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(54) **Method of and apparatus for collating sheets.**

(57) An offset collator comprises a sheet gripper/injector transport station (12), an oscillating sheet receiving station (14) and an offset stapling station (16). Copy sheets from an associated copier or like machine are transported to the station (12) in a specified sequence whereupon they are gripped by gripper/injector devices (36 and 38), and, in a reciprocating motion, inserted into a bin (100) of the station (14) where they are released. The bin (100) is oscillated in synchronism with the reciprocation of the devices (36 and 38), so that the copy sheets are inserted in an alternate offset posture. A logic control system causes the sheets of sets to be offset collated to be inserted between prior-inserted sheets of sets in the bin in proper order so that offset collation is effected. After offset collation is completed, the gripper/injector devices are dissociated from the oscillation of the bin. The offset stapling station then cooperates with the oscillating bin so that the offset collated sets, still in their offset posture, are stapled in the same order that the sets were formed. After offset stapling, the sets are maintained in the bin in their alternate offset posture completely finished and ready for convenient removal by an operator.

In the case of offset sorting, oscillation of the bin is selectively terminated so that the bin receives all sheets of a job in one posture. It stays in this posture until all the sheets corresponding to this particular sorting job are inserted. Then the bin is oscillated to an opposite or alternate offset posture. The bin remains in this posture until all the copy sheets corresponding to this next sorting job are inserted in the bin. In this manner, with the intermittent oscillatory movement of the sheet receiving bin, different jobs can be sorted using the apparatus.

If offset stapling of the sorted jobs is required, the same procedure as for the stapling of the offset collated sets is carried out by the apparatus, so that in either case finished sets or jobs are ready for convenient removal by an operator.

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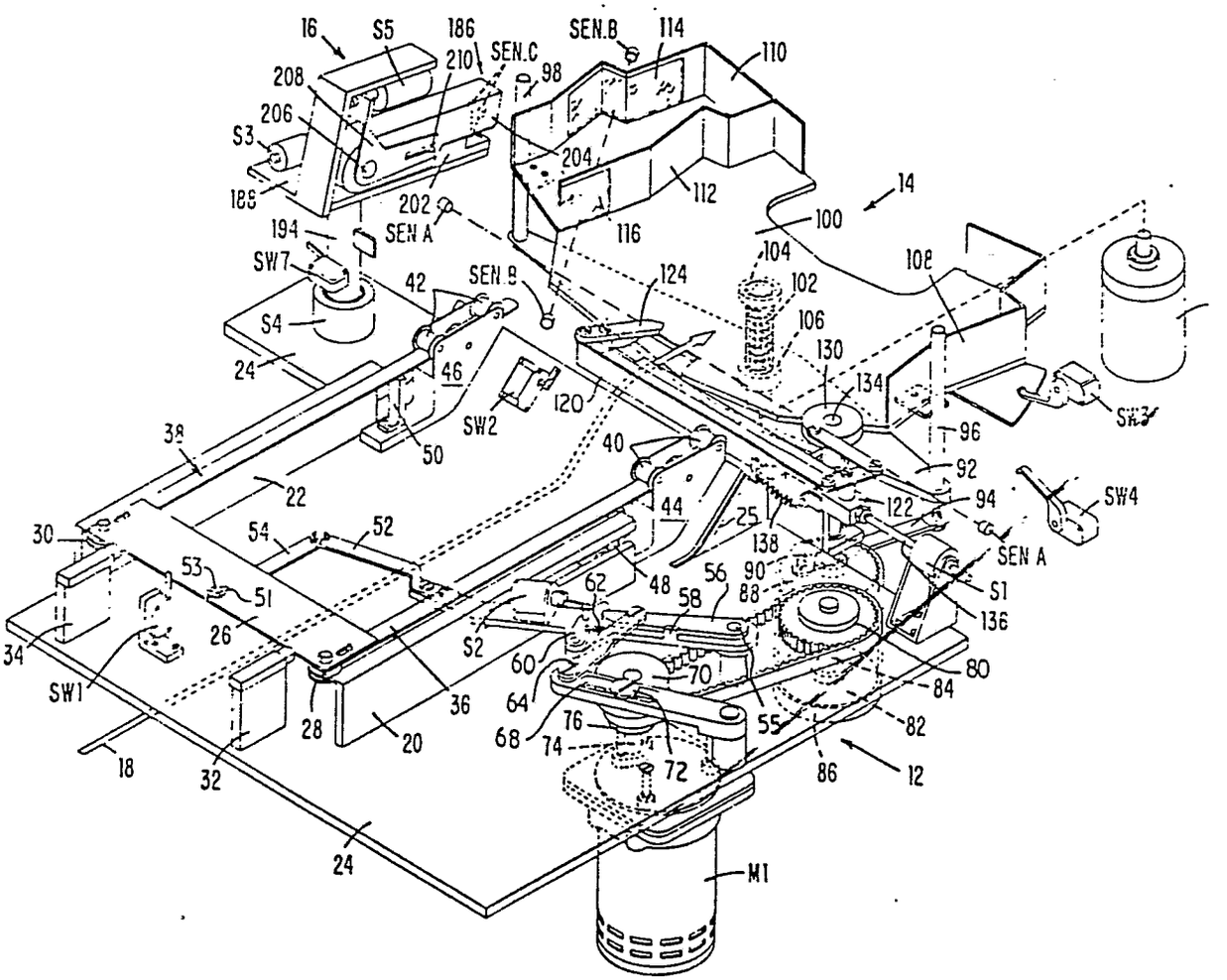
Croydon Printing Company Ltd.

FIG. 1


16
S5
186
SEN.C
210
208
206
S3
188
98
SEN.B
114
110
204
112
14
100
202
SEN A
116
194
SW7
42
SEN B
124
104
102
108
106
130
134
S4
24
46
SW2
120
SW3
96
38
40
92
22
50
44
122
94
SW4
30
54
52
25
138
SEN A
53
51
62
48
56
90
88
S1
136
26
58
34
S2
60
70
80
SW1
64
84
36
76
55
82
28
20
68
74
72
86
12
18
32
24
M1

METHOD OF AND APPARATUS FOR COLLATING SHEETS

This invention relates to methods of and apparatus for collating sheets.

A method of and apparatus for collating sheets has been disclosed in EP-0002317. In particular, there is disclosed and claimed apparatus for collating sets of sheets, which are received serially in groups of similar sheets, comprising means to stack the sheets of the first group received in individually offset fashion, thus demarcating each first sheet from adjacent first sheets, and means to insert individual sheets of the next group in the same offset fashion contiguous to individual first sheets and to insert, if necessary, individual sheets of subsequent groups in the same offset fashion contiguous to individual prior inserted sheets of the same set to form collated sets of sheets. There is also disclosed and claimed a method of collating sets of sheets, which are received serially in groups of similar sheets, comprising the steps of stacking the sheets of the first group received in individually offset fashion, thus demarcating each first sheet from adjacent first sheets, and inserting individual sheets of the next group in the same offset fashion contiguous to individual first sheets, and thereafter inserting if necessary, individual sheets of subsequent groups in the same offset fashion contiguous to individual prior-inserted sheets of the same set to form collated sets of sheets.

