

Aug. 6, 1968

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3,395,913

SHEET MATERIAL DISTRIBUTION SYSTEM

Filed Oct. 11, 1966

5 Sheets-Sheet 2

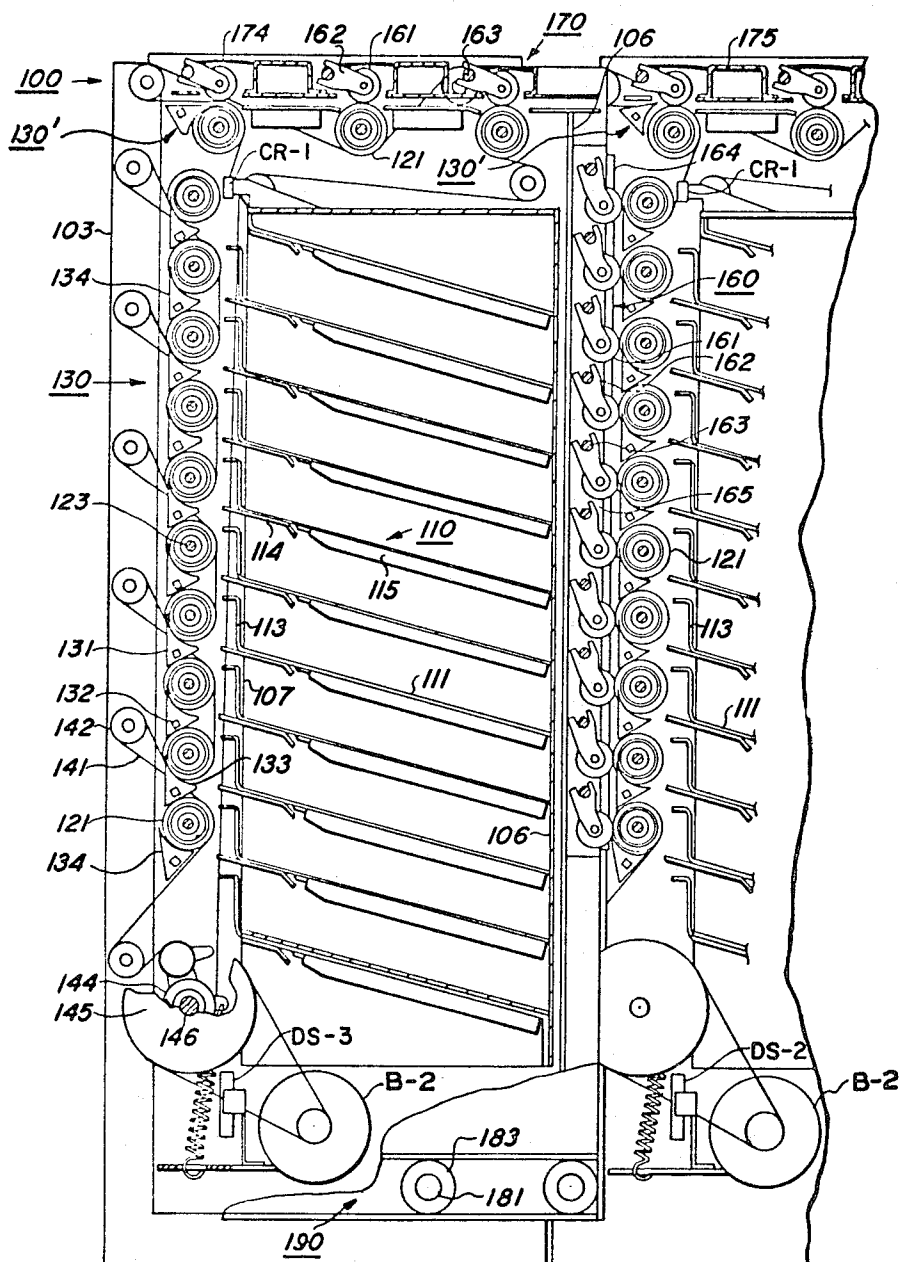


FIG. 2

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SHEET MATERIAL DISTRIBUTION SYSTEM

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5 Sheets-Sheet 3

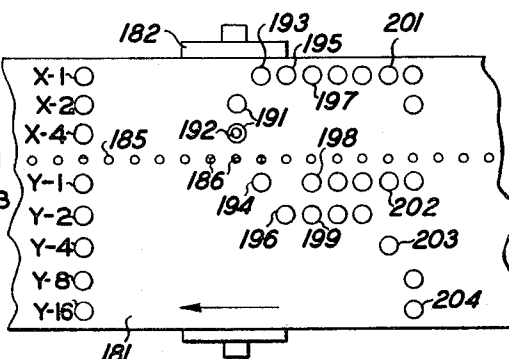
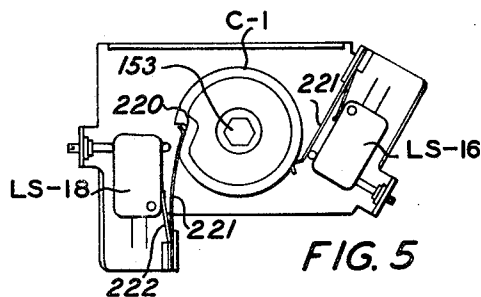
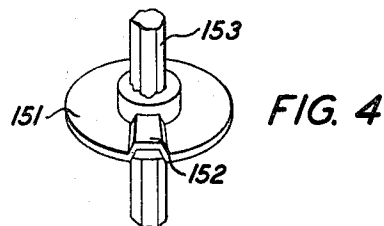
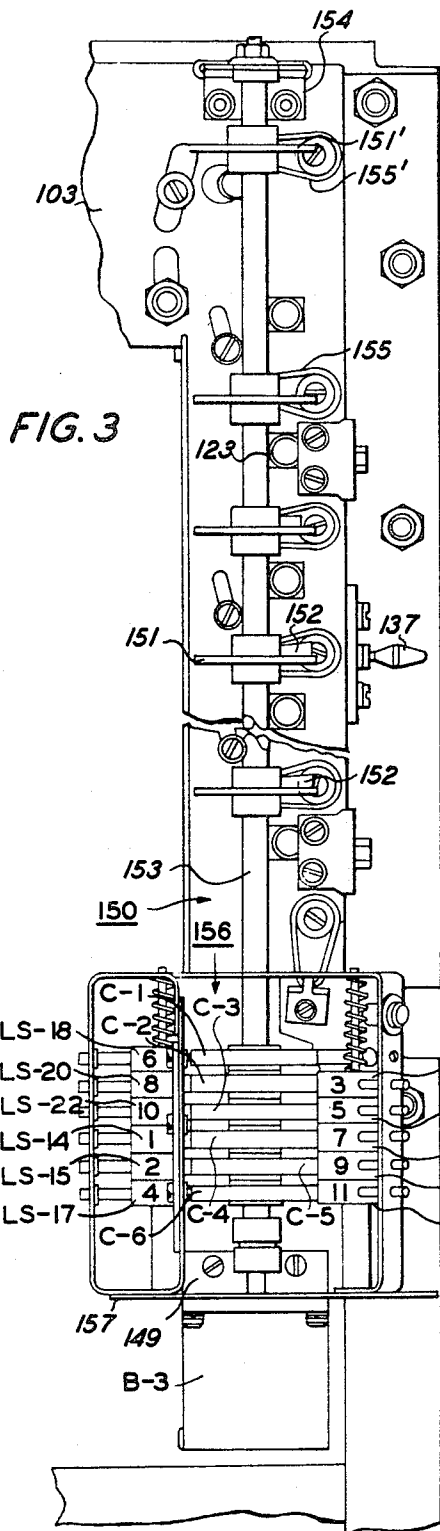


