clock marks on the master and a clock mark scanner is employed;

FIG. **11** is a circuit diagram of the apparatus employed for controlling the scanning;

FIG. **12** is a circuit diagram of the data pickup scanning device and amplifier;

FIG. **13** is a circuit diagram of the feeder control relay and amplifier driver;

FIG. **14** is a circuit diagram of the clock pulse amplifier responsive to rotation of the scanner drive shaft;

FIG. **15** is a circuit diagram of the clock inhibitor employed in the computer apparatus;

FIG. **16** is a logic diagram of the binary storage device for use in conjunction with the apparatus, and

FIG. **17** is a schematic perspective diagram of one form of apparatus for imaging and encoding the masters.

Like reference characters are utilized throughout the drawing to designate like parts.

DETAILED DESCRIPTION

A typical automatic printer or duplicator in connection with which the invention may be employed is illustrated in FIG. **1** which comprises certain conventional elements not constituting a part of the present invention, namely structure **11** carrying a magazine or hopper **12** for master plates, adapted to rest in a stack **13**, means **14** for feeding paper or other sheets upon which printed matter is to be duplicated, if desired an auxiliary

paper feeder 15, a mechanism not shown in FIG. 1 for delivering the masters successively to a master cylinder 16, means not visible in FIG. 1 for ejecting each master after the requisite number of copies of that master has been impressed on sheets to be printed, and a collector or sheet distributor 17 having a plurality of bins or pockets 18 into which printed paper copies may be segregated. There are also a blanket cylinder 16*a* and an impression cylinder 16*b*, the paper being fed between the latter two cylinders. Such machines have also heretofore been provided with mechanical counters which may be set by the operator to cause a predetermined number of impressions to be made from the master and distributed to the distributor 17 in successive pockets. Such machines operate automatically, according to predetermined cycle which include the steps of feeding a master, treating and inking the master, feeding copy paper, stopping the copy paper feed on count down, ejecting the master, and cleaning a blanket which transfers the impression to the paper. The foregoing as thus far described in connection with FIG. 1 is conventional and does not constitute a part of the present invention.

In accordance with the present invention, however, among other features in an illustrative embodiment specially prepared masters are employed. These specially prepared masters differ from those heretofore employed in that they contain not only the writing, drawing and so forth which are to be reproduced on the paper copies but also indicia cooperating with the computer equipment provided in accordance with the invention to control the operation of the duplicator FIG. 1, including the number of copies made from each master and the manner in which the copies are sorted in the sorting bins or pockets of FIG. 1.

As illustrated in FIG. 2, there is a master 19, the central portion of which is left blank and is this is where the usual message to be duplicated is written or drawn. However, in accordance with the invention, the master 19 is provided with one or two rows of boxes or spaces 20 and 21 in which indicia in the form of coded markings are placed for effecting the operation of the circuits to control the duplicator. As illustrated, there is one row of spaces 20 along the end and another row 21 along the side so that either end or side scanning may be employed. For example, there may be spaces 22, 23, and 24 which may be employed for various control markings such as markings to indicate last of the set, if desired. Then there may be a set of seven spaces 25, to permit applying a seven bit binary code for controlling a first counter and a similar set of spaces 26 for applying a code to control a second counter. There are electronic counters provided in accordance with the invention, replacing the mechanical counters heretofore employed, and making it possible for each master to determine the number of copies of that master which will be made independently of the number of copies made of any other master in the hopper. In addition to spaces for the foregoing markings, spaces such as 27 are provided in the row 21 or 20 for digital code markings, for instance five-bit markings for controlling distribution to successive pockets, for example, the first 2 of the pockets 18 of the distributor 17 of FIG. 1. The spaces 27 are followed by additional spaces 28 which may be used for other control purposes, for example a general program selection control for selecting any one of several distribution programs already prepared on punched tape and each associated with its own tape read head.

For use with conventional duplicators the masters are specially prepared sheets. However, in equipment for automatically copying or duplicating original copy such as clippings or pages from publications the coding which is selectable for operation by entering an appropriate binary designation in the spaces 22 to 28, may be marked directly on each original copy or on paste-on sheets, and the original material then serves as the master. It may be fed into the copier or duplicator by appropriate mechanism or first automatically photographed to form a secondary master to be received by the master cylinder 16 of a duplicator.

A scanner 29 is provided including an element which travels along the rows 20 or 21 and reads the information markings for supplying their data to storage and control circuits. However, in the arrangement shown, in order to enable the storage and control circuits to assign to the coded information the correct interpretation, clock impulses are also required. These may be provided by clock marks on the master 19 as illustrated in FIG. 3 or the scanner itself may be arranged to produce clock signals.

