

Aug. 12, 1969

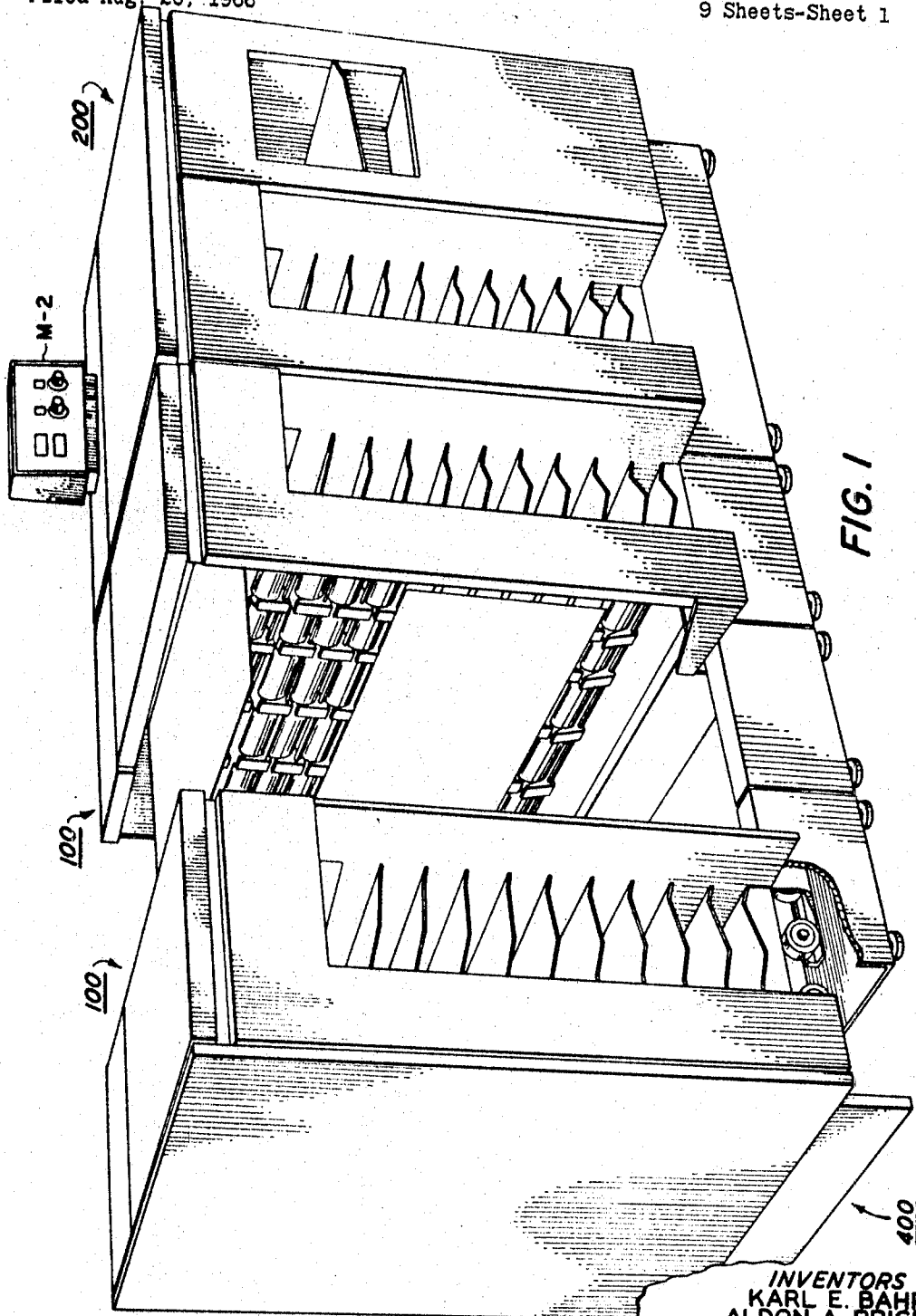
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3,460,824