FIG. 6

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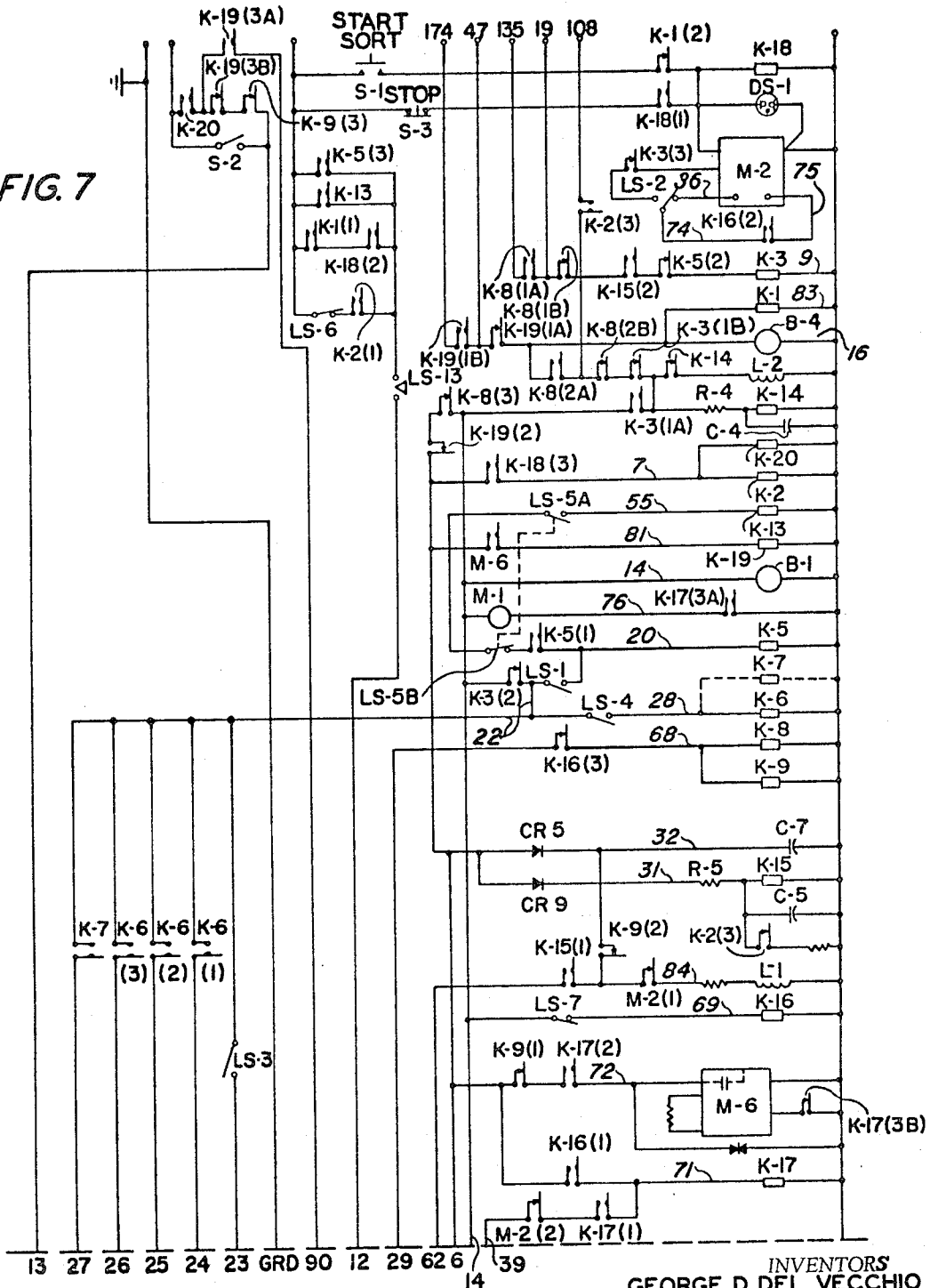
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SHEET MATERIAL DISTRIBUTION SYSTEM