A form of scanner which may be employed is illustrated in FIGS. 4 and 5 having a supporting housing 31 which may be secured to one or both of the sidewalls or master sheet guides 32 of the master hopper 13 in either of two alternative positions by suitable conventional mounting means, not shown. The position for side reading of the master encoded information is illustrated in FIG. 4 and the position for end reading is illustrated in FIG. 5. It will be understood that the surrounding structure shown in FIG. 5 would be present in the FIG. 4 arrangement also, but has been deleted to avoid redundancy. Within the housing 31 is a screw 33 driven by a motor concealed in an enclosure 34 for traversing a reading head 35, which contains a lamp for illuminating the edge of the master and photoelectric responsive reading elements in the form of scanner illustrated in FIGS. 4 and 5. If the form of the master illustrated in FIG. 3 is employed, the photoresponsive reading head is a dual head adapted for reading markings on each of two rows 36 and 37, one the information row, the other the clock counting row.

If the type of master is employed which is illustrated in FIG. 2, the scanner shaft 33 is provided with means for producing clock counter impulses at the same rate as the rate of rotations of the shaft 33. Such synchronized pulse producers are conventional and do not constitute a part of the present invention and need therefore not be illustrated herein. Examples of shaft-rotation-responsive pulse generators for producing electrical impulses in response to movement of a magnet or magnetizable member carried by a shaft are found in U.S. No. 3,301,053 to Walch et al. and U.S. Pat. No. 3,287,969 to Hardy.

The block diagram of FIG. 6 illustrates the general arrangement of the apparatus responsive to coded information on the master with the clock signals, and the storage and control circuits for responding to the information to control the number of copies made of each master and to control the distribution or sorting of the copies. Where the clock marks are provided on the master as in FIG. 3, the scanner reading head 35 includes dual pick-ups 38 and 39 provided with amplifiers 41 and 42 respectively. For the sake of illustration it has been assumed that the pick-ups 38 and 39 are of the photoelectric type in which the current increases and decreases according to whether the scanner "sees" the blank space or a black mark in each information area of the master as the head traverses the master. The invention is not limited to the use of photoelectric responsive scanners, however, and does not exclude the use of electrical impulse producing magnetic pick-ups in case magnetic marks are employed on the master or electrical feelers or other pick-ups in case punched holes are used on the master.

In case a master is of the type illustrated in FIG. 2 and the clock signals are produced by rotation of the scanner shaft, the signals are fed to an amplifier 42', which takes the place of amplifier 42, from an electrical pickup such as the coil 43, responsive to rotation of a magnet 44 carried by the scanner shaft 33 as illustrated in FIG. 6*a*.

A suitable counter 45 serving as a clock counter is connected to the output of the clock pulse amplifier 42 or 42'. For synchronizing and indicating the significance of the output signals from the data scanner pickup 38, an AND gate circuit 46 is provided to which the outputs of the clock counter 45 and the data scanner amplifier 41 are supplied. In order that the data output of one master may be processed while the preceding master is being reproduced a data storage device or memory 47 is provided which receives the output of the AND gate circuit 46.

First and second feeder controls **48** and **49** are provided for the conventional paper feeders **14** and **15** in the duplicator **51**. In the form of circuitry illustrated by way of example, subtracting counters **52** and **53** are provided for actuating the feeder controls **48** and **49** when the desired number of copies stored in the memory **47** has been produced. The subtracting counters **52** and **53** are responsive to the output of AND gate circuits **54** and **55** respectively, each having input from the storage **47** through lines **56** and **57**, respectively, and an input from a counter accept line **58**.

The storage also has an output line **59** to a distributor. Provision is made for erasing the information in the storage **47** when this information has been utilized for actuating the counters **52** and **53**. As illustrated in FIG. **6** schematically, it takes the form of a line **62** from the counter accept line **58** through a delay device **65** to a line **66** to storage erase circuits. The subtracting counter arrangement is indicated in greater detail in the logic diagram of FIG. **7**. The logic diagram for the scanning and clocking device is shown in FIG. **9** or **10**.