The size of other conventional collators is directly dependent on the number of discrete bins and the physical dimensions of the bins. Generally, the number of discrete

bins determines the maximum number of sets that can be collated in a particular job. Consequently, the physical dimensions of the discrete bins, characterized by their height, width and depth determine the maximum sheet size that can be processed and the maximum number of sheets per discrete bin.

As there is an overall physical size limitation, the solution in the other prior art machines has been to strike a balance between the maximum number of sets that can be collated in a job and the maximum number of sheets that can comprise a set. Thus, in order to meet the physical size requirements, typical prior art machines have a capacity of about 20 sets comprising 100 sheets each, giving a total sheet capacity of 2,000.

The solution to the physical size problem as disclosed in EP-0002317 was a unibin collator and a method of offset collation so that sheets to be offset collated would be alternately offset from each other in an arcuate transport path and then inserted, in the proper order, into a unibin receiving station. Consequently, this apparatus eliminated the need for discrete bins. Due to the use of a single bin, the offset collation method and an arcuate transport path, the apparatus was smaller in physical size than typical prior art collators, but yet had the same total sheet capacity thereof.

Nevertheless, although the apparatus disclosed provided many improvements over the prior art, there is still a need for an improved offset collator that is small and provides an offset collator that is simpler in operation, more reliable and simpler in construction.

Additionally, in EP-0002317, it was recognized that there are other job requirements that cannot be satisfied by a collator having a plurality of discrete bins. The example given was of a collator having a maximum set capacity of 20 and a maximum sheet capacity of 100 sheets per set still giving a total sheet capacity of 2,000. Although it has been found in practice that seldom will there be the concurrent job requirement of more than 20 sets and more than 100 sheets per set, there are situations where the job will require the number of sets to be more than 20 and the number of sheets to be more than 100 sheets per set. It is clear from this example that a bin collator cannot readily process these jobs in the conventional sense.

Thus, there is a need to eliminate limitations in job flexibility characterized by the number of discrete bins and the sheet capacity of each bin. Consequently, there is a need for collators having job flexibility limited only by the total number of sheets in a job rather than the total number of sets in a job or the total number sheets in a set.

Notwithstanding the foregoing, there is an additional need for job flexibility in the case where offset collation is not required but sorting is required. Collating is the insertion of a copy of an original in each of a plurality of sets. Sorting is the directing of a sheet or sheets to a given place or rank according to kind or class, e.g., by stacking jobs so as to be demarcated from each other. Consequently, there is a need for an apparatus that not only can perform the offset collation method more reliably, but can also, in the same apparatus, perform a sorting operation without loss of speed, reliability or convenience.

Finally, there is an additional need for offset stapling, that is the stapling of offset collated sets or offset sorted jobs such that the offset collated sets or offset sorted jobs are maintained in their proper order and proper offset posture before, during and after the offset stapling process.

Consequently, there is not only a need for an improved offset collator, but also for one that can alternatively operate in an offset sorting mode, as well as an additional need for an offset stapling station to staple the finished offset collated sets or offset sorted jobs, thereby providing completed finished sets or jobs.

Accordingly, the present invention seeks to provide offset collation in an improved manner delivering sheets of sets to be offset collated to a receiving station without prior angular or offset displacement.

The present invention also seeks to further reduce the physical size of collators without compromising the total sheet handling capacity thereof.

The present invention also seeks to incorporate the capability of offset sorting in the improved offset collator.

The present invention also seeks to provide an offset stapler that can be used with offset sets or jobs such that stapling can be effected while maintaining the offset posture of the offset collated sets or offset sorted jobs.

The present invention also seeks to incorporate all the foregoing devices and functions to provide an improved set finisher.

Accordingly, the invention is characterised in that the means to insert sheets transports all sheets in the same disposition relative to a sheet path into a bin for receiving the sheets, which bin is capable of oscillatory motion in a substantially horizontal plane and means to cause oscillation of the bin to effect offset stacking.

The invention extends to a method of collating sets of sheets, which are received serially in groups of similar sheets, comprising the steps of transporting and inserting sheets in the same disposition relative to a sheet path into a bin for receiving the sheets, oscillating the bin in a substantially horizontal plane to stack the sheets of the first group received in individually offset fashion, thus demarcating each first sheet from adjacent first sheets, transporting and inserting individual sheets of the next group in the same disposition contiguous to individual first sheets, oscillating the bin in a substantially horizontal plane to stack the sheets of the next group in the same offset fashion as the sheets of the first group, and thereafter, if necessary, transporting and inserting individual sheets of subsequent groups and oscillating the bin in the same manner, to form collated sets of sheets.

The invention may also extend to an offset stapler apparatus for corner stapling offset sets or jobs of sheets, comprising a movable sheet receiving bin for receiving and maintaining sets or jobs of sheets disposed in alternate offset posture, and an offset stapling station disposed adjacent to one corner of the sheet receiving bin, the bin cooperating with the stapling station such that the first of the sets or jobs is corner stapled and then removed from the stapling station back into the bin, such that the second of

the sets or jobs is corner stapled and then removed from the stapling station into the bin, and such that the additional sets or jobs are corner stapled in sequence and removed in sequence from the stapling station back into the bin, all of the sets or jobs being maintained in their alternate offset posture to each of the prior or subsequent sets or jobs before, during and after offset stapling thereof.

In an embodiment the apparatus operated as an offset collator, the first sheets of sets to be offset collated, numbering up to the desired number of sets in a job, are transported via a sheet gripper/injector transport station having a reciprocating feed path to and from an oscillating sheet receiving station. These first sheets are injected in the oscillating sheet receiving station, in response to its oscillatory motion, in an alternate offset posture clearly demarcating the sets to be offset collated. The second sheets of the aforementioned sets are then sequentially inserted contiguous to the first sheets of their sets. This process is repeated until all the sheets comprising a set have been inserted into all the sets comprising a job. In the offset collation mode, the aforementioned transport station and its reciprocating motion is synchronized with the aforementioned receiving station and its oscillatory motion such that each sheet that is injected into the receiving station is given an alternate offset posture.

When the apparatus is operated as an offset sorter, the sheet gripper/injector transport station coacts with the oscillating sheet receiving station such that the oscillatory motion of the receiving station is not in synchronization with the reciprocating motion of the transport station during the insertion of each sheet. They are in synchronization

before and after the insertion of each job to be sorted. Thus, the sheets of one job are stacked in the receiving station, when it is in one offset posture, one upon the other. Then the second job to be sorted is stacked on top of the first job when the receiving station oscillates to an opposite offset posture. This process is continued until all the jobs to be sorted have been stacked in the receiving station.