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5 Sheets-Sheet 4

FIG. 7



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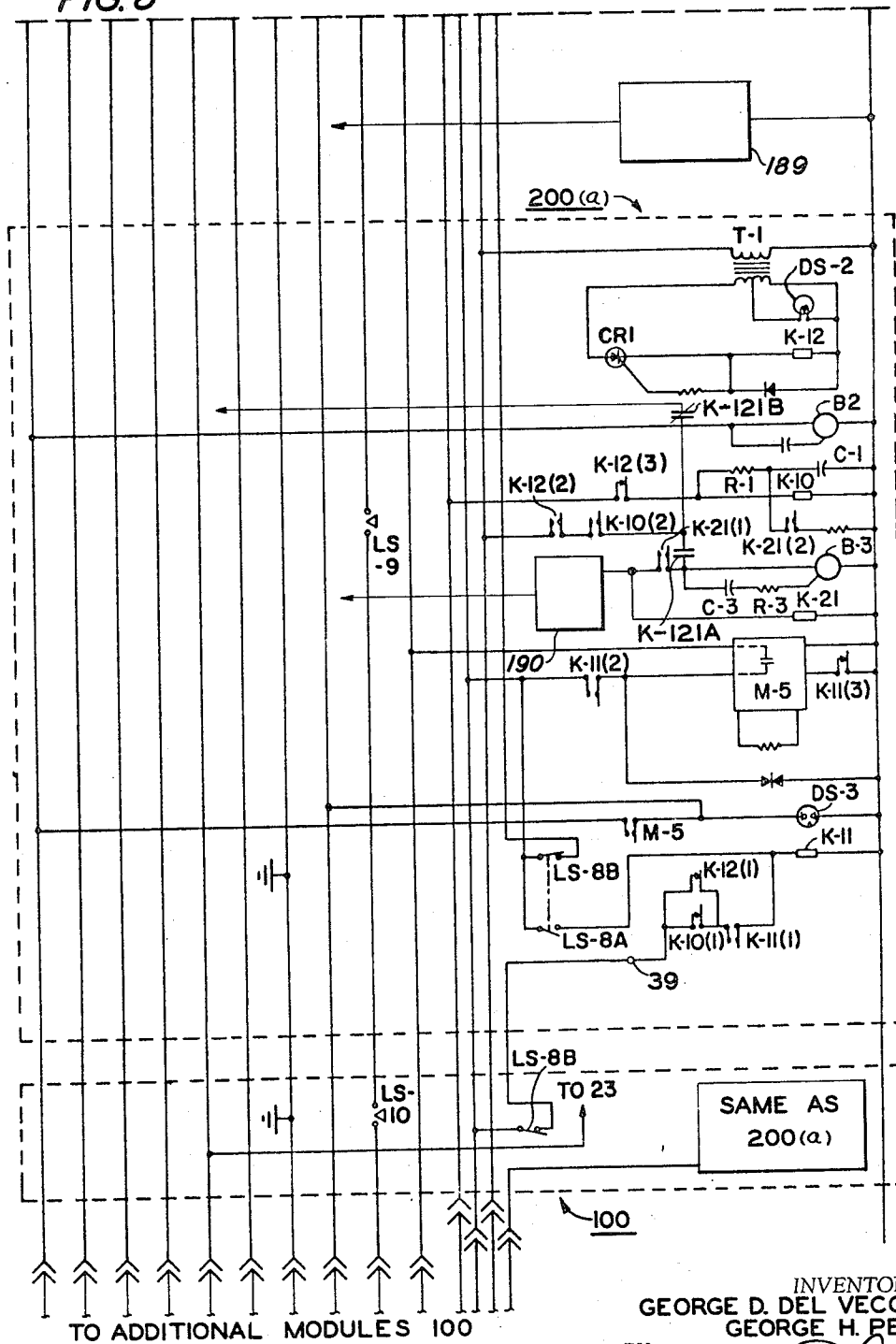
3,395,913

SHEET MATERIAL DISTRIBUTION SYSTEM

Filed Oct. 11, 1966

5 Sheets-Sheet 5

FIG. 8



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3,395,913

SHEET MATERIAL DISTRIBUTION SYSTEM
George D. Del Vecchio, North Rose, and George H. Perry, Pittsford, N.Y., assignors to Xerox Corporation, Rochester, N.Y., a corporation of New York
Filed Oct. 11, 1966, Ser. No. 585,896
6 Claims. (Cl. 271-64)

ABSTRACT OF THE DISCLOSURE

A sorter having catch trays for the reception of sheet material. The sorter is adapted to be used individually or operatively linked with a plurality of similar units. The assembly is capable of directing the output of a reproducing machine into the catch trays of the sorter in accordance with a predetermined program. The program is determined by a prepunched tape and read by a programmer to deliver any number of sheets into any catch tray of the sorter units.

This invention relates to automatic sheet distribution and, in particular, to apparatus adapted to control the distribution of sheet material from reproducing or printing machines.

In prior art devices of this type, the capacity of a sheet distributor or sorter has been limited to a fixed number of sheets per sorter bin or tray and changing the programming of the apparatus to accommodate changing distribution demands. The invention of this application provides a sorter or sheet distributor arrangement having programmer means for controlling the distribution of reproduced copy in accordance with a predetermined program. The programmer is adapted to control delivery of any desired number of sheets to any sorter tray selected by a pre-punched tape. In accordance with the present invention, substantial flexibility in the sorting or sheet distributing machine is provided whereby the programmed sorting ability of the machine may be readily increased, changed or bypassed in accordance with customer requirements without the necessity of utilizing a series of separate individual machines, or requiring separate sorting runs for a desired program that is more extended than the machine is capable for a simple run.

Therefore, it is an object of this invention to improve sheet distributing machines or sorters.

It is another object of this invention to control the operation of a sheet distributing machine which can be readily adjusted as to capacity of the machine and arranged for the sorting in accordance with multiple programs.

It is a further object of this invention to improve sheet distributing machines by coordinating identical units of a given capacity into an integral machine and by adapting the units to be mechanically and electrically coordinated for a timed programmed operation of the assembled units as a unitary machine.

It is still another object of this invention to arrange a sorting machine for both the single sort mode of operation and the program mode without necessitating machine or circuit adjustments.

These and other objects are attained in accordance with the present invention wherein there is provided a sorter or sheet distributing unit adapted to be assembled with a plurality of similar units one with another in conjunc-

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tion with a sorter controller or programmer for directing the output of a reproducing or printing machine into the units in accordance with a predetermined program which may require delivery of any number of sheets to any tray of the sorter units. For example, in any particular company's distribution system for engineering design change/orders, the program may require that for every engineering change the purchasing department may get 2 copies, production department may get 3 copies, and various engineering groups may get from 5 to 12 copies. A punched tape of such a program list might have 9 names listed, such as purchasing, production, and 7 engineering groups. Each tray of a sorter unit would be assigned to a name and the programmer utilized in the invention could instruct the sorter to deliver copies in the following manner: tray 1 . . . 2 copies, tray 2 . . . 3 copies, tray 3 . . . 0 copies, tray 4 . . . 0 copies, tray 5 . . . 6 copies, and so on.

Further objects of this invention, together with additional features contributing thereto and advantages accruing therefrom, will be apparent from the following description of an embodiment of the invention when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a front perspective view of a series of sorter units assembled to form a unitary sheet distributing machine, with one unit out of operative position;

FIG. 2 is a rear elevation section of one of the sorter units to better illustrate a drive and diverting mechanism incorporated into each of the sorter units;

FIG. 3 is an enlarged view of the mechanisms for activating the diverting gates in a diverting mechanism;

FIG. 4 is an enlarged perspective view of a single diverting gate actuator;

FIG. 5 is a fragmentary view of a rotary cam mechanism and switch arrangement for controlling the diverting control mechanism;

FIG. 6 is an enlarged fragmentary view of a prepunched control tape showing a typical arrangement of control openings indicative of a typical program of copy distribution;

FIGS. 7 and 8 are an electrical schematic of the subject invention.

Referring now to FIG. 1, there is shown a sheet distribution arrangement having a pair of sheet distributors 100, each of which includes a plurality of catch bins or trays 110 for holding sheet material which has been delivered to the catch bins or trays. The modular sheet distributor units are shown in cooperation with a sheet distributor 200 with one module in cooperative relation to form a unitary sheet distributing machine and another module extended from cooperative relation to better show the path of paper movement into the copy catch trays 110 or into another modular unit 100, although it is to be understood that the units are placed adjacent one another to form a unitary sheet distributing machine.