FIG. **8** illustrates the type of circuit which may be employed for the clock counter, the storage, and the subtracting counters for the feeders and the distribution pockets. As shown, there is a plurality of electronic valves **67** which may be of the solid state transistor type in cascaded, cross-coupled pairs to form successive bistable circuits, each bistable circuit or pair of transistors being capable of being shifted from one bistable state to the other by output from the previous stage or pair of transistors. Suitable cross-coupling elements including resistors **68**, capacitors **69** and diodes **71** are employed. The transistors **67** are shown as PNP by way of example. Power is supplied through a negative terminal **1**, which may by way of example be −**15** volts. An over bias terminal **2** is provided. Input counting signals are supplied at a terminal **3** to either side of the first stage, and output signals of successive digital orders are taken at terminals **4**, **6**, **8**, and **10**. There is a grounded or 0-volt terminal **5** and positive bias is supplied at a terminal **7**, for example at 9 volts. A terminal **9** is provided for reset signals to restore all stages in parallel to zero position. The functioning of the circuit of FIG. **8** as counting device is illustrated in a logic diagram of FIG. **8***a*. In the interests of space economy, the circuit of FIG. **8** and ******a* is shown as having a four bit capacity. It will be understood, however, that it may be extended to embrace as many bits as required for the particular application.

FIG. **7** is a logic diagram illustrating the arrangement of elements in the subtracting paper counters, such as the counters **52** and **53**, which are shown as being of the binary type, and which are used in place of the mechanical or electrical counters usually found on such duplicators. In the arrangement illustrated, the first counter **52** is a seven-bit binary counter and the counter **53** is a six-bit binary counter, each having both a serial input and a parallel input. In serial input lines **72** and **73**, outputs from AND gate **54***a* and **55***a* are received, which have inputs from enabling signal lines **74** and **75** which are energized by the relays which cause paper to feed from the feeders, and from a signal generator which acts each time a sheet is fed from the feeder. Output terminals from the storage devices are connected to the respective parallel input lines for the first and second subtracting counters represented schematically by the cable bundles **76** and **77**. The outputs from the counters **52** and **53** are supplied through AND gates **78** and **79** to control lines **81** and **82** for controlling the first and second feeders.

FIG. **9** is a logic diagram illustrating the arrangement of the scanning and clocking device when the clock pulses are obtained from the rotation of the scanner shaft **33** by a magnetic pulse generator **43**. The clock counter **45** has its input terminal **3** connected to the output of an AND gate **88** one of whose inputs is the output of the amplifier **42′** of the clock signal pulse generator **43**, the other inputs being the output of a clock inhibitor **83** via an output line **87**, and a scanner return travel inhibit line **84** (See FIG. **11**) which likewise supplies an AND gate **90** whose other input is derived from the data scanner amplifier **41** and whose output is the data pulse line **92**. The clock counter **45** also has a parallel reset line **85** connected to its parallel reset terminal **9**.

The clock inhibitor **83** has a signal input terminal **89** receiving the output of the data scanner amplifier **41**, and has a reset terminal **91**, the latter supplied from the reset line **85**. The output signal terminals of the clock counter **45** are connected through a fragmentarily represented logic circuit **46** to parallel input terminals in the memory stages of the storage **47**.

FIG. **10** illustrates a logic diagram corresponding to FIG. **9** except for an arrangement in which clock marks are provided on the master, and the clock mark scanner pickup **39** is employed. In this case the clock inhibitor **83** is not required since the clock marks on the master are not continued beyond the number required for synchronizing the code marks in the information line of the master.

The arrangement for producing data signals or clock mark signals when the clock marks are placed on the master in the case of a photoelectric type of scanner is illustrated in FIG. **12**. There is a lamp (not shown) for projecting a beam of light on the data spaces in the master through a suitable optical lens system (not shown), and a photoelectric response device such as a selenium cell **98** for example, which has relatively low resistance, for example 300 kilohms, when the light is reflected upon it but increases to a relatively high resistance value, for example 20 megohms, when the beam of light reaches the dark mark on the master so that relatively little light is reflected to the photoelectric device **98**. The photoresponsive device **98** is connected in series with a resistor **99** having a resistance comparable with that of the photoelectric device **98** when it is dark, for example of the order of 10 megohms.