After either of the foregoing operations, if stapling is desired to provide completely finished sets or jobs, an offset stapling station cooperates with the oscillating sheet receiving station such that a corner(s) of the offset collated sets or jobs therein is elevated and supported by the offset stapling station. The first set or job is then corner-stapled whereupon a subsequent oscillation of the oscillating sheet receiving station causes the corner of this first set or job to fall back into the oscillating sheet receiving station. This oscillatory motion also causes the second set or job to be positioned properly in the offset stapling station for subsequent stapling. After stapling of this second set or job, the process is repeated until all the sets or jobs have been corner-stapled. The offset stapling method maintains the sets or jobs in their alternate offset posture before, during and after stapling.

The scope of the present invention is defined by the appended claims; and how it can be carried into effect is hereinafter particularly described with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of the apparatus according to the invention;

FIG. 2 is a broken plan from below of part of the apparatus of FIG. 1;

FIG. 3 is a fragmentary section in elevation of part of the device of FIG. 2;

FIG. 4 is a partial view in plan of another part of the apparatus of FIG. 1;

FIG. 5 is a plan view of the apparatus of FIG. 1 with parts in different positions;

FIG. 6 is a partial plan view illustrating the operation of the offset stapling station;

FIG. 7 is a partial perspective view illustrating the method of offset stapling;

FIGS. 8A to 8D, assembled as shown in FIG. 8, form a circuit diagram of the control logic system for apparatus according to the invention;

FIG. 9 is a timing diagram illustrating the sequential operation of the circuit of FIG. 8 in offset collating mode; and

FIG. 10 is a timing diagram illustrating the sequential operation of the circuit of FIG. 8 in offset stapling mode.

A sheet stacking apparatus (FIG. 1) includes a sheet gripper/injector transport station 12, an oscillating sheet receiving station 14 and an offset stapling station 16. The sheets to be offset collated are fed sequentially, i.e., all

the pages one up to the number of sets to be offset collated, then all the pages two and so on, by a sheet feeder associated with an electrophotographic copier or like machine (not shown) along a sheet path 18 to sheet gripper/injector transport station 12.

If the sheets are to be offset sorted, they are fed according to job order rather then sequentially, i.e., all the pages of the first job, then all the pages of the second job and so on. Accordingly, the apparatus, depending on how the sheets are fed thereto, can be operated as an offset collator or an offset sorter clearly demarcating collated sets or sorted jobs and readying them for the subsequent offset stapling operation.

The sheet gripper/injector transport station 12 comprises right and left slide support rails 20 and 22 secured to a main support plate 24. A gripper/injector carrier 26 is slidably attached to the rails 20 and 22 by right and left rail bearing rollers 28 and 30. Right and left rear carrier stops 32 and 34 fixed to the plate 24 and limit movement of the carrier 26 in one direction.

Right and left gripper/injector devices 36 and 38, including blades 150 and 172 (FIG. 2), are operatively attached to carrier 26 and the blades 150 and 172 project parallel to rails 20 and 22 to be received slidably by right and left gripper/injector mounts 44 and 46 and engaged by spaced right and left gripper/injector device bearing rollers 40 and 42. One lower and two spaced upper rollers are rotatably mounted in the mounts 44 and 46. The mounts 40 and 46 are fixed to plate 24. Fixed to the right and left mounts 44 and 46 are right and left front carrier stops 48 and 50,

respectively, which limit the movement of the carrier 26 in the other direction.

Below the main support plate 24 is a guide plate 25 of similar configuration, and the sheet path 18 passes through the space between the plates 24 and 25, below the plate 24. In the region of the mounts 44 and 46, the plates 24 and 25 are upturned at an angle to their main plane.

One end of a gripper/injector carrier drive arm 52 is pivotally connected by a pivot pin 55 to the plate 24 and the other end thereof is pivotally connected to a gripper/injector carrier drive arm link 54 which itself is pivotally connected to the carrier 26 by a link pin 53, riding in a short slot 51. A gripper/injector carrier drive arm interposer 56 is pivotally mounted on the pivot pin 55 on the plate 24 and lies contiguous to a first length of the arm 52. In normal operation, the interposer 56 is latched against a gripper/injector carrier drive arm stop 58 on the arm 52 by a gripper/injector carrier drive arm latch 60 which is pivotally mounted on the arm 52 beyond the end of and to one side of the interposer 56. The latch 60 is biased by latch spring 62 so that the interposer 56 is latched when the transport station 12 is operating in an offset collation or offset sorting mode.

An injector disable solenoid S2 is operatively connected to the latch 60 and may be energised to withdraw the latch 60 against the spring 62 so as to unlatch the interposer 56, during the offset stapling mode.

An interposer drive link 64 operatively connects one end of an interposer drive arm lever 66 to the interposer 56.

The lever 66 at its other end is pivotally mounted on the plate 24. A slot 68 in the lever 66 receives a pin 72 eccentrically mounted on an interposer arm drive wheel 70.

An injector motor M1, mounted below the plate 24, has a shaft 74 which projects through the plate and carries the wheel 70 together with a main drive pulley 76. A drive belt 78 is entrained around the pulley 76 and an upper intermediate pulley 80 secured to an intermediate pulley shaft 84 rotatably mounted in the plate 24. Below the plate 24, the shaft 84 carries a lower intermediate pulley 82. A drive belt 86 is entrained around the pulley 82 and a driven pulley 88 secured to the end of a shaft 134 rotatably mounted in the plate 24.

The link pin 53 (FIG. 2) on the end of link 54 rides in the slot 51 in the carrier 26 and coacts with one arm of a central three-armed bell crank 138 which is pivotally mounted on the carrier 26. The ends of the other arms of the bell crank 138 are connected by bell crank pull links 142 and 164, respectively, to the one arms of right and left gripper/injector three-armed bell cranks 140 and 162. The bell cranks 140 and 162 are pivotally mounted on the carrier 26. Second arms of the bell cranks 140 and 142 are engaged by bias springs 144 and 146, respectively, to bias the bell crank 140 clockwise and the bell cranks 138 and 142 counterclockwise and to engage the one arm of the bell crank 138 against the link pin 53. Third arms of right and left gripper/injector bell cranks 140 and 162 are operatively attached to right and left gripper/injector actuating pins 146 and 168, respectively. The blade 148 is slidably attached to right top gripper/injector blade 150 by three shoulder rivets on the blade 150 riding in slots in the blade

148. The blade 170 is slidably attached to left top gripper/injector blade 172 by three shoulder rivets 174, 176 and 178 on the blade 172 riding in slots in the blade 170. Right bottom gripper/injector blade 148 has at its forward end (FIG. 3) a right bottom gripper/injector jaw 158, which can interengage with a complementary right top gripper/injector jaw 160 on the blade 150. The blade 170 (FIG. 2) has a similar left bottom gripper/injector jaw 180 and the blade 172 has a complementary left top gripper/injector jaw 182.