As shown in FIG. 2, each of the sheet distributors 100 includes a plurality of catch trays 110 secured in spaced relation to each other between front and rear frame plates 102 and 103, respectively, by means of tabs at the lower end of a catch plate 111 passing through slots provided in right-hand frame plate 106, with the upper end of the catch tray supported from left-hand frame plate 107. The upper end of catch plate 111 is supported by a lateral portion of support plate 113 secured by its upturned portion to the left-hand frame plate 107 with the lateral portion passing through slots in the frame plate into engagement with the catch plate 111.

In order to insure proper alignment of sheet material passing into the catch trays, a deflector plate 114 is suitably secured to the bottom of the lateral portion of support plate 113 to deflect the sheet material downward into the rear of the catch trays. Each catch plate 111 is provided with a plurality of fingers 115 secured to and extending out from the bottom of the catch plate to insure that sheet material passing into an adjacent catch tray will not adhere to the bottom of the upper adjoining catch plate 111 due to the static electrical charges on the sheet material. Each catch plate 111 may be biased against the lateral portion of its adjacent support plate 113 by means of suitable spring tabs secured to the guide fingers 115 and engaging the bottom of the lateral portion of the support plate 113.

As shown in FIG. 2, sheet material is distributed to the catch trays by means of a plurality of drive feed rolls 121 secured in spaced relation between the front and rear frame plates 102 and 103, respectively, and secured thereto by means of adjustable U-shaped brackets securing the roller shaft 123 in slots provided in the front and rear frame plates. Each drive roller is journaled for rotation upon the stationary shafts 123 and is provided with a plurality of undercut surface portions in cooperative relationship with gates 131 of a diverting mechanism 130 which diverts sheet material into the proper catch tray in a predetermined sequential order.

The sheet material is forwarded to the copy catch trays by means of the drive feed rollers 121 driven through a flexible endless drive belt 141 contacting each of the drive rollers and passing over a series of idler rollers 142 whereby each drive feed roller is positively driven at the same linear velocity by means of the drive belt. With the configuration of the drive belt, as shown in FIG. 2, the belt may be replaced if necessary by the removal of only one shaft 146 without necessitating the removal of the drive feed rollers 121.

The endless belt 141 is driven through a friction wheel 144 secured to a timing sprocket 145 rotatably mounted on a shaft 146 secured between front and rear frame plates 102 and 103, respectively, the timing sprocket being driven by an electric motor B-2.

Each of the gates 131 is secured to a gate shaft 132 and journaled for rotational movement between front and rear frame plates 102 and 103, respectively. The gates are formed with a concave portion 133 and a flat portion 134 and positioned on the gate shaft 132 within the undercut portion of the drive rollers 121 adjacent to the path of paper movement when the gates are out of deflecting position. When the diverting mechanism 130 is actuated as hereinafter described, one of the shafts 132 is rotated counterclockwise as viewed in FIG. 2 to move the flat portion out of the undercut of the drive feed rollers to bring the concave portion 133 of the gates into interference with the path of paper movement, thereby diverting the sheet material into a predetermined catch tray (see lower gates 131 in FIG. 1).

As the sheet material is forwarded by means of the upper drive feed rollers 121 cooperating with idler rollers to be hereinafter described, the diverting mechanism 130 is actuated to divert the sheet material into the appropriate catch trays by means of a cam bank, generally indicated in FIG. 3, with the reference numeral 150. The cam bank comprises a plurality of cams 151 each of which controls the rotational movement of a single diverting mechanism or shaft 132 to move the corresponding gate into interference with the path of paper movement, as described above. Each of the cams 151 is supported on a gate index shaft 153 and, as shown in FIG. 3, the shaft is supported at its uppermost end in a bracket 154 secured to the rear frame plate 103. The bracket 154 has a bearing portion mounted therein for rotationally supporting the shaft which is driven by means of a stepping motor B-3 secured to the rear frame plate by means of a bracket 149 connected to the gate index shaft.

The cams 151, each having a rise portion 152, are spaced axially and radially along the gate index shaft whereby rotation of the cam shaft will cause the rise portions 152 to pass a given point in a predetermined sequence. This sequential stepping of the rise portions of the cams will sequentially actuate the diverting mechanism by means of the rise portions 152 of the cams oscillating a trip lever 155 for each of the cams and having a bifurcated end portion engaging the cam surface as seen in FIG. 3. Each diverting mechanism 130, one for each of the distributors 100, has a trip lever secured to the end of the gate shaft 132 to be sequentially actuated whereby the gates will be moved into interference relation with a sheet passing between the drive feed rolls 121 and idler rolls 161 to thereby deflect the sheet into the appropriate catch tray.

As seen in FIG. 3, the gate index shaft 153 has secured to its lower end a rotary cam control device 156 having cam portions to control the actuation of a plurality of limit switches labeled LS-14 to LS-24. The limit switches are mounted in cooperative relationship with corresponding switch actuators and are secured upon the control by means of a bracket 157 secured to the rear frame plate to perform a function to be hereinafter described in detail.

To complete a paper transport for delivering sheet material to the appropriate catch tray when one distributor is placed in cooperative relation with another distributor or a sheet distributor such as disclosed in copending application Serial No. 574,990 filed August 25, 1966, in the name of J. E. Britt et al., there is provided a plurality of idler rollers 161 supported by the right-hand frame plate 106. The idler rollers 161 are individually rotatably mounted on a bifurcated bracket 162 supported on tie rods 163, secured to an idler transport frame 165, and biased in a counterclockwise direction, as seen in FIG. 2, to be held in slight pressure contact with the drive feed rollers 121 of another distributor 100 placed in cooperative relation to form a unitary sheet distributing machine. The positioning of the idler transport 160 and, therefore, the idler rollers 161 is determined by suitable brackets securing the transport and the frame plate 106.

An end plate 400 is provided to complete a sheet transport adjacent the terminal sheet distributor section (see FIG. 1). An idler transport such as idler transport 160 is supported on the inside of end plate 400 and positioned in cooperative relation with the drive feed rollers 121 and diverting mechanisms 130 of the terminal section in a manner as previously described in regard to idler transport 160.

A plurality of parallel guide rails 164 are secured to and positioned on the transport frame 165 such that when a sheet distributor 100 is placed in cooperative relation with another sheet distributor, the path of sheet travel formed thereby will be along the guide rails 164 between the idler rollers 161 and the drive feed rolls 121. The guide rails 164 are channel shaped in cross-section and extend vertically along one side of a sheet distributor as shown in FIG. 2. With a pair of sheet distributors in such a cooperative relation, when a diverting mechanism 130 is actuated by a cam 151, the flat portion 134 of the gate, normally parallel to the path of paper travel, is rotated counterclockwise into interference with the path of paper travel and into the guide rails 164 of the idler transport thereby moving the concave portion 133 of the gate into interference with the path of paper travel to deflect the sheet material into the appropriate catch tray.