MODULAR SHEET DISTRIBUTOR

Filed Aug. 26, 1966

9 Sheets-Sheet 1



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Filed Aug. 26, 1966

MODULAR SHEET DISTRIBUTOR

9 Sheets-Sheet 2

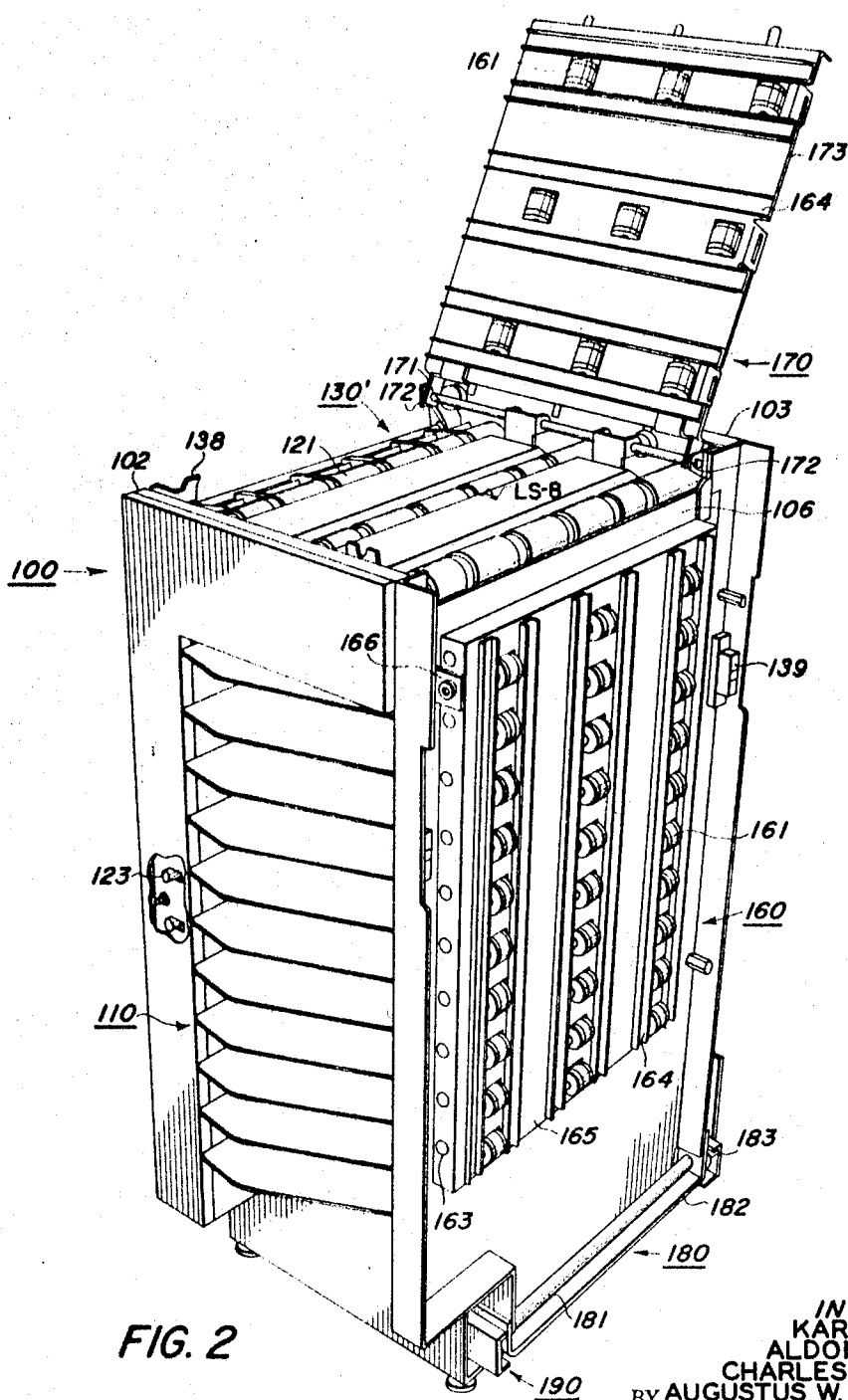


FIG. 2

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MODULAR SHEET DISTRIBUTOR

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9 Sheets-Sheet 3

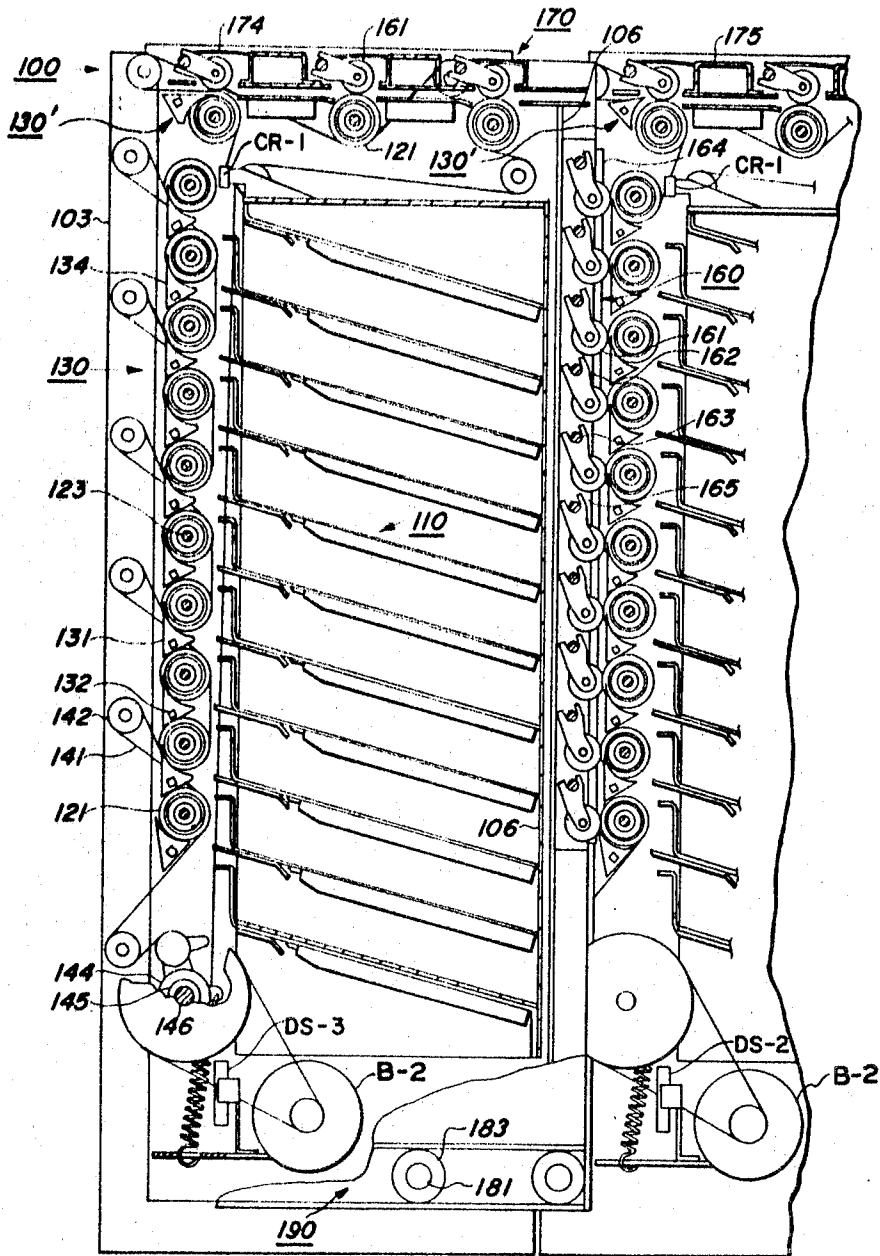


FIG. 3

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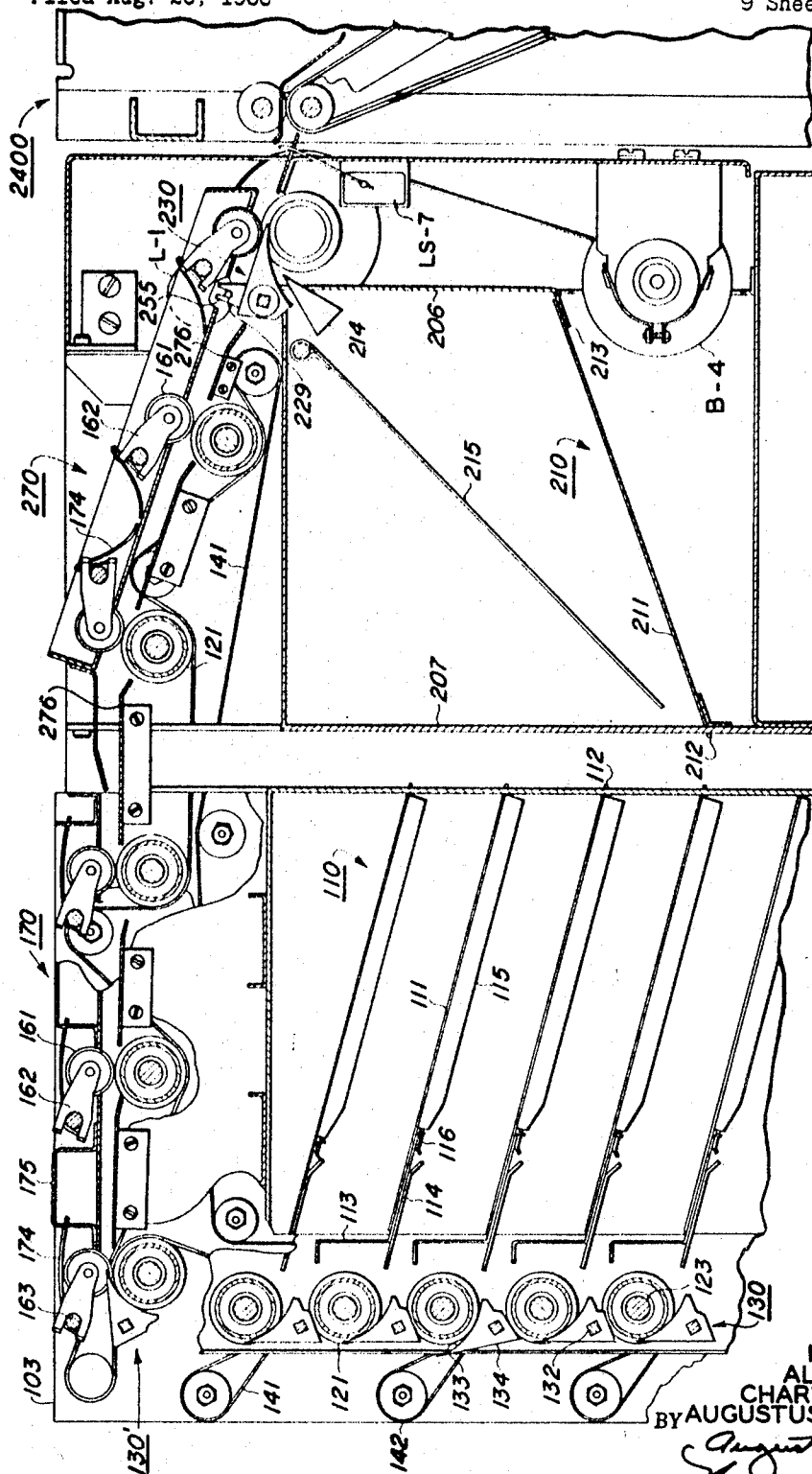
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MODULAR SHEET DISTRIBUTOR