As shown in FIGS. 2 and 3, when the link 54 pulls the pin 53 to the end of the slot 51, the bias springs 144 and 166 move the linkages so that the bell cranks 138, 140 and 162 are pivoted to slide the blades bottom 148 and 170 on the blades 150 and 172, respectively, to engage the jaws 158 and 160, and 180 and 182, respectively, as shown in FIG. 3. When the link 54 pushes the pin 53 to the other end of the slot 51 (FIG. 1), the jaws are opened, as shown in dotted lines at 184 in FIG. 3. A sheet, fed along sheet path 18, can be inserted in the open jaws and thereafter gripped by closure of the jaws. It is preferred that the right and left gripper/injector devices 36 and 38 operate in concert on the leading edge of a copy sheet, as it is fed from an associated copier or like machine (not shown), with its imaged side face down in the case of simplex copies, or in the case of duplex copies, with the odd numbered pages face down.

The oscillating sheet receiving station 14 (FIG. 1) includes a bin drive plate 92 which is centrally pivoted in the apparatus and at its ends carries right and left bin vertical guide posts 96 and 98. The end carrying the guide post 96 is connected by a bin drive link 94 to a pin 90 eccentrically mounted on the pulley 88.

The oscillating sheet receiving station 14 also includes an oscillating sheet receiving bin 100, which has side brackets engaging the guide posts 96 and 98 and is movable up or down, by rotation of a sheet receiving bin elevation screw 102. The upper end of the screw 102 is mounted rotatably in a bearing 104 secured to the bin 100. The screw threaded portion of the screw 102 is engaged by a nut 106 secured to the plate 92 on a common axis with the pivotal mounting of the plate 92. The screw 106 is rotatable by a tubular portion of the shaft of a bin elevator motor M2, which tubular portion can receive the screw 102.

Rotation of the shaft of the motor M2 in one direction or the other causes the screw 102 to rotate in the nut 106, so that the bin 100 is moved up or down guided by the posts 96 and 98. The screw 102 supports the bin 100 through the bearing 104 at the centre of gravity of the bin, thus allowing it to oscillate in a clockwise or counterclockwise direction with stability.

In order that sheets deposited into the bin 100 are properly injected and maintained in an alternate offset posture, it has fixed thereto a right outside contoured frame 108, a left outside contoured frame 110 and an inside contoured frame 112. Inside contoured frame 112 is removably attached to the bin. The outside contoured frames 108 and 110 allow the bin 100 properly to offset alternate sheets of 215.9 x 355.6 mm (8.5 x 14 inches). Right outside and inside contoured frames 108 and 112 allow the bin 100 properly to offset alternate sheets of 215.9 x 279.4 mm (8.5 x 11 inches). In addition, left outside contoured frame 110 and inside contoured frame 112 have inserted therein windows 114 and 116, respectively.

Oscillating sheet receiving station 14 also includes an oscillating sheet separator/supporter device 118 (FIG. 4), which comprises a fixed mounting bar 120 in which is slidably mounted a support for a slidable mounting bar 122. An oscillating finger 124 is pivotally mounted on the fixed mounting bar 120 and connected by an oscillating finger link 128 to one end of an oscillating lever 126 pivotally mounted in the slidable mounting bar 122. The other end of the lever 126 is connected by a driven cam link 132 to an eccentric pin on a wheel 130 (FIG. 1) secured to the driven shaft 134 which also carrier pulley 88. The slidable mounting bar 122 is secured to a solenoid pluger 136 of a solenoid 51 and is biased away from the fixed founting bar 120 by a compression spring 138.

With the solenoid S12 deactivated, the spring 138 causes the slidable mounting bar 122 to slide away from the fixed mounting bar 120 (FIG. 4) so that the finger 124 is pivoted to a home or F1 position. When the solenoid S1 is activated, the slidable mounting bar 122 is moved towards the fixed mounting bar 120 against the spring 128, so that the finger 124 is moved to one operative or F2 position. From this position, a half revolution of the wheel 130 moves the link 132 to pivot the lever 126 and, through the link 128, the finger 124 to a second operative or F3 position. When the finger 124 is in the home or F1 position, the bin 100 can be moved upwardly or downwardly by elevator motor M2.

The offset stapling station 16 (FIG. 1) includes a stapler device 186 fixed to a stapler position bracket 188. The bracket 188 is carried on a stapler pivot shaft 194, to which it is secured and which is pivotable by actuation of a rotary solenoid S4 mounted on the plate 24. When the solenoid S4 is

activated, the stapler device 186 is pivoted into an operative position shown in full lines in FIG. 6 with the axis of the device on the line 196. When the solenoid S4 is deactivated, the stapler device is pivoted into an inoperative positon shown in full lines in FIG. 5 with the axis of the device on the line 198.

The stapler device 186 (FIG. 1) includes a stapler lower jaw 202 with anvil and a stapler upper jaw 204 with a staple supply, which jaws form an opening sufficient to staple sets or jobs having thicknesses of approximately one hundred sheets. The jaws are operatively connected by a stapler pivot pin 206. A stapler bell crank 208 is pivoted on the pivot pin 206 and one arm engages a pin 210 fixed to upper jaw 204. The other arm of the bell crank is operatively connected to the armature of a stapler solenoid S5 which when activated, pivots the bell crank 208 to operate the jaws of the stapler device 186 to staple a set or job in position between the jaws.

A first set or job catcher 190 is pivotally attached to stapler device 186 alongside the jaws. The armature of a catcher solenoid S3 is connected by a catcher link 192 to the catcher 190. Activation of the solenoid S3 ensures that first set catcher 190 is in the proper position, shown in full lines in FIG. 6, to catch the first set or job at the beginning of the offset stapling process. When offset stapling has begun and the first set or job has been stapled, first set catcher 190 is pivoted by deactivation of the solenoid S3 into a side position shown dotted in FIG. 6. It is held in this side position during the remainder of the offset stapling process, as during non-stapling operation.

The inoperative position (FIGS. 1 and 5) is the normal position of stapler device 186 during the offset collation mode or offset sorting mode of operation. During offset stapling, there are odd and even sets of sheets resting in offset positions in the bin 100, as shown in FIG. 6. The stapler device 186 is in the operative position with the catcher 190 below the corner O of the odd sets and the jaw 204 below the corner N of the even sets. As the bin 100 is oscillated, the corners of the odd and even sets move along a path 200 of travel through the stapler device 186. The travel of the corners of the odd sets or jobs is from O to N and the return path is from N to O. The travel of the corners of the even sets is from M to N and the return path is from N to M. Stapling takes place at N for both odd and even sets or jobs.

A stapler sensor SEN.C is positioned in the stapler device 186 so that it senses the presence between the jaws at position N of the corner of a set or job to be stapled and provides a signal to cause the solenoid S5 to operate to staple the corner of the particular set or job to be stapled. Staple sensor SEN.C, for purposes of the invention, can be a light and photocell combination or a light emitting diode/phototransistor combination, and may use a reflective surface on the lower jaw 202.