As seen in FIG. 2, sheet material is adapted to pass across the top of a sorter unit by means of a horizontal transport 170 and down along the guides 164 into the appropriate catch tray depending upon which of the gates 131 has been actuated. The horizontal idler transport is formed with a suitable horizontal base plate to which the parallel guide rails 164 may be secured and is positioned in cooperative relation with gates of a diverting mechanism 130' to perform the same function as here-

tofore described with respect to the mechanism 130. A plurality of tie rods are secured in upturned portions of the frame for the transport 170 and support a plurality of horizontally arranged idler rolls 161. The bifurcated portion of the idler roll brackets 162 engage a tie rod 163 and are biased in a clockwise direction, as seen in FIG. 2, through openings in the transport frame into engagement with the drive feed rollers 121 by means of a leaf spring 174 secured to the lower portion of the bifurcated brackets by means of an upturned lip with the other end of the leaf spring secured in a suitable slot provided in spring retaining brackets 175.

To enable the sheet distributors 100 to be assembled into a unitary sheet distributing machine, suitable mechanical connecting devices, not shown, may be utilized to correctly align the distributors and retain them in cooperating relation. A diverting mechanism 130' is similar in construction to the diverting mechanisms 130, positioned adjacent the left end of the horizontal transport 170 to control delivery of sheet material to the catch trays of a sorter in which the diverting mechanism is contained or to pass the sheet material to an adjoining sorter for distribution therein.

In order to divert the sheet materials passing through the horizontal transport into the vertical transport formed in a particular distributor, for delivery into the appropriate copy catch tray therein, the gates of the diverting mechanisms are rotated whereby the concave surface 133 will be in interference with the path of paper movement. If it is desired to distribute the sheet material to an adjoining distributor or sorter, the gate index shaft 153 is rotated to a position whereby the bifurcated portion of the trip lever 155' is engaged by the drop portion 152' of the cam 151' whereby the gate for the diverting mechanism 130' will be positioned out of interference relationship with the path of the paper movement through the horizontal transport with the flat portion of the gate positioned, in the stepped portion of the drive feed rollers, adjacent to the path of paper travel thereby allowing the sheet material to pass to the next sheet distributing sorter.

The sorter control programming device SC comprises a tape reader 180 which includes a sprocket mechanism for advancing sequentially a tape, indicated by the reference numeral 181 having thereon a pattern of information areas in the form of punched holes arranged to be indicative of a particular sorter program. As shown in FIG. 6, a portion of the tape 181 is shown in relation to a sprocket mechanism 182 in the reader 180 adapted to advance the tape in the direction of the arrow. The desired sheet distribution program for any particular run on the distribution machine may be punched by a suitable tape punching mechanism arranged to select and effect a program upon the tape. The finished or punched tape having the desired program formed thereon may then be used to control the diverting means for each of the units 100 in order to accomplish that program.

The tape reader head may be provided with a plurality of electrical switches each comprising a feeler switch element and arranged in a line transverse to the movement of the tape wherein each of the feelers is adapted to cooperate with a row or channel of punched holes formed in the tape. When a particular feeler element is in alignment with its corresponding hole, contact with another switch element is accomplished to close a circuit for a purpose to be described hereinafter. As a typical example of such a mechanism and its cooperative relationship with the tape, the portion of the tape 181, shown in FIG. 6, is provided with a plurality of rows or channels and a switch with a feeler element (not shown) associated with each channel. Preferably, the punch tape is approximately 1" wide, is of 8 channel paper or Mylar with suitable hole spacing and, as shown in FIG. 1, would be in the form of a closed loop. While a closed loop is preferred for the tape form, it will be apparent that

the tape may assume any other form, such as straight lengths.

The sorter controller SC is also provided with a sorter "ON" button, a sorter "OFF" button, and an indicator light and can be arranged so that when the sorter "ON" button is actuated and a tape is not present in the controller, the distribution machine will be adapted for distributing a single sheet to each of the sorter trays in the distribution machine and upon insertion of a sheet in the last tray of the machine will then commence the operation over again as long as there are additional sheets to be stored. In other words, if no tape is present in the reader, the reader will automatically revert to the simple sort mode of operation wherein the sorter will place one copy in each bin until the copy run ends.

As shown in FIG. 6, a typical distribution pattern has been formed upon the tape 181 which, as previously stated, is preferably of 8 channels and includes a series of equally spaced apertures 185 which serve as a means of permitting the teeth 186 for the sprocket 182 to produce a constant speed and continuous movement of the tape. In FIG. 6, for illustrative purposes there is shown a vertical column of eight holes labeled X-1, X-2 and X-4 for the first three upper holes and Y-1, Y-2, Y-4, Y-8 and Y-16 for the lower five holes. The logic utilized for receiving the signals produced by the sensed holes is in the binary configuration. Therefore, as will be understood hereinafter, the hole designations and purposes thereof will be described in binary terms. In the particular section of the tape shown, the first or top three channels, indicated by the apertures X-1, X-2, and X-4, or their coded weight in the binary sense, designate the distribution units 100 in the distribution machine wherein the unit closest to the reproduction machine is labeled X-1 and so on. The first unit then would be indicated by X-1, the second by X-2, the third by a hole in both X-1 and X-2 channels, the fourth by a hole in the X-4 channel, and the fifth sorter unit by a hole in each of the X-1 and X-4 channels. The illustrated taped program then is capable of controlling sorting to five sorter units. For additional units, additional channels of the tape can be possible. In any event, the X-6, caused by holes in the X-2 and X-4 channels, is unrecognized and, for the present description, is utilized to control the beginning of the sort. The next four channels, labeled Y-1, Y-2, Y-4 and Y-8, or their coded weight in the binary sense, designate the channels that will be used to control the diverting of sheets of paper into the trays of each of the units 100, the number of which for each of the units is shown to be 10. The hole Y-16, which like X-6 is not recognized, may be utilized to produce a signal in the reader for effecting termination of the particular sort program. When the distribution machine is sorting by a program in the first unit, the punched program will utilize a hole in the X-1 channel, for the second unit, a hole in the X-2 channel will be utilized for the second unit and a hole in each of the channels X-1 and X-2 designate a third unit.