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9 Sheets-Sheet 4



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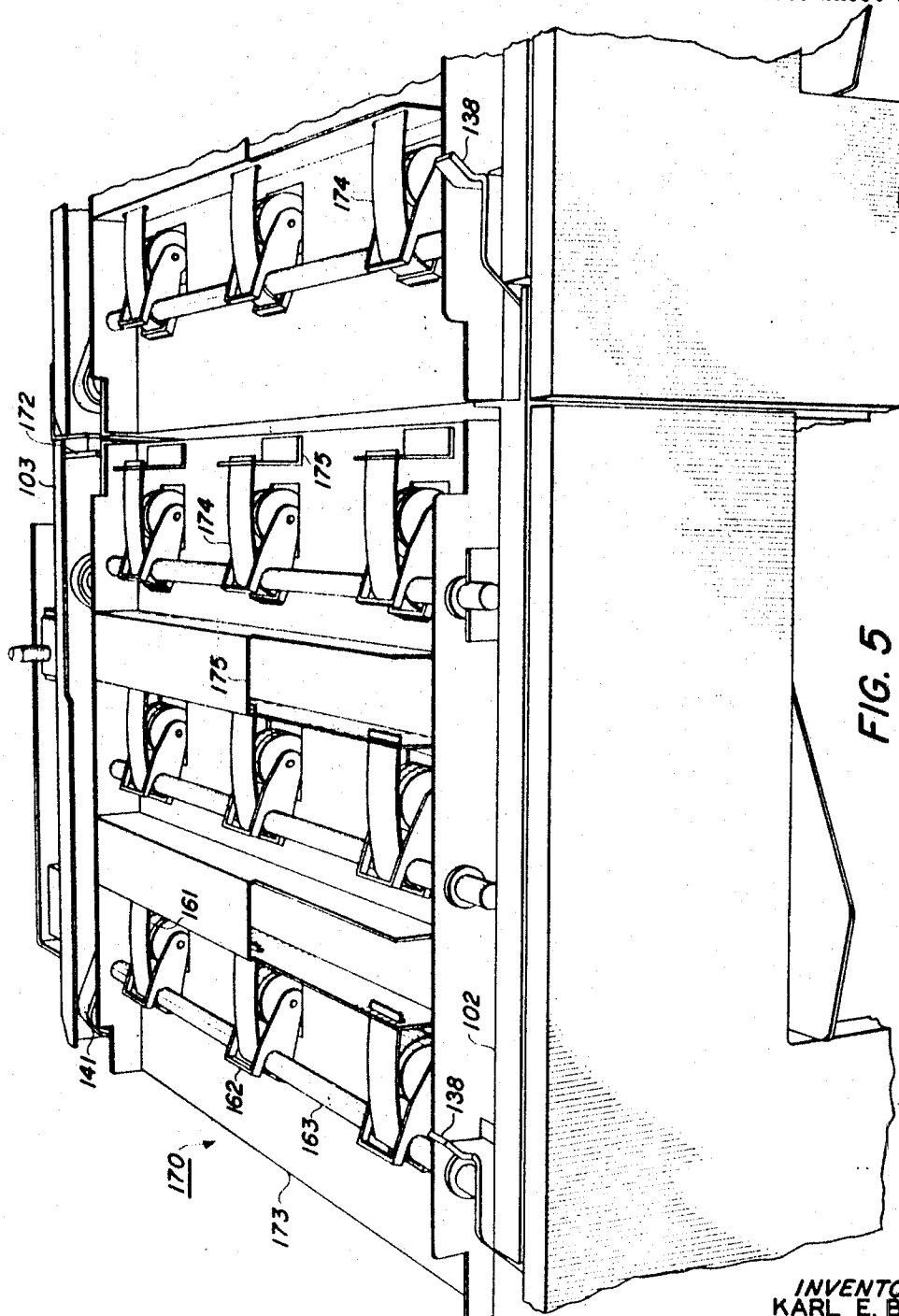
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MODULAR SHEET DISTRIBUTOR

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9 Sheets-Sheet 5



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9 Sheets-Sheet 6

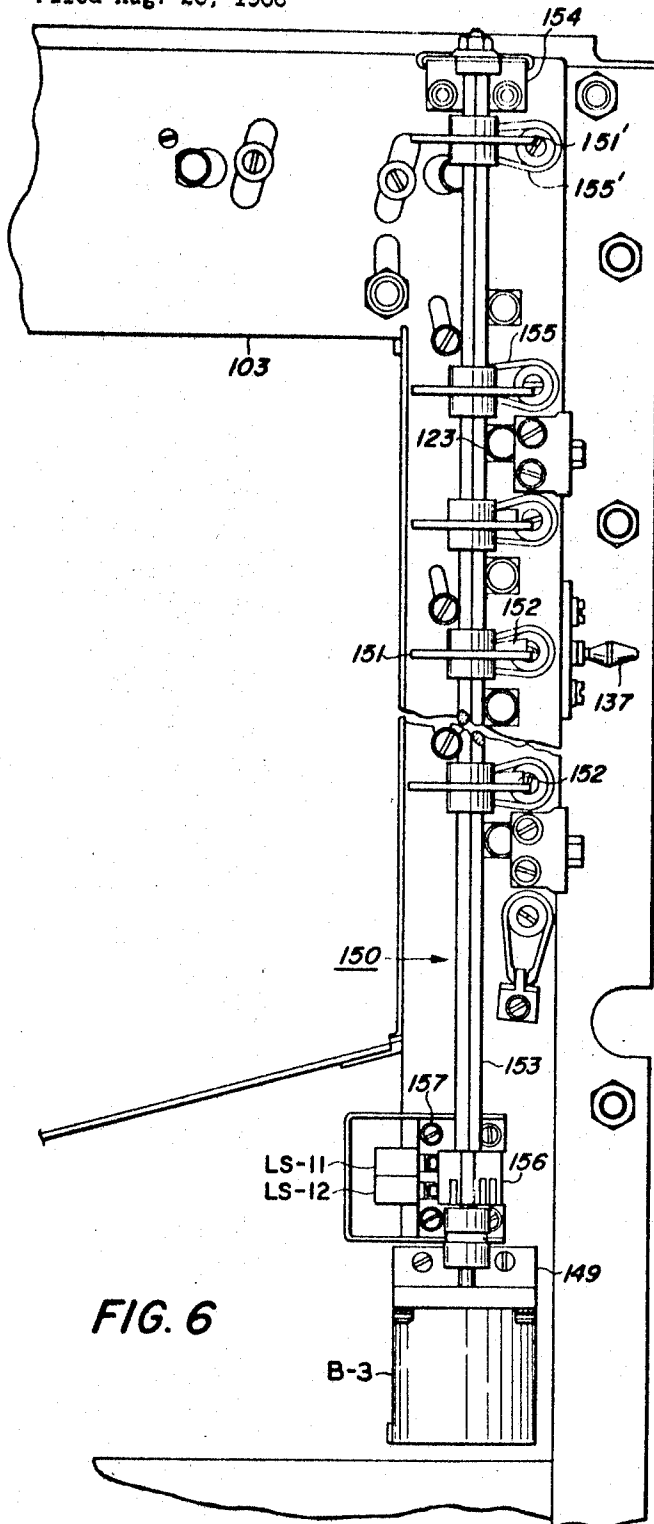
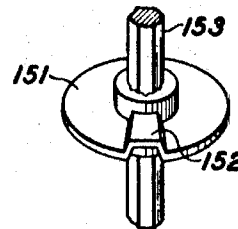