The elements **98** and **99** are connected in series across a power supply having terminals **101** and **102** which may for example be at +9 volts and −15 volts with a grounded or zero-volt terminal **103**. Two amplifier stages are provided including solid state devices such as NPN transistors **104** and **105** connected between power supply terminals **102** and **103** and having load resistors **106** and **107** respectively. The transistor **104** has a base **108** connected to a junction terminal **109** of the photoelectric response device **98** and the resistor **99** and the transistor **105** has a base **111** connected to the collector terminal **112** of the transistor **104**, which is in turn slightly positively biased through a resistor **113** connected to the positive bias terminal **101**. The collector terminal **114** serves as the signal output terminal of the amplifier. When the photoelectric response device **98** is darkened upon scanning a black mark on the master its resistance rises, causing potential of the junction terminal **109** and the transistor base **108** to rise thus cutting off the flow of current in the transistor **104**, permitting the potential of the terminal **112** to fall from approximately 0 volts to very nearly the potential of the negative terminal **102**. This lowers the potential of the base **111** of the transistor **105** causing it to become conducting. Current then flows through the load resistor **107** raising the potential of the signal output terminal **114**. In this manner a positive voltage pulse is supplied by the amplifier whenever a code mark is scanned. It will be understood that the scanner and amplifier shown in FIG. **12** represents a circuit usable as the scanner and amplifier **38**, **41** of FIGS. **9** and **10** or **39**, **42** of FIG. **10**.

The feeding of paper in a duplicator **51** such as that illustrated in FIG. **1** is caused by conventional means controlled by a relay. Such a control, specifically the control **48**, is represented in FIG. **13** by a relay winding **115** operating contacts which perform conventional functions in such apparatus. However, in accordance with the present invention, circuit devices such as hereinbefore described are employed for the control of the feeder relay winding **115** as illustrated in FIG. **13**. Each control relay is actuated by the output of one of the subtracting counters through a diode gate and amplifier means.

An amplifier **117**, shown as being of the solid state PNP transistor type, is provided which is connected in series with the feeder relay winding **115** and a direct current power

supply circuit having positive terminal 118 represented as being grounded or at 0 volts and a negative terminal 119 represented as being −15 volts. The transistor 117 has a base 121 supplied by the outputs of the stages of the subtracting counter 52 or 53 through diode AND gate 78 (or 79) and normally closed contacts 115*a* of the feeder relay which are associated with and driven by the winding 115. As shown, the base 121 is positively biased by the AND gate 78 so that the transistor 117 and the winding 115 normally do not conduct current. The winding 115 is not energized while the subtracting counter is waiting to be satisfied. When the counter is satisfied, all the diodes of the AND gate 78 go negative and the transistor 117 conducts. This energizes the winding 115 and causes the associated normally closed contacts 115*a* to open, allowing the base 121 to be held negative by the bias resistor 123 connected to the negative terminal 119. A reset terminal 124 is provided which is connected to the base 121 for resetting the transistor to nonconducting condition when a positive pulse is supplied at the terminal 124.

A suitable amplifier for the counting pulse received from a magnetic induction-type clock pulse generator 43 is illustrated in FIG. 14. It includes a pair of amplifier stages such as PNP transistors 125 and 126 connected across a direct-current power supply source having a 0-voltage terminal 127 and a negative voltage terminal 128. The stages are connected as collector follower stages with collectors resistors 131 and 132. A signal output terminal 134 is connected to the collector of the transistor 126.

The input circuit of the transistor 125 includes a resistor 126 positively biasing the transistor 126, and a resistor 137, a capacitor 138 and the pulse generator 43 series connected between the base of a transistor 125 and the negative terminal 128. The generator 43 is shunted by a rectifier or diode 139, poled so that only positive pulses from the generator 43 are supplied to the transistor 125. The circuit of FIG. 14 represents in more detail the pulse generator amplifier combination 43, 42′ of FIG. 9.

As illustrated in FIG. 15 the clock inhibitor 83 is a bistable circuit which may comprise a pair of solid state devices such as PNP transistors 141 and 142 connected to a grounded or 0-volt power supply terminal 143 and negative power supply terminal 144, for example at −15 volts, through collector resistor 145 and 146 and cross coupled through resistors 147 and 148 shunted by capacitors 149 and 150 of high capacity such as one-tenth microfarad. The bases of transistors 141 and 142 are preferably positively biased through resistors 152 and 153. Signal input is provided through the terminal 89 from the data scanner amplifier 41 to the base of transistor 141 through a resistance-capacity circuit 154. The external reset line 91 is coupled to the base of the transistor 142 through a resistance-capacity circuit 155.

The arrangement of the storage device 47 is illustrated by the logic diagram of FIG. 16 representing the connections of the binary units employed. Registers or groups of storage stages 156 and 157 are provided for storing the data concerning the number of sheets to be duplicated from each of the two copy sheet hoppers, and are caused to discharge their data into the subtracting counters 52 and 53 via lines 76 and 77 upon reception of a counter accept signal via counter accept line 58. Such a signal triggers the AND gate circuits 54 and 55 (fragmentarily illustrated) at the appropriate time to cause transfer of the stored data. The counter accept line 58 is also connected through a line 62 and through a delay device 65 to a line 66 for supplying a storage erase impulse to the storage after the subtracting counters have emptied.