An injector home switch SW1 (FIG. 1) is mounted on the plate 24 between the carrier stops 30 and 32, and is disposed to sense when the carrier 26 is in a home position, and, accordingly, when the gripper/injector devices 36 and 38 are in a position to receive sheets fed along the sheet path 18. A sheet path switch SW2 is mounted on the inclined portion of the plate 24 and has a sensing lever extending through an

aperture therein, which is so disposed as to sense when a sheet has been gripped by the gripper/injector devices, and is ready to be injected into the oscillating sheet receiving station 14. A bin up limit switch SW3 and a bin down limit switch SW4 are disposed above and below a bracket extending from the bin 100 to sense the upper and lower limits of the bin to facilitate proper offset collation, offset sorting and offset stapling.

A bin position A switch SW5 (FIG. 5) and a bin position B switch SW6 are disposed on either side of a bracket extending from the bin 100 to sense, respectively, whether the bin is in a counterclockwise A or clockwise B position. The counterclockwise A position is the preferred position for offset collation, offset sorting or offset stapling to begin. A stapler-in-position switch SW7 (FIG. 6) is disposed to be engaged by a bracket on the stapler pivot shaft 194 to sense that stapling device 186 is in an operative position so that offset stapling can begin.

A bin down sensor SEN.A (FIGS. 1 and 5), which can be a light and photocell combination or a light emitting diode/phototransistor combination, is disposed so as to determine that oscillating sheet receiving bin 100, when operating in the offset collation or offset sorting mode, has received approximately twenty-five sheets or an increment thereof. After twenty-five sheets or an increment thereof are received, this sensor operates to cause the bin to be lowered so that offset collation or offset sorting can properly continue. This sensor is also used in carrying out an offset collation home procedure.

A bin down sensor SEN.B, which can be a light and photocell combination or a light emitting diode/phototransistor combination, is disposed so as to determine that the bin 100, when operating in the offset stapling mode, has deposited therein a stapled set or job. If so, this sensor operates to cause the bin to be lowered so that the next set or job can be properly offset stapled.

The apparatus has three modes of operation: the offset collation mode; the offset sorting mode; and the offset stapling mode.

A. The Offset Collation Mode

The general principles of offset collation have been described in EP-0002317, to which reference may be made for further details. Whilst in the present embodiment sheets are inserted by a reciprocating motion of sheet gripper devices, use could be made of a belt, bar and releasable gripper arrangement similar to that shown in EP-002317, without offset of the sheets.

In the present embodiment (FIG. 1) sheets (not shown) of sets to be offset collated are fed sequentially from an associated copier of like machine (not shown) along sheet path 18. This sequential relationship is the feeding of all the pages one of the copy sheets of a multipage document up to the number of sets to be offset collated, the feeding of all the pages two, the feeding of all the pages three, and so on. With the copy sheets fed in this sequential order, the apparatus, according to the invention, automatically performs the offset collation method.

As shown in FIGS. 1 and 5, stapler device 186 is in an inoperative position when offset collation is taking place.

Initially, the carrier 26 is against the stops 32 and 34 (FIG. 1), the switch SW1 is closed and the link 54 pushes the pin 53 to the end of slot 51 to pivot the bell crank 138 (FIG. 2) against the springs 144 and 166 concurrently to pivot the bell cranks 140 and 142. This causes the jaws 158 and 160, and 180 and 182 to open.

The interposer 56 (FIG. 1) is latched to the arm 52, the bin 100 is centralised between its two limit positions of oscillation and below the sheet path 18 between its upper and lower vertical limit positions, and the finger 124 is centred between its F2 and F3 positions, the solenoid S1 being activated.

The first sheet of the first set is fed along the sheet path 18 and as soon as it enters the jaws (FIG. 3) the sheet path switch SW2 is made and the injector motor M1 is energised. This causes the wheel 70 to start rotating and privot the arm 52 about the pin 55. This moves the link 54 and the pin 53 moves to the other end of the slot 51 (FIG. 2), allowing the springs 144 and 166 to pivot the bell cranks 138, 140 and 162 and to slide the bottom blades 148 and 170 on the blades 150 and 172 to close the jaws 158 and 180 upon the jaws 160 and 182 to grip the sheet. Continued rotation of the motor M1 pivots the arm 52 further and the link 54 draws the carrier 26 away from the stops 32 and 34 and the switch SW1, so that the gripper/injector devices 36 and 38 move forward carrying the sheet (not shown) into oscillating sheet receiving station 14.

The motor M1 performs a half revolution during the insertion of the first sheet and this causes a quarter revolution of the pulley 88. This causes the link 94 to pivot the plate 92 and the bin 100 counterclockwise to a bin position A which is sensed by the switch SW5 (FIG. 5). Just before the carrier 26 and gripper/injector devices 36 and 38 reach the full extent of their forward travel, the actuating pins 146 and 168 (FIG. 2) are engaged by the stops 48 and 50 (FIG. 1), respectively, and cause the bell cranks 140 and 162 to pivot against the springs 144 and 166 and the bottom blades 148 and 170 to slide upon the blades 150 and 172 to open the jaws 158 and 160, and 180 and 182 to release the sheet. The sheet drops into the bin 100.

To complete this cycle, the motor M1 continues to rotate causing a withdrawal of the carrier 26 and gripper/injector devices 36 and 38. The actuating pins 146 and 168 (FIG. 2) leave the stops 48 and 50 (FIG. 1) but the jaws do not reclose because the link 54 is pushing the carrier 26 back and the pin 53 is at the end of the slot 51. As the motor M1 completes one revolution, the carrier 26 reaches the stops 32 and 34 and switch SW1. The switch SW1 is made, causing the motor M1 to be de-energised and the link 54 holds the carrier 26 against the stops 32 and 34. During the withdrawal half of the revolution of the motor M1, the pulley 88 is rotated through a quarter revolution to pivot the plate 92 and bin 100 to the central position between bin position A and B switches SW5 and SW6. The gripper jaws are open ready to receive the second copy sheet.

When the second copy sheet, which is page one of the second set, makes sheet path switch SW2, the same process is repeated except that the bin 100 is pivoted in a clockwise direction until bin position B switch SW6 is made. Thus, the second copy sheet is offset from the first copy sheet. The feeding of the copy sheets (pages one) is continued, the odd and even numbered copy sheets being alternately offset as shown in FIG. 6. If, during this feeding, the number of copy sheets in the bin 100 exceeds approximately twenty five, the bin down sensor SEN.A detects this condition and a partial homing procedure is begun. Elevator motor M2 is energised, with the carrier 26 withdrawn, so that the bin 100 is lowered by an increment of approximately twenty five sheets in order that the gripper/injector devices 36 and 38 may clear the sheets that have already been inserted therein.