FIG. 7

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MODULAR SHEET DISTRIBUTOR

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9 Sheets-Sheet 7

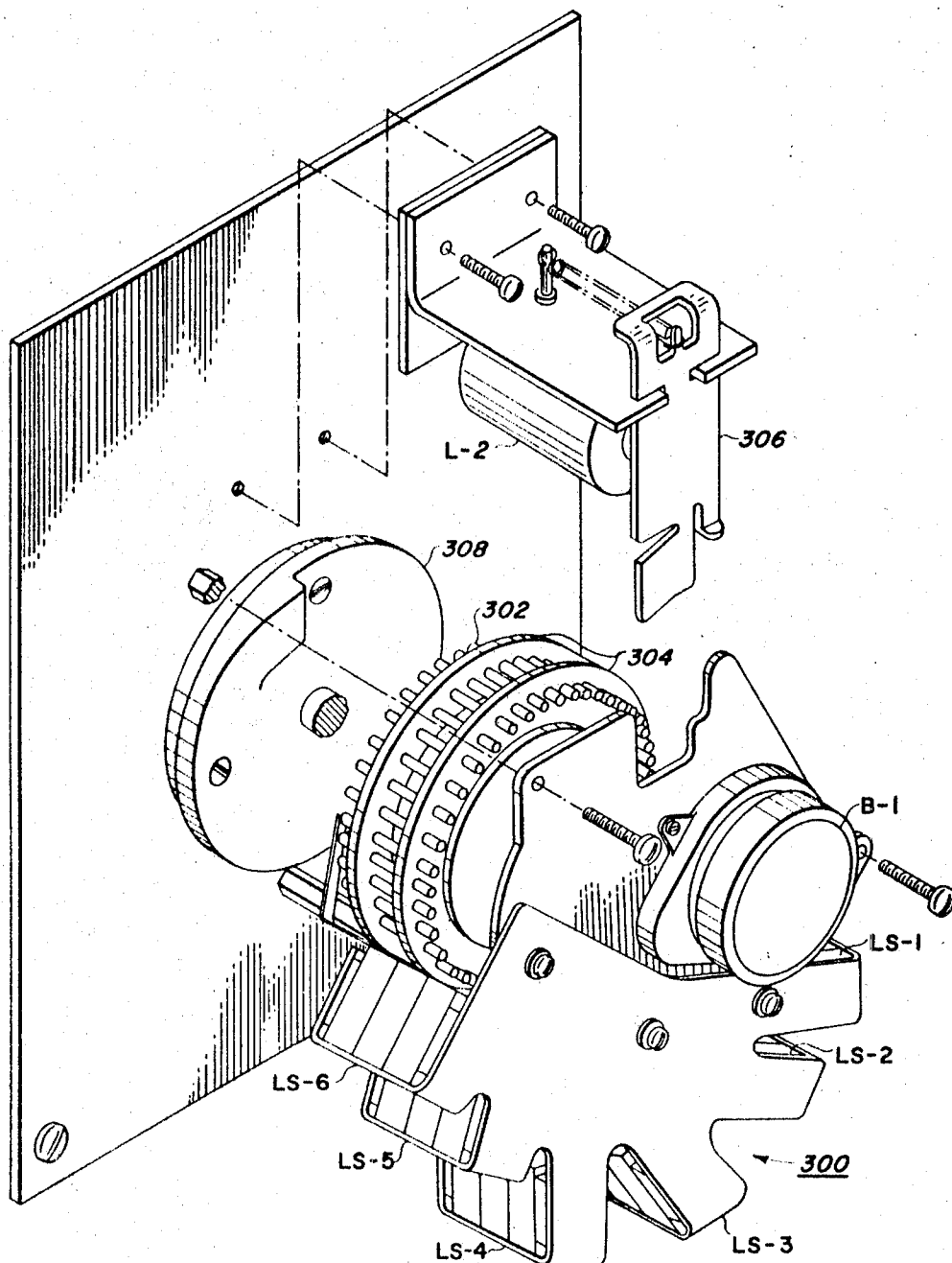


FIG. 8

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MODULAR SHEET DISTRIBUTOR

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9 Sheets-Sheet 8

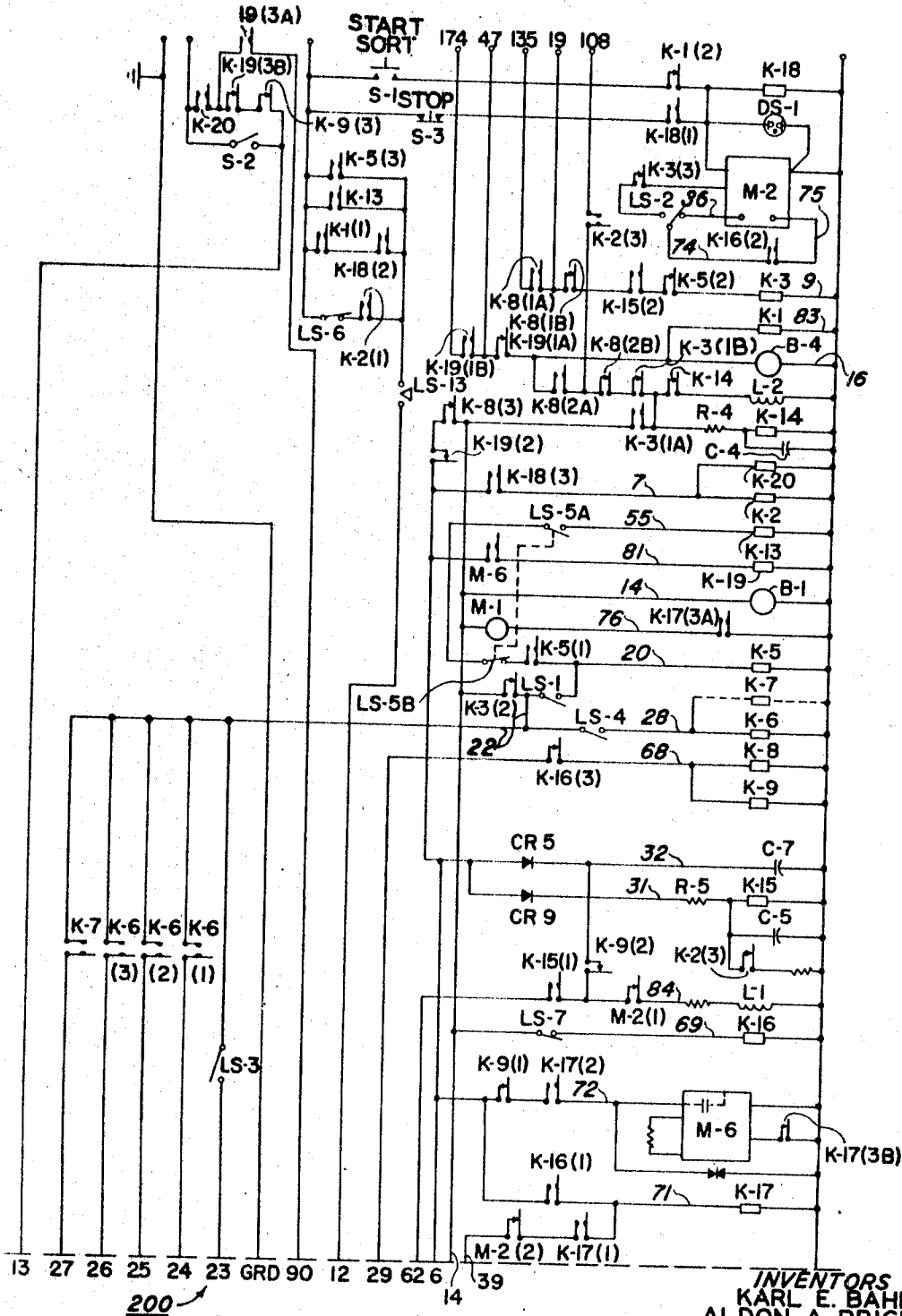


FIG. 9a

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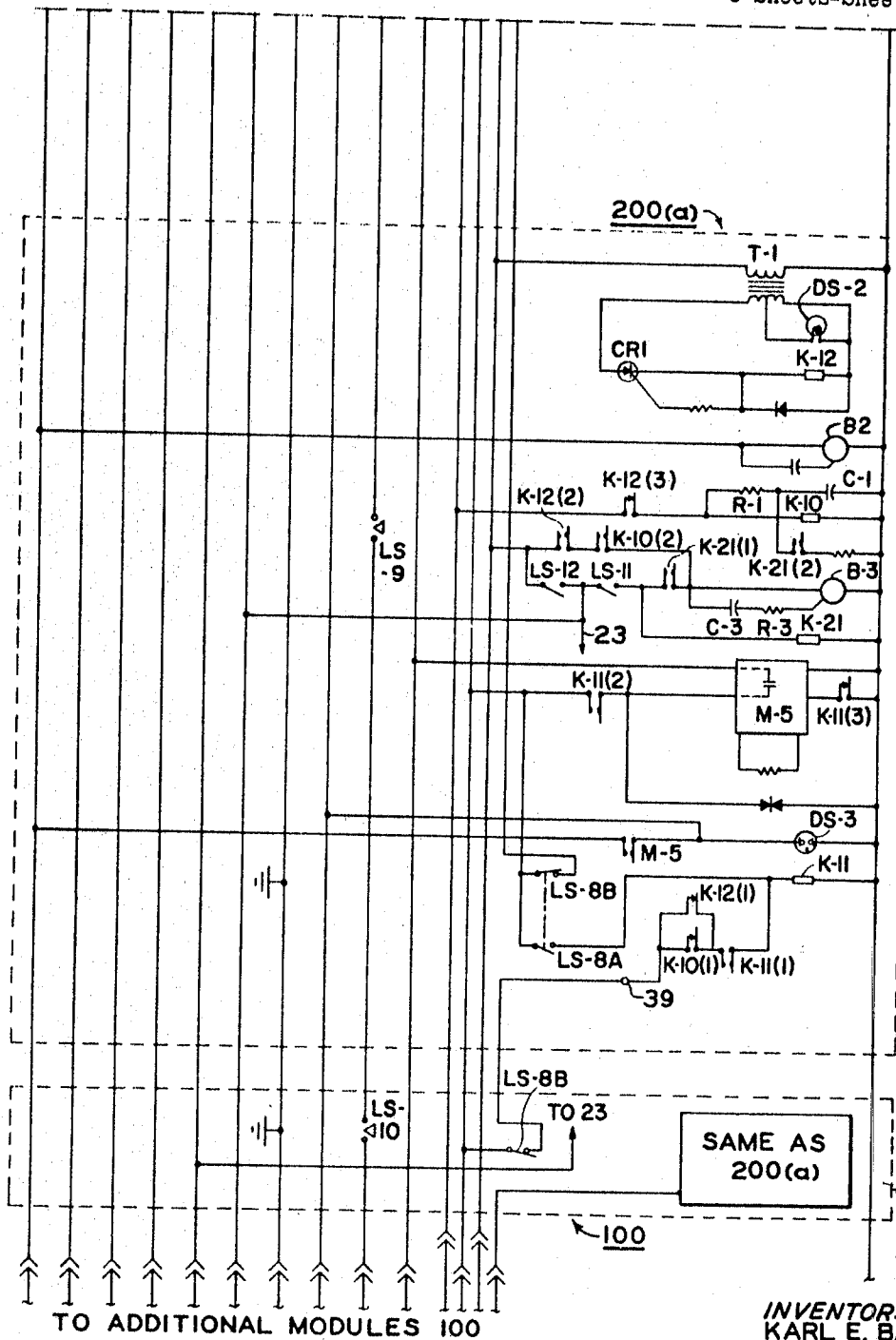
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MODULAR SHEET DISTRIBUTOR