In order that the desired number of copies will be placed in each of the pockets 18 of the distributor 17, the storage 47 also includes registers 170 and 171 for the first group of pockets. For simplicity in the drawing only two such pockets counters are shown, although there may be a greater number. For distribution in excess of such a predetermined number of pockets, an additional general distribution program register 172 is provided and instruction tapes, which may be punched tapes or magnetic tapes, are provided containing the instructions for any desired additional number of pockets together with suitable tape reader and distributor control thereby. The general distribution program register 172 is arranged to select by code number and activate the reader for whichever one of such tapes is desired. While not illustrated in this view, it will be understood that suitable analogous counter accept circuitry including appropriate AND gate circuits similarly related to the storage stages 170, 171, 172, and similar storage erase provisions, will be provided on the distributor frame and will be suitably timed and triggered on the basis of the chosen pattern of distributor functions. The counter accept signals in either case will be drawn from any suitable machine function occurring at the appropriate time for transfer, such as the signal for ejecting a master from the master cylinder in the case of line 58, and the signal which indicates completion of the previous count or program in the case of the distributor apparatus.

The master 19′ illustrated in FIG. 3 for use with the clock marks on the master is shown blank. It will be understood, however, that if desired the masters may be pre-printed with the black marks in every space of the clock track 3 7 for the number of spaces utilized in the information track 36. The masters may be produced in any desired manner. Foe example, blanks printed in manner illustrated by FIGS. 2 or 3 may be provided with the rectangles delineating space for signal marks already printed on the blanks. Then whatever message is to be duplicated is typed, written or drawn on the blank. If clock marks have not already been pre-printed in the spaces 27 these are marked in with black pencil or black crayon and suitable markings for the digital code representing the desired information in the spaces 22, 23, 24, 25, 26, 27 and 28, referring to FIG. 2, (or their corresponding spaces in FIG. 3) are marked in which black pencil or crayon. Then the filled in sheet forms a completed master and is utilized to produce copies on a duplicator of the type illustrated in FIG. 1.

If desired a projector 173, FIG. 17 may be utilized with suitable lens system 174 for projecting an image from a typed or written sheet 175 on a photosensitive master 19′′ which is subsequently developed in the usual manner. If it is desired to use an original sheet not preprinted with the spaces for code markings, a separate blank 176 with the code markings may be placed in a separate projector 177 and projected along edges 20′ and 21′ of the photosensitive master at a location which lies beyond the normal typed or printed page on which the message normally appears.

Instead of printers 173 and 177 there may be provided, if desired, printers of the cathode ray tube used in photo typesetting described by Klensch and Simshauser in "The CRT in Photo Typesetting Systems" — IEEE Spectrum, Volume 6, Number 9, pages 75–80, September 1969. As another alternative, the masters may be output of computers in a high speed line printer which prints not only the text material but also the code and clock marks for the rows 36 or rows 36 and 37 on the margin of each master.

Suitable means are provided for causing the scanner to make an excursion along the edge tracks of the next exposed master at either the side or the end, according toe the arrangement selected, whenever the top master is removed from the hopper and placed in printing position with respect to the roll of the duplicator. Then the scanner is arranged to return at the end of the scan so that the master which has been read may in turn be transferred from the hopper to the printing position and the next master code marks may be read, etc. Preferably a reversible drive motor 178 is provided having a separate winding 179 for a forward movement and winding 180 for reverse rotation to produce a return movement as illustrated in FIG. 11. Any desired type of reversible motor may be employed.

The circuit of FIG. 11 can best be understood by considering that the circuit means in the duplicator 51 provide, in a known manner, at an intermediate point in the previous printing cycle, whenever it is time to feed a new master into ready position, a maintained alternating voltage on line 183 which

may be considered a "master feed signal," and that lines **192** would normally carry the effect of this signal directly to the master feed clutch. As soon as the mater being fed in response to this signal will have progressed out of the hopper and into a certain position approaching the cylinder, its presence will be sensed and circuitry on the duplicator will terminate the master feed signal on line **183**. The circuit of FIG. **11**, however, acts as a delay circuit superimposed upon this normal function, and so controls switching as to prevent forwarding of the master feed signal from line **183**, when received, until after the scanning of the master about to be fed has been performed.