The circuit which is adapted to respond to the sensing of the tape 181 and provide impulse signals for the controlling of energization of the index motor B-3 and thereby control the actuation of the diverting gates 131 is the X-decoder-Y-decoder logic circuit illustrated in FIG. 8 by the reference numeral 189. For any particular distribution pattern, the circuit 189 is arranged to react to the sensing of the beginning of sort holes 191 formed in the channels X-2 and X-4 as a means for commencing programmed distribution in accordance with the program pattern. After the index motor B-3 has been energized for causing a particular gate 131 to permit a sheet to advance to a tray, the switch mechanism 156 will effect a termination of energization of the motor B-3. The circuit 190, in FIG. 8, includes the switches in the mechanism 156, and other circuitry to effect such operation. As shown in FIG. 6, the hole 191 in the channel X-4 cooperates

with a feeler switch element 192 which may be spring biased to project through the hole 191 when the same is moved immediately above the button. The button may be associated with a microswitch in the reader head 180, and together with the sensing of the other hole 191 in the X-2 channel, is adapted to complete a circuit in the sorter control SC for the control circuit 189. As previously stated, a plurality of similar switches are provided along a line transverse to the tape movement and parallel to the axis for the sprocket 182 thereby being in alignment with the beginning of sort hole 191. This line may be considered as the sensing line or position for the reader head 180. When the tape 181 is inserted in the reader 181 and placed upon the sprocket 182 without regard to the location of a sorting program thereby resulting in the hole 191 not being in position to receive the switch element 192, the reader 180 may be arranged to drive continuously the sprocket 182 at relatively high speed until the hole 191 is moved to a position to be cooperative with the element 192, whereupon the drive mechanism for the sprocket 182 will stop. In this latter condition of the controller SC, the distribution machine is in condition for distribution operation.

Distribution is accordance with the taped program is then affected by continuous relatively slower speed driving movement of the sprocket 182 which moves the tape 181 to position the next series of holes into a sensing position which in the illustrated pattern comprises the upper hole 193 and a lower hole 194. With these holes being sensed, the first sorter unit X-1 will be brought into action and the first and upper tray Y-1 will receive one sheet of paper that is brought into the nip of the entry rollers for the horizontal transport 170 of the sorter unit. Continual movement of the tape 181 will next bring in the upper hole 195 and the lower hole 196. The sensing of these holes will result in the transporting of another sheet of paper into the second tray of the first sorter unit. By virtue of the next series of holes, namely, 197, 198 and 199, the first unit X-1 again will be affected and the third tray will receive a copy. This will be seen from the fact that the 198 aperture refers to Y-1 and the 199 aperture refers to Y-2, the addition of which, namely three, will provide the third tray of the first sorter unit with one copy. Similar, the next two series of apertures will also provide a sheet into the third tray of the unit resulting in the third bin receiving a total of three sheets. When the tape is moved to present the next series of holes for sensing by the head 180, these series of holes, numbered 201, 202, and 203, will result in a copy being inserted into the fifth tray determined by the addition of Y-1 and Y-4. The next incremental movement of the tape will present the last series of apertures in the pattern. The result of this pattern is to effect distribution of a sheet into the ninth tray. It will be obvious that the remaining trays of the first unit X-1 could be utilized in the patterned distribution, all that need be required would be that the tray number be the sum of the numbered Y numbers, that is, for the sixth bin, Y-2 and Y-4 channels would need holes, and so on.

Also included in the last series of holes is the hole 204 which is utilized with a suitable switch mechanism such as the type associated with the element 192 to terminate further operation of the sorter programmer SC and thereby effect a standby condition of the distribution machine by that switch's actuation.

To begin the sorting operation, the automatic sorter control programmer SC has applied thereto the pre-punched tape 181 to control the desired number of sheets in as many catch trays of a distributor unit as desired and to any number of units. The first sheet distributor 100 whether alone or in combination with others is placed in cooperative relationship with a printing or reproducing machine, especially one of the type disclosed in copending application Ser. No. 400,363 filed Sept. 30, 1964, in the names of R.F. Osborne et al. whereby the machine

output is fed into the pinch of the sheet distributor drive rollers 121 and 161 of the horizontal transport 170.

An operator places an original document to be reproduced and distributed in accordance with the distribution pattern pre-punched into the tape 181 on the platen 22, closes the cover 21 of the machine of the above-referred-to patent application to R. F. Osborne et al., programs the reproducing machine for the desired total number of copies of the original document through the reproducing machine programmer, and depresses the sorter "ON" button on the sorter control programmer SC. The distribution machine is now in readiness for completely automatic distribution of the copies of the original document. The operator then begins complete reproduction and sorting operation by depressing the start button of the reproducing machine which applies power throughout the machine and to line 47 of the sheet distributor (see circuit diagram of FIG. 7).

Although for convenience of illustration, the automatic sorting controller and distributor are described in operation with the xerographic reproducing machine of the aforementioned copending application, it is not intended to be limited thereto but may be utilized with any source of seriatim fed sheet material and connected to any source of 110 volts, 60 cycle A.C. type of power to provide a command signal and power to start and maintain operation of the sorting controller and distributor.

As is described in the above referred to copending application, Ser. No. 574,990, the power to line 47 energizes a relay K-1 through a normally closed relay contacts K-19(1A). Energization of K-1 relay closes K-1(1) contact to apply power through all interlocks that may be provided and which must be closed for machine operation to lines 6 and 14 thereby energizing power relays K-2 and K-20 of the distributor. Power to line 6 is provided through normally closed contacts K-8(3) and K-19(2).

Automatic controlled actuation of the diverting and, consequently, automatic sorting by the diverting mechanism is initiated by means of the programmer under the control of the controller SC which includes the pre-punched program, the tape 181, and the tape reader 180 which is adapted to produce control signals to the drive and diverting mechanism in each of the sorter units 100.

As the sheet material is fed into the first distributor unit 100 or X-1, as prescribed on the tape 181, the sheet contacts the actuator arm of count switch LS-7 positioned at the initial entry point to the distributor machine 200. The closing of count switch LS-7 energizes relay K-16 which performs several functions. The energization of relay K-16 causes the normally open contacts K-16(1) to close energizing the relay K-17 which is held energized through normally closed contact M-2(2) provided in the controller SC and the normally open contact K-17(1) which is closed by energization of relay K-17, and the normally closed contact of limit switch LS-8 located in the middle of the horizontal transport 170 of the sheet distributor. Upon actuation of relay K-17, the normally open contacts K-17(2) close thereby supplying power through normally closed contacts K-9(1) to the jam detection controller timer M-6, and the normally closed contacts K-17(3) are opened to form a discharge path for resetting the timer M-6.