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9 Sheets-Sheet 9



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1

3,460,824

MODULAR SHEET DISTRIBUTOR

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Filed Aug. 26, 1966, Ser. No. 575,476

Int. Cl. B65h 37/00, 29/58

U.S. Cl. 270—58

7 Claims

ABSTRACT OF THE DISCLOSURE

A modular sheet distributor capable of being used in combination with like modular sheet distributors to form a larger capacity unitary sheet distributor. Each distributor includes an input and an output end with transport means connecting them and a first diverting means located adjacent the transport means to selectively transport sheet material towards the output end, or in the alternative, towards stacked copy catch trays. Each of the copy catch trays has an associated diverting means for selectively permitting the fed sheet material to be distributed to a preselected tray.

This invention relates to sheet distributing and, in particular to apparatus adapted to distribute sheet material seriatim fed into the apparatus from various types of reproducing or printing machines.

More specifically, this invention relates to a modular sheet distributor adapted to vary the capacity of a unitary distributing machine by readily increasing or decreasing the number of modular units of a given machine to meet a particular customer requirement or to provide for varying work loads.

In prior art devices of this type the capacity of the sheet distributor or sorter has been limited to a fixed number with no provision for increasing or decreasing the capacity of the apparatus to accommodate changing work loads. The invention of this application provides a modular sorter or sheet distributor unit capable of being readily combined with other modular units forming a unitary sorting or sheet distributing apparatus of any desired size of capacity in multiples of the modular unit. In accordance with the present invention substantial flexibility in a sorting or sheet distributing machine is provided whereby the capacity of the machine may be readily increased or decreased in accordance with varying work loads or customer requirements without the necessity of utilizing a series of separate individual machines each having separate feeding tables, diverting mechanisms and transport systems associated therewith.

Therefore, it is an object of this invention to improve sheet distributing mechanisms.

It is another object of this invention to improve sheet distributing apparatus by readily adjusting the size and capacity of the apparatus.

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

These and other objects are attained in accordance with the present invention wherein there is provided a modular sheet distributing apparatus adapted to be assembled with a plurality of similar modular units one with another in connection with a transition unit for directing the output of a reproducing or printing machine into the units.

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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 units assembled to form a unitary sheet distributing machine, with one unit out of operative position;

FIG. 2 is a front perspective view of a single modular unit to illustrate the features thereof;

FIG. 3 is a front elevation section of the invention of this application to better illustrate the drive and diverting mechanisms;

FIG. 4 is an enlarged section of the diverting mechanism, catch tray, and transition unit;

FIG. 5 is a front perspective view of a portion of the transport system to illustrate the features thereof;

FIG. 6 is an enlarged view of the mechanisms for activating the diverting gates;

FIG. 7 is an enlarged perspective view of a single diverting gate actuator;

FIG. 8 is an enlarged view of a timing mechanism with parts separated to better illustrate the electrical mechanism;

FIG. 9a and b are an electrical schematic of the subject invention.

Referring now to FIG. 1, there is shown an embodiment of the modular sheet distributor 100 which includes a plurality of catch trays 110 for holding sheet material which has been delivered to the catch trays. The modular sheet distributors 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 or the end plate 400 is positioned adjacent the modular unit to complete a sheet transport for distributing the sheets to the terminal modular unit.

As shown in the drawings the modular sheet distributor 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 112 at the lower end of 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 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 is biased against the lateral portion of its adjacent support plate 113 by means of spring tabs 116 secured to the guide fingers and engaging the bottom of the lateral portion of the support plate as seen in FIG. 4.

As shown in the drawings, especially FIG. 3, sheet material is distributed to the catch trays by means of a plurality of drive feed rolls 121 secured in spaced rela-

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tion between 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 provided with an undercut surface portion in cooperative relationship with gates 131 of the diverting mechanisms 130 which divert 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 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 novel configuration of the drive belt, as shown in FIG. 3, 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.

The diverting mechanism 130 which include a series of gates 131 secured to a gate shaft 132 are journaled for rotational movement in 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 adjacent to the path of paper movement when the gates are out of deflecting position. When the diverting mechanisms are actuated as hereinafter described, the shaft 132 is rotated to raise 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.

As the sheet material is forwarded by means of the drive feed rollers cooperating with idler rollers to be hereinafter described, the diverting mechanisms 130 are sequentially actuated to divert the sheet material into the appropriate catch trays by means of a cam bank 150 each cam 151 controlling the rotational movement of a single diverting mechanism to move the flat portion of the gate, adjacent the path of paper movement, out from the recessed portion of the stepped drive rolls and into interference with the path of paper movement. The cam support shaft 153, as shown in FIG. 6, is supported at its uppermost end in a bracket 154 secured to the rear frame plate 103 and having a bearing portion mounted therein for rotational movement of the cam support shaft driven by means of a stepping motor B-3 secured to the rear frame plate by means of a bracket 149 and connected to the cam support shaft. The cams 151, each having a rise portion 152 are positioned on the cam support shaft whereby rotation of the cam shaft will cause the rise portions to pass a given point in a predetermined sequence. This sequential stepping of the rise portion of the cam will sequentially actuate the diverting mechanisms by means of the rise portions 152 of the cams oscillating a trip lever 155 having a bifurcated end portion engaging the cam surface as seen in FIG. 6. Each diverting mechanism 130 has a trip lever secured to the end of the gate shaft to be sequentially actuated whereby the gates will be moved into interference relation with a sheet passing between the drive feed rollers 121 and idler rolls 161 to thereby deflect the sheet into the appropriate catch tray.

As seen in FIG. 6, the cam support shaft 153 has secured to its lower end a control sprocket 156 having an upper and lower portion to control the actuation of limit switches LS-11 and LS-12, respectively. The limit switches are mounted in cooperative relationship with the control sprocket 156 by means of a bracket 157 secured to the rear frame plate and perform a function to be hereinafter described in detail.

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To complete a paper transport for delivering sheet material to the appropriate catch tray when one modular unit is placed in cooperative relation with another modular sheet distributor or a sheet distributor such as disclosed in copending application Ser. No. 574,990 filed Aug. 25, 1966 in the name of J. E. Britt et al., there is provided a plurality of idler rollers 161 supported by 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 counter clockwise direction, as seen in FIG. 3, to be held in slight pressure contact with the drive feed rollers 121 of another modular distributor 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 brackets 166 secured to the transport and right-hand frame plate 106.

An end plate 400 is provided to complete a sheet transport adjacent the terminal sheet distributor section. An idler transport such as idler transport 160 is supported on 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. Suitable mechanical connectors such as bayonets are secured to end plate 400 to mechanically interlock with suitable receptacles of the type shown in FIG. 2, for securing the end plate to the terminal section to complete a unitary distributing machine.

A plurality of parallel guide rails 164 are secured to and positioned on the transport frame 165 such that when the sheet distributor module is placed in cooperative relation with another sheet distributor module, the path of sheet travel formed thereby will be adjacent the guide rails 164 between the idler rollers 161 and the drive feed rolls 121. With a pair of sheet distributor modules 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 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 the drawings, sheet material passes across the top of the sorter module by means of a horizontal transport 170 and down adjacent left-hand frame plate 107 into the appropriate catch tray. To facilitate the removal of occasional sheet material jams, the horizontal transport 170 is supported at one side by a pivot rod 171 mounted on the rear frame plate 103 by means of brackets 172 appropriately secured thereto, to enable the transport to be pivoted out of cooperative relation with the drive feed rolls 121 as best shown in FIG. 2, thereby enabling sheet material jams to be cleared from this section of the sheet distributor module with extreme ease. The horizontal idler transport is formed with a base plate 173 having parallel guide rails 164 secured thereto and positioned in cooperative relation with gates of a diverting mechanism 130' to perform the same function as heretofore described. A plurality of tie rods are secured in upturned portions of the transport frame and support a plurality of 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. 5, 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 modular sheet distributors to be assembled into a unitary sheet distributing machine suitable mechanical connecting devices such as bayonets 137

and receptacles 139, and hook 138 are secured to the modules to correctly align the modules and retain them in cooperating relation. A diverting mechanism 130' is similar in construction to the diverting mechanism 130, is positioned adjacent the left end of the horizontal transport 170 to control delivery of sheet material to the catch trays of the sorter module in which the diverting mechanism is contained or to pass the sheet material to an adjoining module for distribution therein.