When all the pages one of the sets comprising a job have been inserted in the bin 100 and the carrier 26 withdrawn, a complete homing procedure is begun. The finger home solenoid S1 is deactivated by a homing signal and causes the finger 124 to rotate to the home or F1 position (FIG. 2). The same homing signal causes elevator motor M2 to rotate to raise the bin 100 until the bin up limit switch SW3 is made. Then, elevator motor M2 reverses its rotation lowering the bin until bin down sensor SEN.A is made. In the mean time the solenoid S1 has been activated causing the finger 124 to pivot back to its position before the start of the complete homing procedure, that is centred between the F2 and F3 positions. Accordingly, as the bin is lowered, the first page one is engaged by the finger 124 and the sheets in the bin are supported by the finger 124. The finger 124 is above the sheet path 18 and below the level of the bin 100 at its up per vertical limit position. In its F3 position, the

finger 124 can support a sheet with its corner in the M position (FIG. 6) but not a sheet with its corner in the O position. In its F2 position, the finger 124 can support a sheet with its corner in the O position, but not a sheet with its corner in the M position. In order that the pulley 88 be correctly positioned to begin a counterclockwise rotation of the plate 92 and bin 100 when the first page two arrives, if the last page one is an odd sheet, the motor M1 is rotated one revolution. If the last page one is an even sheet, there is no need.

When bin down sensor SEN.A is made, the motor M2 continues its lowering rotation, as in the partial homing procedure, to lower the bin 100 by an increment of approximately twenty five sheets. The apparatus is now ready to accept the first page two of the first set. When this is fed along the sheet path 18, the same process occurs as described above. As the bin 100 is pivoted counterclockwise, the finger 124 is also pivoted counterclockwise, allowing the first page one of the first set to drop into the bin 100. The gripper/injector devices 36 and 38 holding the first page two move into the bin and insert it on top of the first page one of the first set, contiguous thereto. After release of the sheet and withdrawal of the carrier, the cycle is completed, when the switch SW1 is again made. The apparatus is then ready for the feeding of the second page two of the second set.

When this sheet makes sheet path switch SW2, injector motor M1 is energised and the process is repeated with the bin 100 and the finger 124 pivoting clockwise. This allows the second page one of the second set to drop into the bin on top of the first page two. The second page two of the second

set is then inserted into the bin on top of and contiguous to the second page one of the second set.

This is repeated, as necessary, so that when the last page of the last set is inserted into the bin 100, all the sets are separated in an alternate offset posture, and all the sets are properly offset collated.

As sheets accumulate in the bin 100, the bin down sensor SEN.A is obscured from time to time by the pile and issues a signal to lower the bin by an increment of approximately twenty five shsets. No further sheets are fed during the lowering of the bin. If a large number of sheets is fed to the collator, it is possible for the bin to make bin down limit switch SW4. When this happens there is an indication to the logic control system that the capacity of the bin has been met and no further offset collation can take place. This switch is also used in conjunction with a final homing procedure after offset collation is completed, to raise the bin up into the proper position for offset stapling.

B. The Offset Sorting Mode

In the offset sorting mode, there is no collation of sheets received sequentially. However, sets of sheets are alternately offset by intermittent operation of the bin pivotation mechanism. Thus the sets are demarcated from each other by their positions.

In offset sorting, sheets of jobs to be sorted are fed in sequence from an associated copier or like machine (not shown), so that the sheets of the first job are inserted in oscillating sheet receiving station 14, when the bin 100 is

in a counterclockwise position A. All the sheets of the first job are inserted one upon the other, while the bin pivotation mechanism is disassociated from the reciprocating action of the gripper/injector devices 36 and 38. After all the sheets of the first job are inserted into the bin 100, it is pivoted to a clockwise position B, whereupon all the sheets of the second job are inserted and stacked one upon the other, clearly demarcating the first job from the second job in an alternate offset position. Further jobs may be added, the bin being pivoted before insertion of the first sheet of each new job. In offset sorting, the sheets of a job are placed one upon the other. Hence, the oscillating sheet separator/supporter device 118 has no function in this mode of operation.

In this mode of operation, the bin down sensor SEN.A detects when increments of approximately twenty five sheets have been stacked in the bin 100 and a partial homing procedure is begun. Elevator motor M2 is energised causing the bin 100 to be lowered in order that the gripper/injector devices 36 and 38 may clear the sheets that have already been inserted therein.

Several methods can be used to modify the apparatus to operate in an offset sorting mode. One such method is to modify the combination of top intermediate pulley 80, bottom intermediate pulley 82 and intermediate pulley shaft 84 to include a well known "single revolution clutch device." The single revolution clutch device would include a latch drive arm fixed to the intermediate pulley shaft 84. It would also include a clutch latch plate fixed to bottom intermediate pulley 82, a latch drive arm operatively connected to the clutch latch plate and pivotally connected by a pin to the

latch drive arm. Finally, it would include a solenoid operatively attached to the latch drive arm and arranged to rotate with the total assembly.

Accordingly, when the solenoid is de-energized, the apparatus would operate normally as in the offset collation mode, that is, the bin 100 would rotate counterclockwise and clockwise or clockwise and counterclockwise in synchronism with the insertion and withdrawal of the sheet gripper/insertor devices. However, in the offset sorting mode, the rotation of the bin 100 would be disassociated from the power drive elements of the apparatus by energizing the solenoid thereby unlatching the top and bottom intermediate drive pulleys 80 and 82 when the bin is in either a counterclockwise or clockwise position which corresponds to an odd or an even job. The solenoid would be operated to release the clutch at the time when the bin is properly located and prevent further rotation of the clutch latch plate and thus of the shaft 134.

Another method is to modify sheet receiving bin drive link 94 to include an interposer device similar to the one used on gripper/injector carrier drive arm 52. To accomplish this modification, sheet receiving bin drive link 94 would include two links slidably attached via two slots and two shoulder fasteners. One slot, for purposes of illustration the bottom slot, would have a notch therein and be operatively connected to one end of a latch. The other end of this latch would be pivotally connected to the top link. A centre portion of the latch would be operatively connected to a solenoid. Thus, when the solenoid is de-energized, both the bottom and top links are latched up and the apparatus would operate as in the offset collation mode. When the

apparatus is to be operated in the offset sorting mode, the solenoid is energized when the bin 100 reaches one of its positions A and B, and the bottom link is unlatched from the top link and, therefore, the links would move to maximum travel in their slots. As long as the links are unlatched, the bin 100 would stay in a particular position. After the insertion of a job, the links are latched up, and the bin is rotated in synchronization to the other of positions A and B for the insertion of the next job. When the bin reaches this position, the solenoid is energized again, unlatching the links and thus keeping the bin in position until insertion of all the sheets of the next job is completed.

After the completion of the offset sorting process, a complete homing procedure is begun, as previously mentioned in connection with the offset collation mode.

C. The Offset Stapling Mode

In the offset stapling mode, the offset collated or offset sorted sets in oscillating sheet receiving station 14 are stapled in the offset stapling station 16.