If alternating current is the supply source, the motor may be of the single-phase, split-phase condenser type having a condenser or capacitor **182** interposed in the connections. The connections are shown only schematically in FIG. **11** since reversible motors are well known to those skilled in the art. The motor **178** is connected in a circuit between line **183** which is energized by the master feed signal and a return or common line **184** which may be neutral or ground line. The forward winding **179** is normally energized when voltage appears on the line **183**. There is then circuit from the line **183** through normally closed contacts **185***a* of a limit relay, which has a winding **185**, the motor winding **179** and the return line **184**. There is also a circuit from the line **183** through normally closed contacts **185***c* of the limit relay **185** and a winding **187** of a scan relay to the return line **184**.

In addition there is also a potential connection from the line **183** through normally open contacts **185***b* of the limit relay **185**, contact B of a double throw scan switch **186** which normally lies on its contact A, but senses the home position of the scanner and shifts to its contact B in response to activation by the scanner head upon arrival thereat. This connection further proceeds via line **190**, the normally closed contacts **187***a* of the scan relay **187**, the input or alternating-current terminals of a full-wave rectifier **189** and back to the return line **184**, but this circuit is open whenever voltage first appears on line **183** since the relay **185** is not energized and contacts **185***b* are normally open. The direct current output terminals **191** of the full-wave rectifier **189** are connected through lines **192** to the winding of a conventional master feed control clutch (not shown).

A normally open scan limit switch **181**, in circuit between the line **183** and the limit relay winding **185**, is mounted at the end of the forward travel of the scanner, and when activated, energizes winding **185** to open the contacts **185***a* and **185***c* and close the contacts **185***b* to start the return travel of the scanner. At this point, of course, the scan home switch **186** is unaffected by the scanner and therefore lies in normal position on contact A completing the circuit to the return motor winding **180**. Since it is off of contact B the circuit to the rectifier and line **192** is still incomplete. There are also relay contacts **185***e* which are normally open, and which close when the limit relay winding **185** is energized. Since they are in parallel with the scan limit switch **181** they provide a holding circuit for maintaining energization of the return motor winding **180** even after the scanner carriage backs off the limit switch **181**.

When the carriage completes its return excursion it strikes the switch **186** and moves it to contact B breaking its circuit and stopping the motor. Since limit relay **185** is still held in by its holding contacts **185***e*, contacts **185***b* are closed and **185***c* are opened, deenergizing scan relay **187** allowing contacts **187***a* to close. There is now a circuit from line **183** through switch **185***b*, switch **186** on contact B and switch **187***a* to the rectifier and line **192**, causing the master to feed out of the hopper and into a position where it eliminates the voltage signal on line **183**, thus causing relay winding **185** to drop out and restoring the circuit of FIG. **11** to its initial state.

The limit relay winding **185** also has normally open contacts **185***d* in the inhibit clock counter return line **84** of FIGS. **9** and **10**. The scan relay winding **187** has normally open contacts **187***b* in the parallel reset line **85**.

In the apparatus illustrated the scanning is intended to be done with the master in static condition. As illustrated in FIGS. **4** and **5**, the scanning head **35** travels toward the lower right hand corner (See FIGS. **2** and **3**) of the master in either of the two attitudes of the motor driven lead screw **33**. Then the head returns to await another signal to scan.

The track markings containing the information blocks may be printed with a non-reproducing ink of low color contrast so that they will not be seen by the photoelectric responsive devices nor will they be printed. However, if it is desired that the clock and information marks be in the same medium as the printed image, the clock and information tracks can be located in the margin of a master that is larger than the printed copy so that the marks will be beyond the edge of the copy.

As illustrated, in FIG. **2**, the information field is made up of eight items of information. The first three and the last two deal with the duplicator proper and the remainder deal with the distributor. Those dealing with the duplicator proper are the index block **22**, the "first hopper" block **23** the "last of set" block **24** (which represent any particular two duplicator functions which it is desired to control), the first feeder counter blocks **25**, and the second feeder counter blocks **26**. The two groups of blocks designated **27** are for distributing to the first two distributor pockets, and the last group of blocks **28** are for the selection of an appropriate general distributor program.

In the alternate embodiment of the invention, represented by the master of FIG. **3**, there are two rows of track markings on each margin, one for information marks and one for clock marks, designated **36** and **37** respectively. The clock marks in row **37** must appear one in each block, and they re counted serially in the binary manner by the clock counter illustrated in FIG. **10**.

in the FIG. **2** embodiment the counting pulses are generated by rotation of the shaft **33** and are counted serially by the clock counter illustrated in FIG. **9**.