In order to divert the sheet material passing through the horizontal transport into the vertical transport formed by the cooperating modular units for delivery into the appropriate copy catch tray, the gates of the diverting mechanisms are rotated whereby the concave surface will be in interference with the path of paper movement. If it is desired to distribute the sheet material to an adjoining module, the cam support 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 module.

To facilitate movement of one sorter module into cooperative relationship with another sorter module and to facilitate the removal of sheet material jams occasionally occurring in the vertical transport formed by the cooperating modules, there is provided a dolly 180 secured to the front and rear frame plates 102 and 103 and right-hand frame plate 106 as by welding and to the left-hand frame plate 107 by means of a bracket thereby allowing the sheet distributor module to be readily movable. The dolly 180 is provided with three shafts 181 passing through upturned portions of the frame plate 182 and having roller wheels 183 journaled for rotation upon the ends of each of the three shafts. A trackway 190 having vertically adjustable leveling feet is provided to engage the rollers 183 of the dolly whereby the sheet distributor module may be moved into cooperative relation with another module to form a unitary sheet distributing machine or out of cooperative relationship for removal of sheet material jams occurring in the vertical transport formed by the cooperating modules. As can be seen from the drawings, the modularity of the units permits a module, and, consequently, supplemental sheet guiding means in the form of idler rolls 161 to be moved into cooperation with sheet transport rollers 121 on the first side of a basic module to form a sheet feed path therebetween. In like manner, the movement of another module into cooperation with the basic module may cause supplemental sheet transport means in the nature of rollers 121 to be brought into cooperation with sheet guiding idler rolls 161 on the opposite side of the basic module to form another sheet feed path therebetween.

Machine operations

To begin the sorting operation, the sheet distributor programmer M-2 is set to collect the desired number of sheets in as many catch trays of the distributor as desired. For example, assume that twenty booklets are to be made, each booklet containing 100 pages. The sheet distributor 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. An operator places an original document to be reproduced on the platen 22, closes the cover 21, programs the reproducing machine for the desired 20 copies of the original document through the machine programmer, depresses the sort button S-1 on the distributor

programmer M-2 and dials the appropriate number of documents to be sorted in the sheet distributor on the distributor programmer M-2. The machine is now in readiness for completely automatic reproduction and sorting of the 20 copies of the original document. The operator then begins machine operation by depressing the start button of the reproducing machine which applies power throughout the machine and to line 47 of the sheet distributor. Although for convenience of illustration, the distributor is 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 to start the distributor.

The power to line 47 energizes relay K-1 through normally closed relay contacts K-19(1A). Energization of K-1 relay closes K-1(1) contact to apply power through all the interlocks, 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) which are two jam detection contacts for two different modes of sheet material jams which may occur in the distributor.

With the power so provided memory wheel drive motor B-1 is energized to continuously rotate the memory wheel 300 which performs a function to be hereinafter described in detail.

Sequential stepping of the diverting mechanisms is controlled by means of a photosensor CR1 secured to a tie plate between front and rear frame plates 102 and 103 respectively, and a light source DS-2 appropriately secured to left-hand frame plate 107 and directing a light beam through openings in the catch trays 110 into the photosensor whereby passage of sheet material into the copy catch trays 110 will interrupt the light beam and effect a sequential stepping of the diverting mechanism to direct the next sheet material into the adjacent catch tray. Since the light source DS-2 requires a finite time to attain brightness and the indexing of the diverting mechanisms is actuated by the trailing edge of the sheet material as it passes into the copy catch trays, to ensure proper delivery of the sheet material into a copy catch tray, a time delay is provided to prevent false indexing. When the sheet material is delivered into a catch tray the sensor again sees light and indexes motor B-3 one step to move the next diverting mechanism into interference relationship with the paper path. Thus if you applied power immediately through line 6 to relay K-15 it would appear to the system that the photosensor is being remade, as if sheet material has passed into a copy catch tray, and indexing would occur resulting in the diverting mechanisms being stepped. Therefore, to prevent this immediate energization of relay K-15, a time delay is provided through resistor R-5 and capacitor C-5 to prevent the immediate energization of line 62 which applies power to relay K-10 in the catch tray portion of the distributor and controls indexing of the diverting mechanisms.

To prevent relay K-10 from energizing when the light is on, a normally closed contact of relay K-12 is provided in series with relay K-10. When the light DS-2 has reached the proper intensity relay K-12 is energized closing normally opened contacts K-12(2) and opening normally closed contacts K-12(1), thereby placing the index motor B-3 and the paper jam timing control relay K-11 in a stand-by condition.

As previously explained, the power is provided to line 14 and the photosensor lamp transformer T-1 is energized immediately putting power to the lamp DS-2 which directs the light beam through openings in the copy catch trays into the photosensor which controls sequential indexing of the diverting mechanisms 130. Upon the light

beam reaching sufficient intensity relay K-12 is energized opening normally closed contacts K-12(3) to prevent the energization of relay K-10 which could cause a false indexing of the diverting mechanisms. At this point in time the sheet distributor is ready to accept the first sheet material for distribution therein.

As the sheet material is fed into the distributor the sheet contacts the actuator arm of count switch LS-7 positioned at the initial entry point to the distributor 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 jam control relay K-17 which is held energized through normally closed contact M-2(2) and the normally open contact K-17(1) which is closed by energization of relay K-17, and 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, normally open contacts K-17(2) close supplying power through normally closed contacts K-9(1) to the jam detection controller timer M-6, and 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.

In the event that a paper jam occurs in a modulator unit at the time other sheet material is passing through the transition portion and the reproducing or printing mechanism used in cooperation with the sheet distributor is still processing sheet material for distribution in the sheet distributor, a time delay is provided to allow the sheet material to clear count switch LS-7. To prevent sheet material from stopping at the interface between the sheet distributor and the reproducing machine when relay K-16 is energized, normally closed contact K-16(3), in series with K-9 relay, opens to prevent power from flowing in line 29 to energize relay K-9. This provides a time delay sufficient for the sheet material to move on into the distributor thereby allowing limit switch LS-7 to again open de-energizing relay K-16 so that the contacts K-16(3) will close supplying power to relays K-8 and K-9 to shut down the sheet distributor.

In addition, when a sheet closes limit switch LS-7 thereby energizing relay K-16, normally open contacts K-16(2) are closed to actuate the distributor count-down programmer M-2. The programmer M-2 for the sheet distributor counts the number of sheets passed into the distributor to achieve coincidence of the number of copies programmed into the programmer between terminals 36 and 75. When the number of counts received by the programmer is coincident with the number of sheets desired to be sorted, as indicated on the programmer M-2, a relay inside the programmer energizes, opening normally closed contact M-2(1) to de-actuate an overflow solenoid L-1 which allows the diverting mechanism 230 to direct further copies emerging from the reproducing machine into the overflow or catch bin 210. The overflow solenoid remains de-energized through open contacts M-2(1) thereby holding the diverting mechanism 230

in interference with the path of paper movement directing the sheet material into the catch bin 210 until such time as coincidence is reached in the reproducing machine programmer indicating that the required number of copies have been reproduced. When coincidence is reached the sorter reset mechanism, hereinafter described in detail, is activated which, after a time delay sufficient to let the last copy produced clear limit switch LS-7 at the interface, reset programmer M-2 to thereby again close contacts M-2(1) energizing the solenoid L-1 and allowing the diverting mechanism 230 to be moved back out of interference with the paper path, and normally closed contacts M-2(2) to again close re-instating the power path to jam control relay K-17. M-2(2) contacts are included in the power path to relay K-17 to prevent a false indication of a paper jam which would occur while sheet material is being diverted into the copy catch bin 210. Because the copy contacts the actuator of normally open limit switch LS-7 before entering the copy catch bin, relay K-17 would be energized, which would energize jam detection controller M-6. M-6 would then terminate operation of the sheet distributor since sheet material is being diverted into the catch bin and will not contact limit switch LS-8 to de-energize the jam controller M-6. Therefore, without contacts M-2(2) opening the power path to relay K-17 the sheet distributor would be shut down as a false sheet material jam would be indicated.