To initiate the offset stapling mode, a staple mode signal is necessary to initiate a stapling home procedure. Solenoid S1 is activated which causes finger 124 to pivot to the F1 position (FIG. 4), where it remains throughout offset stapling. The bin 100 is raised by the elevator motor M2 until the bin up limit switch SW3 is made, and the stapler device 186 is swung into the operative position (FIG. 6). The solenoid S3 is activated to move the first set or job catcher 190 to the proper position to catch the first (odd) set or job. The motor 1 is energized to move the bin 100

counterclockwise to position A and stopped. Before such energization, the solenoid S2 is energized to disconnect the arm 52 from the interposer 56 so that movement of the latter is not transmitted to the carrier 26 and gripper/injector devices 36 and 38. Then, the bin 100 is lowered, the stapler 186 and catcher 190 passing through a cutout portion of the bin and catching the stack of jobs on the top of the upper jaw 204. The motor M2 is stopped by the bin down sensor SEN.B sensing that the bin is a predetermined distance below the stapler device. This sensor has the same function in the offset stapling mode as the bin down sensor SEN.A has in the offset collation mode. This sequence of events results in the corner of the stack resting on top of stapler device 186, ready for the beginning of the stapling operation.

With the bin 100 in the lowered position, the motor M1 rotates for one revolution, pivoting the bin 100 to the position B. During this pivotation clockwise, the first set or job drops onto the catcher 190, the second and subsequent sets remaining on the top of the upper jaw 204 of the stapler device 186. The first set is then in correct vertical alignment with the lower jaw 202 of stapler device 186 to be inserted for stapling. A subsequent counterclockwise pivotation of the bin 100 by the motor M1 places the first set or job between the jaws in a position to be stapled. At this time, the second set in position M is clear of the stapler device 186 and drops onto the first set, the third and subsequent sets remaining on top of the upper jaw of the stapler device. When a set or job is in the jaws of the stapler device 186, the staple sensor SEN.C causes staple solenoid S5 to be activated to operate the stapler device 186 at position N (FIG. 6).

After the stapling of the first set or job, or concurrently therewith, the catcher 190 is moved to the side position by de-activation of catcher solenoid S3. Clockwise pivotation of the bin 100 feeds the second (even) set between the jaws of the stapling device into the stapling position N, and the first set in position O, having been stapled, is dropped into the bin 100. The third set or job clears the stapler device 186 and drops onto the second set. This oscillatory operation continues (FIG. 7), until all sets or jobs have been stapled, whereupon the logic control system stops the offset stapling operation and stapler device 186 is swung to the inoperative position by the action of staple position solenoid S4.

FIG. 6 illustrates, by way of example, the stapling of nine sets comprising approximately six sheets each. As shown, six sets or jobs have been stapled and dropped into the bin. The seventh set or job has been stapled and rests on the lower jaw 202 of the stapler device 186. The eighth set or job rests upon the seventh and is about to be moved into position to be stapled. The ninth set or job rests on top of the stapler device 186. The stack is rotated in a clockwise direction, which moves the eighth set or job into position between the lower and upper jaws 202 and 204 of stapler device 186. When this occurs, the seventh set or job drops off the lower jaw 202 onto the stack, and the ninth set or job drops from the top of stapler device 186 onto the eighth set or job, ready to be moved to a position to be stapled on the next counterclockwise rotation of the stack. When the eighth set or job is rotated after stapling, it will fall onto the stack and the ninth set or job will be in a position for stapling.

FIG. 4 illustrates the rotational movement during the offset stapling process of the corners of the odd and even sets or jobs. Initially the corners of the odd sets or jobs are in position N and those of the even sets or jobs are in position M. Clockwise rotation, as shown, brings the corners of the odd sets or jobs to position O, with the first set resting on catcher 190, and the corners of the even sets or jobs to position N, with the second set resting on the upper jaw 204 of the stapler device 186. Subsequent counter-clockwise rotation moves the odd set corners from position O to position N and the even set corners from position N to position M. Clockwise and counterclockwise rotations thereafter alternate.

D. The Logic Control System

The logic control system is shown in circuit diagram form in FIG. 8 and its operation is illustrated in timing diagram form in FIGS. 9 and 10.

The circuit includes fourteen relays R1 to R14, R1 HOME, R2 ELVN, R3 INJMT, R4 STPCMP, R5 STAPLE, R6 PRESTP, R7 STAPLER, R8 TWOCNT, R9 POSAR, R10 POSBR, R11 SEN.C, R12 SEN.B, R13 POSAR B, and R14 UPLMTR.

Relay R1 has pick and hold coils (FIG. 8A, lines 805 and 810). Relay R2 has a pick coil (FIG. 8A, line 815). Relay R3 has pick and hold coil (FIG. 8A, line 820 and 825). Relay R4 has a pick coil (FIG. 8A, line 830). Relay R5 has a pick coils (FIG. 8B, line 840). Relay R6 has pick and hold coils (FIG. 8B, lines 850 and 855). Relay R7 has pick and hold coils (FIG. 8B, lines 860 and 865). Relay R8 has pick and hold coils (FIG. 8B, line 875 and FIG. 8C, line 880). Relay

R9 has pick and hold coils (FIG. 8C, lines 885 and 890). Relay R10 has pick and hold coils (FIG. 8C, line 895 and 900). Relay R11 has a pick coil (FIG. 8C, line 905). Relay R12 has a pick coil (FIG. 8C, line 910). Relay R13 has a pick coil (FIG. 8B, line 845). Relay R14 has a pick coil (FIG. 8B, line 870).

Relay R1 has six contacts, normally open contacts R1.1 (line 810) and R1.3 (line 915) and normally closed contacts R1.2 (line 815), R1.4 (line 925), R1.6 (line 820) and R1.7 (line 850). Relay R2 has one normally open contact R2.1 (line 915). Relay R3 has four contacts, normally open contacts R3.3 (line 825) and R3.4 (line 920) and normally closed contacts R3.1 (line 805) and R3.2 (line 815). Relay R4 has one normally open contact R4.2 (line 835) and one normally closed contact R4.1 (line 825). Relay R5 has eight contacts, normally open contacts R5.1 (line 825), R5.2 (line 830), R5.3 (line 805), R5.4 (line 930), R5.5 (line 850) and R5.6 (line 865), and normally closed contacts R5.7 (line 815) and R5.8 (line 825). Relay R6 has four contacts, normally open contacts R6.1 (line 855), R6.2 (line 860) and R6.5 (line 875), and one normally closed contact R6.4 (line 945). Relay R7 has two normally open contacts R7.1 (line 865) and R7.2 (line 840). Relay 8 has five contacts, normally open contacts R8.1 (line 880), R8.2 (line 935) and R8.3 (line 820), and normally closed contacts R8.4 (line 825) and R8.5 (line 830). Relay 9 has two normally open contacts R9.1 (line 890) and R9.3 (line 945), and a normally closed contact R9.2 (line 900). Relay R10 has two normally open contacts R10.1 (line 900) and R10.3 (line 945) and a normally closed contact R10.2 (line 890). Relay 11 has five contacts, normally open contacts R11.1 (line 945), and R11.3 (line 820), and normally closed contacts R11.2 (line 880), R11.4

(line 825) and R11.5 (line 830). Relay R12 has one normally open contact R12.1 (line 815) and two normally closed contacts R12.2 (line 820) and R12.3 (line 820). Relay R13 has two normally open contacts R13.1 (line 830) and R13.3 (line 850). Relay R14 has two normally open contacts R14.2 (line 820) and R14.3 (line 850) and two normally closed contacts R14.1 (line 810) and R14.4 (line 825).