The clock counting arrangements in the two forms are largely analogous however, so that the scanning operation will be described in detail mainly for the FIG. **2** form, from which the corresponding operation for the FIG. **3** form will be readily apparent. In this embodiment there are no clock marks on the master nor is there a clock mark scanner. In an illustrative arrangement, the lead screw **33**, the revolutions of which are counted, has 10 turns to the inch and makes one revolution for each of the information blocks which are spaced one-tenth inch apart. On the approach to the information field, the clock counter is inhibited from counting by the clock inhibitor **83** shown in FIG. **15**. The first information block, the index block **22**, requires a mark in every case. When the photoresponsive device sees a mark in this information block **22**, the inhibitor stage **83** flips over and enables the clock counter to make use of the amplified magnetic pulse delivered to the gate **88** in FIG. **9**.

At the end of its travel the lead screw driver motor is reversed and the scanning head is returned to its starting position. During the return travel both the clock counter amplifier **42'** and the information pickup amplifier **41** are inhibited from transmitting count signals to the clock counter **45** and the storage **47**.

Reverting momentarily to the embodiment of FIGS. **3** and **10**, as the scanning head travels over the field, the clock counter **45** counts all the spaces since each will contain a mark. When the data scanner **38** sees a mark at a particular block a "yes" signal combines with the clock counter output, at that time, and a discreet AND gate which is associated with that particular count value, such as gate **194**, **194'** or **194''**, sends a signal into storage (FIGS. **10** and **16**). Storage is necessary because the subtracting counters are still in use, being now occupied in performing the function ordered by the previous master. While specific storage stages have not been illustrated for the functions represented by spaces **23** and **24** on the master track, it will be readily understood that similar storage provision for these can be made if required.

After the scan the duplicator completes its cycle and ejects the old master and inserts the new one. The storage has in it the information relative to the new master that is being put on the cylinder. Since the subtracting counters are through with counting for the old master, they can now accept the information for the current master out of storage. This is done by a counter accept signal from a set of contacts on a conventional sequence start relay (not shown) in the duplicator **51** through line **58** and discreet AND gate circuits **54** and **55** (FIGS. **6** and **16**).

On this transfer, the complement of the desired count is put into the subtracting counters **52** and **53** shown in FIGS. **6** and **7**.

Then, when the paper feeds begins, they need only to count to saturation and the function takes place. The relay or control **48** that causes paper to feed from the first feeder provides the enabling signal via AND gate **54***a* to the first counter, and the relay **49** that causes paper to feed from the second feeder provides enabling signal via AND gate **55***a* to the second counter as illustrated in FIG. **7**.

Before either of the counters count to saturation the zero level voltages come through the diode gate **78** of the subtracting counter as illustrated in FIG. **13**. This view represents specifically the gate arrangement in connection with counter **52**, but, except for the number of bits, it is also representative of the gate associated with the counter **53**. All or any one bit of the subtracting counter can keep the transistor **117** backward biased. When all the bits to go minus 15 volts, the transistor **117** is forward biased, pulls in the relay **115**, opens the normally closed contact **115***a* between gate **78** and the base **121** of the transistor **117** and the transistor **117** is thereafter forward biased until the reset signal is applied to the base **121** from the line **124**. The relay stops the feed of the associated feeder via one of its normally open contacts **115***b* (FIG. **13**) which, upon closing, provide a feeder stop signal to the conventional circuit (not shown) which governs feeder operation.

DISTRIBUTOR

The first group of two pockets **18** of the distributor **117** are counter controlled. The remainder of the distributor pockets, along with the general distributor program, are tape controlled. There is a choice on each master of a predetermined number of tape programs, for example 31. The first two pockets counters in the illustrated apparatus are shown as having each a 31 sheet capacity. The voltages are retained in the memory device for a period of time from when the master is scanned until the end of the duplicator cycle. At that time, the memory data is transferred to suitable subtracting counters in the distributor, similar to the previously described sheet feed counters (or in the case of register **172**, to an appropriate tape selection circuit) and then the storage is erased. This is effected by duplicator counter accept and storage erase circuits corresponding to the circuits **58**, **65** and **66** for the feeder counters. Thus the memory of FIG. **16** can command the number of sheets to be accepted by each of the first two distributor pockets (registers **170** and **171**) and can command which of the 31 general program tapes to employ (register **172**). The general distributor program tape which is thus selected controls the number of sheets that the remainder of the sorter pockets will accept.