When sheet material is being passed to the catch tray portion of the sheet distributor, it contacts limit switch LS-8 closing normally open contacts LS-8A which energizes jam timing control relay K-11 which is held energized through its own contact K-11(1) and either of the normally closed contacts K-12(1) or K-10(1) which will be further described with reference to indexing of the diverting mechanisms 130. When the sheet material is passed from the sheet distributor 200 to a sheet distributor module 100 after contacting limit switch LS-8 on the catch tray portion of the sheet distributor, it must proceed further and contact limit switch LS-8 on the sheet distributor module in order to drop out jam control relay K-11 and reset the jam detection. When jam control relay K-11 is energized by contact of the sheet material with limit switch LS-8 on the catch tray portion of the sheet distributor, the relay closes normally open contacts K-11(2) which supply power to the jam detection controller timer M-5. If the sheet material is jammed without contacting limit switch LS-8 on an adjoining module, K-11 will remain energized and through the closed contact K-11(2) the jam detection controller timer M-5 will proceed through its timing cycle and terminate machine operation. However, if the sheet material proceeds to the adjoining sheet distributor module and contacts limit switch LS-8 on that module the relay K-11 will be de-energized opening the relay contacts K-11(2) and de-energizing the jam detection controller timer M-5 through the normally closed contacts K-11(3).

In the event the sheet material is to be distributed within the sheet distributor 200 without passing to a sheet distributor module 100 and, thereby, contacting the limit switch LS-8 on that module, the sheet material must interrupt the light beam projecting into the photosensor to prevent the jam detection controller timer M-5 from again terminating operation. As the sheet material is passed to the sheet distributor for distribution therein, it contacts limit switch LS-8 which energizes the jam timing control relay K-11 thereby providing power to jam detection controller timer M-5. When the light beam to the photosensor DS-2 is interrupted, upon its reactivation, which indicates that the sheet material has completely passed into a catch tray 110, normally closed contacts K-10(1) and K-12(1) will be opened dropping out relay K-11 which opens normally closed contacts K-11(2) removing power from M-5 and closing K-11(3) contact which discharges the capacitor in the timer M-5 thus

making it ready to time the next sheet of paper entering the module.

The sequential stepping of the diverting mechanisms 130 and 130' is controlled by limit switches LS-11 and LS-12 actuated by the sprocket 156 secured to the lower portion of the cam support shaft 153. The portion of the control sprocket contacting limit switch LS-11 has one detent in its circumferential surface to indicate the reset position, No. 1. When the actuator of the limit switch LS-11 is extended into the detent, the limit switch is open and therefore, at all other times during the stepping of the control sprocket 156 the contacts of limit switch LS-11 are closed. The portion of the control sprocket 156 which is contacted by the actuator of limit switch LS-12 has a detent in its circumferential surface every 30° of the sprockets 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 module.

In the No. 1 position for the beginning of a sorting program, the actuator of limit switch LS-11 is positioned in the detent of its appropriate portion of the control sprocket 156 and the actuator of limit switch LS-12 is positioned in an adjoining detent. At the start of the distributing program, due to the positioning of the cams 151 and 151' on the support 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 will be diverted by the diverting mechanism 131' into the vertical transport to be delivered to the first copy catch tray 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. 7 but positioned in a reverse manner on the shaft 153 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 shaft is rotated sufficiently for the bifurcated lever arm 155' to fall into the drop portion 152'. This movement of the diverting mechanism 131' out of the path of paper movement occurs at the point in time when all of the diverting mechanisms 130 have been sequentially actuated to deliver a sheet material into an appropriate catch tray. This movement is controlled by positioning the cams on the cam shaft 153 in a sequential order whereby each cam will pass a predetermined point at a predetermined time as previously discussed.

To index the diverting mechanism to sequentially divert the sheet material into the appropriate catch tray, a pulse is provided to the index motor B-3 through contacts K10-2 and K12-2 causing the motor to move the control sprocket sufficiently to close limit switch LS-12 causing relay K-21 to energize providing a power path through limit switch LS-12, LS-11, and closed relay contacts K-21(1) directly to the index motor B-3 which rotates the cam support shaft 153 until the actuator of limit switch LS-12 falls into the next detent of the control sprocket and is opened disconnecting power from the index motor. Therefore whenever the trail edge of the sheet material goes through the light beam projecting to the photocell CR-1 normally open contacts K-12(2) and K-10(2) are closed supplying power to the index motor. The power to the motor is then terminated upon the actuator of limit switch LS-12 falling into the next detent of the control sprocket. Normally closed contacts K-12(1) and K-10(1) are opened to de-energize the jam timing control relay K-11 to prevent energization of the jam detection controller timer M-5 which would effect machine shut down as previously described. When sheet material breaks the light beam projecting into the photosensor CR1, light sensor control relay K-12 immediately de-energizes opening the closed contacts K-12(2) and closing contact K-12(3) connected in se-

ries 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) 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 energize the index motor B-3.

This stepping procedure continues until such time as programmer M-2 reaches coincidence at which time the sheet distributor and modules are reset. After the sheet material has been delivered to the last copy catch tray in the sheet distributor 200, the index motor is stepped once more to rotate the cam shaft 153. In this last movement, the diverting mechanism 130' is rotated out of interference with the path of paper movement by the strip lever 155' falling into the drop portion 152' of the cam 151'. Since the index motor B-3 will not step until the light beam from DS-2 into photosensor CR-1 is broken and remade, the cam shaft 153 will not be rotated and the diverting gate 130' will remain out of interference with the path of paper movement allowing the sheet material to pass to the sheet distributor module 100.

When the sheet material enters the modular unit 100, the first sheet will be passed into the first copy catch bin due to the diverting mechanism 130' and the first diverting mechanism 130 being in interference with the path of paper movement at the initial or reset position. The interrupting and remaking of the light beam DS-2 into the photosensor CR-1 of the sheet distributor module will cause the index motor B-3 of the module to step under the same control as previously described with reference to the sheet distributor 200. This procedure continues with regard to additional modules until such time as the programmer M-2 reaches coincidence and the sheet distributor and modular units are reset by the memory wheel 300.

To provide for occasional paper jams occurring in the transition portion of the sheet distributor, the previously described jam detection controller timer M-6 is provided to close normally open contact M-6 thereby energizing jam control relay K-19. Upon energization of jam control relay K-19 normally closed contacts K-19(3B) open which removes power from all drives, and contacts K-19(3A) close to energize DS-3 indicator lamp to indicate that a jam has occurred in the sheet distributor. Normally closed contacts K-19(1A) open to isolate the power lines of the reproducing machine from the sheet distributor, and relay contacts K-19(1B) close shorting the power lines 47 and 174 together which indicate to the reproducing machine that a jam has occurred and to begin machine shut down. In the sheet distributor, power line 6, relays K-2, and relay K-20 remain energized and the jam indicator light DS-3 remains on until the sorter interlock is broken. When an interlock is broken the main power relays K-2 and K-20, the jam detection controller timer M-6, relay K-19 and the light actuated photosensor CR1, are deenergized and the jam detection mechanism is again reset. Only the sorter on-off control relay K-18 and the indicator lights of the programmer M-2 remain energized. Upon the clearing of the jam and the restarting of the machine the sheet distributor will again continue to function until coincidence is reached in the programmer M-2.

In the event that a paper jam occurs in a sheet distributor module, as previously described, the jam detection controller timer M-5 will be energized to energize line 29 for actuating jam control relays K-8 and K-9, and contact M-5 of the appropriate sheet distributor module which actuates jam indicator light DS-3 to indicate a

paper jam has occurred. The energization of jam control relays K-8 and K-9 causes their appropriate contacts to be actuated thereby accomplishing the sheet distributor shut down provided that sheet material is not holding limit switch LS-7 in a closed position, as previously stated, in which case the sheet distributor will function as hereinafter described. Upon energization of jam control relays K-8 and K-9, K-9(3) contacts open which stop the drive mechanisms and K-9(2) contacts open to immediately remove power from the overflow solenoid L-1 so that the diverting mechanism 230 will be moved into interference relationship with the path of paper movement to divert all additional sheet material into the catch bin 210. In addition line 6 remains energized and therefore, jam control relay contact K-9(1) is put in series with the power line to jam detection controller timer M-6 to be opened by the actuation of jam control relay K-9 for preventing the controller M-6 from indicating a paper jam has occurred in the transition portion of the sheet distributor when in actuality it has occurred in a sheet distributor module.