Movement of the paper into the sheet distributor causes the actuation of limit switch LS-7 energizing the timer M-6. As the paper proceeds along its path of movement, limit switch LS-8 is actuated opening the normally closed contact LS-8B thereby de-energizing relay K-17 by opening the holding circuit thereto. The de-energization of relay K-17 removes power from the timer M-6 and allows contacts K-17(3) to close which discharges the capacitor of the timer mechanism M-6 to indicate that the sheet material has proceeded through the transition portion of the sheet distributor and has proceeded to the copy catch

tray portion. If the sheet material were to get jammed somewhere between limit switch LS-7 and limit switch LS-8, the normally closed contacts LS-8B would not be opened and the jam detection controller timer M-6 would remain energized through the energized relay K-17 and would cause a shutdown of the sheet distributor. The complete description of the circuit diagram of FIG. 7 and FIG. 8 is provided in the above-referred-to application to Britt et al. Further description thereof is unnecessary for the present invention except in so far as it relates to the operation of the sorter controller.

The operation of the diverting mechanism 130 and 130' to effect programmed sorting is controlled by the limit switches LS-14 to LS-23 actuated by the rotary switching mechanism 156 secured to the lower portion of the cam support shaft 153. The switching mechanism 156 comprises six cams, C-1, C-2, C-3, C-4, C-5, and C-6, arranged axially along the shaft 153 such that the first cam, C-1, serves to actuate the limit switch LS-18; the second cam, C-2, the switches LS-16, LS-20; the third cam, C-3, the switches LS-17 and LS-22; the fourth cam, C-4, the switches LS-14 and LS-19; the fifth cam, C-5, the switches LS-15 and LS-21 and the sixth cam, C-6, the switches LS-17 and LS-23. These cams are identical in construction and only one will be described briefly along with its associated actuating elements. As shown in FIG. 5, the cam C-1 is formed with a detent 220 which is co-operable with a spring finger 221 mounted on the frame of the mechanism 156 and normally biased against the periphery of the cam C-1 by a leaf spring 222. When the finger 221 is extended into the detent, the limit switch LS-18 is open and, therefore, at all other times during the rotation of the shaft 153, the contact of limit switch LS-18 is closed. Each of the other cams is also provided with a detent that is cooperable with spring fingers similar to the finger 221 for actuating the limit switches associated therewith.

The switches LS-18, LS-20, LS-22, LS-14, LS-15, and LS-17 are arranged one above the other in a single block with the corresponding fingers 220 in alignment in a common line parallel to the shaft 153. Similarly, the switches LS-16, LS-17, LS-19, LS-21, and LS-23 are also arranged in a single block with the corresponding fingers 221 arranged in a line parallel to the index shaft 153 and approximately diametrically opposed to the other line of fingers. The detents 220 for the cams are arranged radially of the shaft 153 such that there is a detent every 30° of the mechanism 156 rotation representing each bin and a position whereby the diverting mechanism 130' is positioned out of interference relationship with the path of paper movement to pass sheet material to an adjoining sheet distributor, unit or sorter 100.

In the No. 1 position for the beginning of a sorting program, the finger 221 for the limit switch LS-14 is positioned in the detent of its appropriate cam C-4. At the start of the distributing program, due to the positioning of the tape 181 on the sprocket 182 with the holes 193 and 194 being sensed by the controller reader head SC and the cams 151 and 151' on the index shaft 153, the diverting mechanism 131' and the first diverting mechanism 130 are held in interference relationship with the path of paper movement whereby the first sheet entering the sheet distributor unit X-1 will be diverted by the diverting mechanism 131' into the vertical transport to be delivered to the first copy catch tray Y-1 by the diverting mechanism 130 associated with the first tray.

The cam 151' which actuates the diverting mechanism 131' is of the type shown in FIG. 4 but has two diametrically opposed drop portions 152' and positioned whereby the diverting mechanism 131' is held by the dwell portion in interference relationship with the path of paper movement at all times except at such time when the index shaft is rotated sufficiently for the bifurcated lever arm 155' to fall into either of the drop portions

152'. This movement of the diverting mechanism 131' out of the path of paper movement occurs at one point in time when the first five diverting mechanisms 130 have been actuated, or bypassed and occurs at a second point after the next five mechanisms 130 have been actuated, to deliver a sheet material into an appropriate catch tray. No sheet will be diverted however to another sorter unit until after the tenth tray has been considered and there is a circuit or program demand for another sorter unit. This complete indexing action of the diverting mechanism is controlled by positioning the cams C-1 to C-6 on the gate index shaft 153 in such an order whereby each cam will pass a predetermined point at a predetermined time.

To control the indexing of the diverting mechanisms to divert the sheet material into the appropriate catch tray in accordance with the pre-punched program on the tape 181, a pulse is provided to the index motor B-3 through contacts K-10(2) and K-12(2) causing the motor to move the rotary switching mechanism 156 sufficiently to close one of the limit switches LS-14 to LS-23. This causes the relay K-21 to energize providing a power path through the actuated limit switch and the closed relay contacts K-21(1) directly to the index motor B-3 which rotates the cam support shaft 153 until the actuator of that limit switch is moved away from its respective detent of the mechanism 156 and is opened disconnecting power to the index motor. The power to the motor then is terminated upon the actuator of a limit switch falling into the next detent of the rotary mechanism 156. When the sheet material breaks the light beam projecting into the photosensor CR-1, light sensor control relay K-12 immediately de-energizes opening the closed contacts K-12(2) and closing contact K-12(3) connected in series with relay K-10 which is thereby energized closing relay contacts K-10(2). When the sheet material passes through the light beam and the light again contacts the photosensor, relay K-12 immediately is energized closing relay contacts K-12(2) and K-12(1A) providing power to the index motor B-3 through closed relay contacts K-10(2). Although K-10 relay is in series with relay contacts K-12(3), the opening of the relay contacts does not cause an immediate de-energization of relay K-10 due to the time delay occasioned by capacitor C-1 and resistor R-1. Therefore, the power flows through the contacts K-12(2) and K-10(2) to condition the index motor B-3 for energization. The first sheet then of paper produced by the reproduction machine is directed into the first tray in the sorter unit and the cam C-2 is now in position wherein its detent contains the actuator for the limit switch LS-16 thereby conditioning the sorter machine for another reading of the tape 181.