Certain embodiments of the invention and certain methods of operation embraced therein have been shown and particularly described for the purpose of explaining the principle of operation of the invention and showing its application, but it will be obvious to those skilled in the art that many modifications and variations are possible, and it is intended therefore, to cover all such modifications and variations as fall within the scope of the invention. It will be recognized, for example, that although the preferred form shown involves reading the data on a master in the hopper, or before it reaches the master cylinder, this function can just as well be performed with the master on the master cylinder during the printing operation, in which case the indicia on the master can be read directly and applied to the printing operation of the current master without necessarily being held in memory. In a particular example, a peripheral location of the indicia relative to the home position of the master cylinder can be used to indicate the number of copies to be printed, and the signal derived from the sensing of this indicia directly on each revolution can be combined with information derived from a stepping operation occurring at the feed of each sheet. When the signal coincide a further signal would result, stopping the copy paper feed and/or shutting off the printing machine at the number of copies represented by the indicia on the master margin.

What is claimed is:

1. In a reprographic device comprising:

means for reproducing an image from each master of a series of masters upon each of a plurality of copy sheets, said means including mechanisms operating to perform a plurality of subfunctions related to the accomplishment of said reproducing function, said master being one having a control indicia pattern of data increments placed thereon characteristic of instructions for performance of at least one such subfunction;

reading means for sensing the control indicia pattern placed on the master to indicate the performance of a predetermined subfunction by the appropriate mechanism said reading means embodying sensing and signal producing means activated to produce signals upon the sensing of said indicia pattern;

means responsive to signals produced by said signal producing means for regulating the operation of said appropriate mechanism to perform the subfunction in accordance with the instructions contained in the control indicia pattern;

the improvement comprising:

storage means for a master awaiting processing;

said reading means being associated with said master storage means and operable to sense the control indicia on a master stored therein before processing of a previous master is complete;

signal storage means for storing the output of said signal producing means while the reproduction of copies from a previous master is proceeding;

and mean for calling forth the content of said signal storage means and applying the same to the signal responsive means in response to completion of the copy reproduction of the previous master in the series and the device arriving in condition to reproduce the sensed master.

2. A device as set forth in claim **1** in which the master storage means is a hopper for holding a stack of masters and the reading means senses the indicia on the top master of the stack of masters in the hopper.

3. A device as set forth in claim **2** in which the masters are provided with a control indicia track extending transversely of the direction of master travel in exiting from the hopper, and the reading means is powered to move parallel to the track while the master is stationary in the hopper.

4. A device as set forth in claim **2** in which the masters are provided with a control indicia track extending parallel to the direction of master travel in exiting from the hopper and the reading means is powered to move parallel to the track while the master is stationary in the hopper.

5. A device as set forth in claim **2** in which the masters may be provided either with a control indicia track extending parallel to or transversely of the direction of master travel in exiting from the hopper, and the reading means is powered for linear travel and mounted upon a guide disposable parallel to either track depending upon the type of master being processed.

6. In a reprographic device comprising:

means for reproducing an image from a master upon each of a plurality of copy sheets, said means including mechanisms operating to perform a plurality of subfunc-

tions related to the accomplishment of said reproducing function, said master being one having a control indicia pattern consisting of indicia units arranged in a linear track and characteristic of instructions for performance of at least one of such subfunctions;

reading means at a point adjacent one of the locations normally occupied by each master on the device for sensing the control indicia pattern placed on the master to identify and call for performance of a predetermined subfunction by the appropriate mechanism, said reading means embodying sensing and signal producing means activated to produce signals upon the sensing of said indicia pattern;

means responsive to signals produced by said signal producing means for regulating the operation of said appropriate mechanism to perform the subfunction in accordance with the instructions contained in the control indicia pattern;

the improvement comprising:

said sensing and signal producing means embodying a single sensing device for sensing the control indicia, and producing signals in response thereto;

means for progressing the single sensing device and the master relative to each other in such direction that the sensing device effectively proceeds lengthwise of the indicia unit track on the master and generates signals serially in response thereto;

means to store the signals received serially from said reading device as electrical control information accessible in parallel.

7. A device as set forth in claim 6 in which the signal storage means is a digital device having individual bistable storage stages corresponding each to one of the indicia unit positions on the master indicia track, in which control means are also provided for directing the serially incoming indicia unit signals each to its corresponding storage stage, and which includes means for transferring in parallel the information in certain stages of the storage means to corresponding stages of a utilization device.

8. A device as set forth in claim 7 in which the control means for directing the incoming unit signals comprises a clock counter generating counting signals and an AND gate matrix jointly responsive toe the clock counter signals and the input unit signals.

9. A device as set forth in claim 8 in which there is also provided a second sensing element for reading a clock track parallel to the control indicia track with individual positions corresponding to the unit positions on the indicia track, and generating signals for stepping the clock counter.

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