The contacts of jam control relay K-8 are actuated whereby normally closed contact K-8(3) opens to remove power from line 14 which is the power line for all the index mechanisms and control components. Contacts K-8(1A) close shorting power line 19 and 135 to indicate to the reproducing mechanism that a jam has occurred and to retain the count of the number of copies reproduced. When the paper jam is cleared the reproducing machine may again continue to reproduce copies of an original document until the reproducing machine programmer has reached coincidence indicating that the desired copies have been reproduced. Relay contact K-8(1B) opens to isolate this circuit from the sheet distributor in the same manner as relay contact K-19(1A) previously described, and relay contact K-8(2A) closes to short power lines 47 and 108 together which causes the reproducing machine to complete the reproducing cycle and to shut down while retaining its count of the number of copies reproduced. With a jam occurring, M-5 contacts will remain closed energizing the jam indicator lamp DS-3 which will remain energized until an interlock is broken thereby preventing further operation of either the reproducing machine or the sheet distributor.

In the event of a shut down of the reproducing machine, lines 108 and 19 are energized which through line 15 actuate the memory wheel solenoid L-2 and energize memory wheel control relay K-14 through diode CR-4, resistor R-4 and capacitor C-4 to provide a finite time delay before energization of relay K-14. Therefore, after the time delay has occurred relay K-14 will energize opening the normally closed contacts K-14 and disconnecting the power source from the memory wheel solenoid L-2. This momentary de-energization of the solenoid effects the punching out of pins 302 on the memory wheel to actuate the limit switches positioned adjacent the rotating pins of the memory wheel.

The memory wheel 300 is used for both resetting and terminating operation of the sheet distributor mechanism. In some situations it is desirable to terminate operation of the sheet distributor such as in the case of a malfunction in the reproducing machine, but not to reset the mechanism for a new run. However, when the number of copies being reproduced of the original document has been reached, it is desired to terminate operation of the sheet distributor and to reset it for the beginning of another program. Therefore, control relay K-3 is provided to be energized when it is desired merely to terminate operation of the sheet distributor without resetting the distributor for a new program. To this end, 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 programmer 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. However, it does not interrupt the power to limit switch LS-6 which controls the termination of the sheet distributor operation and therefore when the pins 302 of the memory wheel 300 contact normally closed limit switch LS-6, the switch opens and causes the sheet distributor to terminate operation. Therefore, upon restarting the reproducing mechanism and the sheet distributor, the distributor is 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, line 108 is energized actuating the memory wheel solenoid L-2 and moving the pins 302 into actuating position whereby they will actuate the limit switches LS-1 through LS-6 to reset the sheet distributor and terminate operation. Therefore, the only way in which the sheet distributor may be reset is upon a coincidence signal through line 108 indicating that the reproducing mechanism with which it is utilized has reached coincidence, that is the number of reproductions of an original document has been reached. Actuation of limit switch LS-1 energizes reset control relay K-5 to reset the distributor. Next, limit switch LS-2 is actuated to close the reset path for the programmer M-2 resetting the programmer 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 resetting to position No. 1 is accomplished by power being supplied through limit switch LS-11 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-11 is de-actuated by means of its actuator moving into the detent on the sprocket 156. Limit switch LS-4 energizes the reset relay K-6 for all sheet distributor modules to reset each module by applying power through LS-11 in each module to drive each index motor B-3 until LS-11 is de-actuated.

Limit switch LS-5 is energized closing contact LS-5A to energize sheet distributor delay shut down control relay K-13, and LS-5B contacts open to de-energize reset control relay K-5 which was previously energized through limit switch LS-1, thereby insuring that enough time elapses prior to sheet distributor shut down to allow the last sheet emerging from the reproducing machine to arrive at its predetermined destination. The last limit switch on the memory wheel to be actuated is LS-6 which is actuated after operation of the reproducing machine is terminated. At this time the only power path left to the sheet distributor is through limit switch LS-6 and K-2(1) contact. Therefore, when limit switch LS-6 is actuated it de-energizes relay K-2 and terminates all power to the sheet distributor except power to relay K-18 and the programmer M-2 thereby leaving the sheet distributor in a stand-by condition for another program.

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 modular sheet distributor adapted for combination with other like modular units for use in a unitary sheet distributing machine comprising
 - a plurality of catch trays supported in spaced relation to each other,
 - first transport means for transporting sheet material through the sheet distributor,
 - second transport means for transporting sheet material from a location adjacent said first transport means to a position adjacent said plurality of catch trays,
 - selectively actuatable diverting means adjacent said first

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transport means and said second transport means for directing sheet material from said first transport means to exterior of the device or along said second transport means,

diverting mechanisms positioned adjacent said catch trays actuable into and from interference relationship with sheet material passed adjacent thereto to divert said sheet material into one of said catch trays, means to selectively actuate said diverting mechanisms into and from interference relationship with sheet material passed adjacent thereto in response to a control signal actuated by sheet material passed into said catch tray, and

means to connect a second modular sheet distributor into operative relationship adjacent said second transport means to thereby present sheet guiding means which, together with said second transport means, form a path of sheet material movement from said diverting means to said catch trays for the delivery of sheet material thereto.

2. The apparatus of claim 1 wherein said means to selectively actuate said diverting mechanisms comprises a plurality of cam members carried in operative relationship with said diverting mechanisms on a rotatable support shaft,

said cam members each having a dwell portion and an actuating portion and positioned on said support shaft such that said actuating portions will pass a predetermined point at a predetermined time as said support shaft is rotated in response to said control signal.

3. The apparatus of claim 1 wherein said diverting mechanisms comprise

a plurality of gates carried by a rotatable support shaft adjacent the entrance to said catch trays,

said gates including a flat portion and a concave portion, and

a bifurcated lever secured to said support shaft and operatively connected to said selective actuating means for moving said flat portion of said gates from a position adjacent said path of sheet material movement into a position wherein said concave portion of said gate is in interference relationship with said path of sheet material movement to divert sheet material into a predetermined catch tray.

4. The apparatus of claim 1 wherein said means to selectively actuate said diverting mechanisms into and from interference relationship with sheet material passed adjacent thereto is controlled by an electrical circuit including a photoelectric sensor responsive to the trailing edge of sheet material passed into said catch trays.

5. A modular sheet distributor adapted to be utilized in combination with like modular sheet distributors to form a larger capacity unitary sheet distributing machine including

a plurality of catch trays carried by a support member in spaced relation to each other,

sheet diverting means carried by the support member, transport means to move sheet material along a first sheet feed path to a position adjacent said sheet diverting means,

a plurality of diverting mechanisms rotatably supported by said support member and positioned adjacent said catch trays to divert sheet material thereto,

a sheet transport section carried by said support member and positioned adjacent said diverting mechanisms and said catch trays comprising, when used in

cooperation with supplemental sheet guiding means, one portion of a second sheet feed path to forward sheet material from said diverting means past said diverting mechanisms into said catch trays, and

a sheet guiding section carried by said support member on a side opposite said sheet transport section and positioned on said support member to comprise, when used in cooperation with supplemental sheet transport means, one portion of a third sheet feed path.

6. A modular sheet distributor capable of use with like sheet distributors including

a sheet input station for the reception of sheet material from exterior thereof,

a sheet output station for the discharge of sheet material to exterior thereof,

first sheet transport means to move sheet material along a first sheet feed path from said input station to said output station,

first sheet diverting means operatively positioned adjacent said first sheet feed path and also being operatively positioned adjacent a second sheet feed path,

means to selectively actuate said first sheet diverting means into and out of interference relationship with sheet material moved along said first sheet feed path to thereby selectively permit such moved sheet material to move to said sheet output station or along the second sheet feed path,

a plurality of catch trays supported in spaced relation to each other along the second sheet feed path,

a sheet transport section adjacent said first sheet diverting means and said catch trays comprising, when used in cooperation with supplemental sheet guiding means, one portion of the second sheet feed path,

a sheet guiding section on a side of the sheet distributor opposite from said sheet transport section comprising, when used in cooperation with supplemental sheet transport means, one portion of a third sheet feed path,

a plurality of second sheet diverting means located adjacent said catch trays and adjacent the second sheet feed path, and

means to selectively actuate said second sheet diverting means into and out of interference relationship with sheet material moved along the second sheet feed path to thereby selectively permit the directing of a sheet into one of said catch trays.

7. A sheet distributor as set forth in claim 6 wherein each of said catch trays has a second sheet diverting means in association therewith and further including a supplemental catch tray at the end of the second sheet feed path remote from said first sheet diverting means to receive sheet material moved along the second sheet feed path which is not directed by one of said second diverting means into an associated catch tray.

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