As shown in FIG. 6, the next programmed sorting step is accomplished as the holes 195 and 196 are sensed. Upon this occurrence, the index motor B-3 is again energized by a circuit containing a switch closed by sensing of the hole 196 and the closed switch LS-16 in series therewith to produce 30° of rotation of the shaft 153 for actuating the diverting mechanism for the second tray Y-2 which now receives one sheet. As the shaft 153 rotates, the actuator finger for the switch LS-16 moves out of the detent in order to open the switch series circuit thereby terminating energization of the motor B-3 circuit. Similarly, when the sprocket 182 is rotated again to move the holes 197, 198 and 199 into a sensing position, the motor B-3 is again energized to index the shaft another 30° so as to actuate the third tray diverting mechanism to cause transfer of the next sheet into this tray. When the next series of holes corresponding to holes 197, 198 and 199 are sensed, the index motor B-3 is not energized and the shaft 153 is not indexed because while the switch in the controller SC is closed the particular limit switch involved, namely, LS-16, remains in the exact condition as previously encountered resulting in the

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diverting mechanism for the third tray remaining open for causing the next sheet of paper to be directed into this tray. The next series of holes on the tape 181, being the same, will also cause the next sheet to be directed into the third tray. The next series of holes 201, 202 and 203 will cause indexing of the shaft 153 to effect the next transported sheet to be directed into the fifth tray. The next and final series of holes for the particular program illustrated will cause the last sheet to be distributed in accordance with the prepunched program to reach the ninth tray in the third module unit. Along with this series of holes includes the hole 204 which will effect end of sorting.

When the number of copies being reproduced of the original document has been reached, termination of operation of the sheet distribution machine occurs as the hole 204 is sensed by the controller SC. When it is desired to terminate operation of the sheet distribution machine without resetting the same for a new program, the normally closed relay contacts K-3(2) are opened to interrupt all the reset circuits by interrupting the power to line 22 from which all the reset circuits are supplied. In addition, normally closed contact K-3(3) is opened to interrupt the reset of the timer M-2. Since all of the reset limit switches are supplied with power through line 22, the interruption of the power to line 22 prevents the closing of LS-1, LS-2, LS-3, LS-4 and LS-5 from effecting a reset of the distributor units. However, it does not interrupt the power to limit switch LS-6 which controls the termination of the sheet distributor operation and with this switch opened causes the sheet distributor units to terminate operation. Therefore, upon restarting the reproducing mechanism and the sheet distributors, the distributors are not reset but again continues the previous program.

When the desired number of copies of an original document have been reproduced on the reproducing machine, the tape 181 will have moved through the area upon which there is a program pre-punched and, as previously stated, with the absence of a hole thereon for the feeler element 192, the controller SC will drive the sprocket 182 until the tape has moved to where the beginning of sorting hole 191 is once again cooperative therewith. The machine is now in condition for a re-run of the same taped program or the removal of the tape and insertion of a new tape. The tape 181 may also contain any number of or multiple programs thereon for a particular length of tape. Each program section of tape would require a different beginning of sort hole arrangement 191 and an end of sorting hole 204.

As described in the above-referred to copending application, when the number of copies have been produced on the reproduction machine, line 108 is energized and switches LS-1 to LS-6 are actuated. Actuation of limit switch LS-1 energizes reset control relay K-5 to reset the distributor units. Next, the limit switch LS-2 is actuated to close the reset path for the timer M-2 resetting the timer for the next program. Next, limit switch LS-3 is actuated to reset the catch tray portion of the sheet distributor 200 applying power directly to the index motor B-3 from line 14 which causes the diverting mechanisms to be reset.

This action covers resetting of the unit 10 for the first tray and power being supplied through the limit switch LS-18 which energizes relay K-21 closing the normally open contact K-21(1) directly applying power to the index motor B-3 until limit switch LS-18 is de-actuated by means of its finger actuator moving into the detent on the cam C-1. Limit switch LS-4 energizes the reset relay K-6 for all sheet distributor units to reset each unit by applying power through LS-18 in each unit to drive each index motor B-3 until LS-18 is deactuated.

The limit switch LS-5 is energized closing contact LS-5A to energize the sheet distributor delay shutdown control relay K-13, and LS-5B contacts open to de-ener-

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gize reset control relay K-5 which was previously energized through limit switch LS-1, thereby insuring that enough time elapses prior to sheet distributor shutdown to allow the last sheet emerging from the reproducing machine to arrive at its predetermined destination.

As previously stated, for single sheet sorting, that is, to use the distribution machine in the manner to produce sequentially one sheet at a time sort to each tray until all of the rays are equally utilized, the operator need only to remove the tape 181 from the controller SC. Operation will then be the same as described in the above-referred application to Britt et al.

From the foregoing, with the use of the programmer SC and tape reading device, in conjunction with the decoder logic circuits, the distribution machine is adapted to collate or sort reproductions of a document in accordance with a desired program and is capable of sorting so as to effect distribution that requires a single copy in any one tray, no copies in any one tray or many copies for any particular tray. The controlling circuits are also arranged so that the single sort feature is still available for machine operation and is possible to produce more than one programmed sorting action for one application of a program tape to the reader without requiring attendance by the machine operator. It is also envisioned that the sorting program may be greatly extended and varied by adding any number of sorting units, coupled with a program tape configuration that is capable of multi-unit control.

While the invention has been described with reference to the structure disclosed herein, it is not to be confined to the details set forth in this application but is intended to cover such modifications or changes as may come within the scope of the following claims.

What is claimed is:

1. A sheet material distribution system for distributing sheet material into pre-arranged stations in accordance with a predetermined program comprising

a plurality of catch trays supported in spaced relation to each other,

a plurality of diverting mechanisms positioned adjacent said catch trays each being in cooperative relationship with a tray and being actuatable into and from interference relationship with sheet material passed adjacent thereto to divert individual sheet material into its corresponding tray,

an actuator means to selectively actuate said diverting mechanisms into and from interference relationship with sheet material passed adjacent thereto,

a reader adapted to receive a pre-programmed recording medium and sense pre-formed information control areas thereon for producing control signals in accordance with these areas,

an encoder circuit associated with said reader and said actuator means being responsive to said signals for producing actuation of the latter in accordance with said signals for diverting sheet material into said trays or to bypass the same in accordance with the informational areas on said medium to effect the distribution into said trays for the desired number of sheet material.

2. The system of claim 1 wherein said plurality of trays form a first series of trays and including

means to convert a second series of catch trays into operative relationship with said first series,

and means for diverting sheet material from said first series to said second series in response to appropriate signals to this effect upon said medium.

3. The system of claim 1 wherein said plurality of trays form a first series of trays and including

means to convert a plurality of series of catch trays into operative relationship with said first series,

and means for diverting sheet material from said first series to any of said plurality of series in response to appropriate signals to this effect upon said medium.

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4. The system of claim 1 wherein the reader and encoder circuit are adapted to sense a first predetermined area upon the medium for controlling the beginning of automatic sorting of a sorting program and to sense a second predetermined area for controlling the end of the sorting program. 5

5. The system of claim 1 wherein the reader and encoder circuit are adapted to sense a plurality of groups of informational areas upon a pre-programmed recording medium, each group of informational areas being a complete program of distribution.

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6. The system of claim 1 wherein the reader includes means for permitting single sort operation of the distribution system in the absence of a recording medium in the reader.

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