Switches SW1 to SW7 are included in the circuit and switch SW1 has a normally open contact SW1.1 (line 825) and a normally closed contact SW1.2 (line 825). Switch SW2 has a normally open contact (line 825). Switch SW3 has a normally open contact (line 870). Switch SW4 has a normally open contact SW4.1 (line 805) and a normally closed contact SW4.2 (line 815). Switch SW5 has two normally open contacts SW5.1 (line 845) and SW5.2 (line 885). Switch SW6 has a normally open contact (line 895). Switch SW7 has a normally open contact SW7.1 (line 815) and a normally closed contact SW7.2 (line 855).

The circuit also includes solenoids S1 (line 925), S2 (line 930), S3 (line 935), S4 (line 940) and S5 (line 945), single shots SSA (line 805) and SSB (line 945), motors M1 (line 920) and M2 (line 915), sensors SEN.A (line 815), SEN.B (line 910) and SEN.C (line 905), a delay device (line 820) and a job finished lamp L1 (line 835).

In the offset collation mode (FIG. 9), a homing procedure signal is input to single shot SSA, when each of the alternately offset sets in the bin has received a sheet. The bin is in the central position and the carriage 26 against stops 32 and 34. The relay R1 is picked by single shot SSA through normally closed contact R3.1 and is then held through

now closed contact R1.1. This prevents picking of relay R2 because contact R1.2 is now open. Solenoid S1 is de-energised because contact R1.4 is now open. Contact R1.6 opens in a picking circuit to relay R3. Relay R6 cannot be picked because contact R1.7 is now open. Closure of contact R1.3 energises the motor M2 to elevate the bin 100. The sensor SEN.A senses this elevation, but cannot pick relay R2 because of open contact R1.2.

The bin 100 rises until the up limit switch SW3 is closed, which picks relay R14. This breaks the hold circuit of relay R1 by opening contact R14.1. Relay R2 can now be picked because contact R1.2 recloses, solenoid S1 is energised by closure of contact R1.4, contact R1.6 closes and in conjunction with closed contact R14.2 picks the relay R3, contact R1.7 recloses in the pick circuit of relay R6, and contact R1.3 opens to de-energise the motor M2 and stop elevation of the bin.

The relay R3 is a delay relay which takes at least 10 milliseconds to drop out. Picking of the relay R3 prevents picking of relays R1 and R2 by opening contacts R3.1, and R3.2, respectively. Closure of contact R3.4 energises motor M1 and the carriage 26 is moved away from the stops 32 and 34 so that the switch SW1 opens. The relay R3 is then held through reclosed contact SW1.2 and now closed contact R3.3, the delay being sufficient for these to operate and hold the relay R3 before it drops out.

The motor M1 rotates through a half revolution, pivoting the bin to position B. Although both the switches SW5 and SW6 are open until this position is reached, the switch SW5 was previously closed by the bin in position A. This picked

the relay 9 through closed contact SW5.2, and opening of contact R9.2 released the hold circuit of relay R10. This closed the contact R10.2, which in combination with closed contact R9.1 completed the hold circuit for relay R9. One or other of relays R9 and R10 is always picked and held.

As the bin reaches position B, switch SW6 closes and picks the relay R10, releasing the hold circuit of relay R9 and completing the hold circuit of relay R10.

The motor M1 continues to rotate through another half revolution until the bin 100 is in the central position and the carrier 26 reaches stops 32 and 34 and closes switch SW1. Closure of switch SW1 opens contact SW1.2 and breaks the holding circuit of relay R3. Closure of contact SW1.1 does not pick relay R3 as switch SW2 is open. Motor M1 stops because contact R3.4 opens.

Contact R3.2 closes and because sensor SEN.A is up, relay R2 is picked and closes contact R2.1 to start the motor M2 to lower the bin 100. The stack of offset sets of sheets rests upon the finger 124 which is in the central position between the F2 and F3 positions.

When the next sheet of the first set is fed along the sheet path 18 and reaches the switch SW2, closure of this switch picks the relay R3 through closed contacts R5.8, SW1.1 and R1.6. The relay R3 energises the motor M1 through now closed contact R3.4 and the carriage moves away from the stops 32 and 34, so that the switch SW1 opens. The relay 3 remains picked during the switching of switch SW1, so that the holding circuit of relay R3 may be completed through closed contacts R5.8, SW1.2, R4.1 and R3.3. The bin 100 is

moved from the central position to position A to receive the sheet and the first set of sheets drops off the finger 124 as it moves to the F3 position. When the bin 100 reaches position A, the switch SW5 is closed, picking the relays R9 and R13 and thus releasing relay 10. The next sheet is inserted and released, and the carrier 26 withdrawn to the stops 32 and 34. During this time, the switch SW2 opens, but the relay R3 remains held.

When the carrier 26 reaches the stops 32 and 34, the switch SW1 is closed, diabling the holding circuit of relay R3. The motor M1 is de-energised and the arrival of the next sheet of the second set is awaited. When this arrives, the switch SW2 is closed and the operation repeated, except that the bin moves to position B and back, and the finger 124 to the F2 position and back, releasing the second set onto the bin prior to insertion of the next sheet. The switch SW6 is closed, picking the relay R10, and thus releasing the relays R9 and R13.

After this the operation is repeated as many times as necessary until a homing procedure signal is input, after each of the alternately offset sets in the bin has received a further sheet.

If during these operations, there are so many sheets in the bin that sensor SEN.A goes up, the relay R2 is picked when the relay R3 is next released. The bin 100 is lowered by the motor M2 until the sensor SEN.A goes down and releases the relay R2.

In the offset stapling procedure (FIG. 10), an offset stapling mode signal is input from an associated copier or

like machine (not shown) or from a switch on the apparatus, to pick the relay R5. Contact SW1.1 is closed and contact SW1.2 is open, because the carrier 26 is against the stops 32 and 34 to actuate the switch SW1. Contact R5.1 closes in the hold circuit of relay R3, but contact R3.3 remains open. Contact R5.2 closes in the pick circuit of relay R4, but contact R13.1 remains open. Contact R5.3 closes and the relay R1 is picked by single shot SSA through closed contact R3.1 and is then held through now closed contact R1.1. This prevents picking of relay R2 because contact R1.2 is now open. Solenoid S1 is de-energised because contact R1.4 is now open, and the finger 124 moves to the home or L1 position. Contact R1.6 opens in a picking circuit to relay R3. Contact R1.7 opens in the picking circuit of relay R6. Closure of contact R1.3 energises the motor M2 to elevate the bin 100. Contact R5.4 closes and energises solenoid S2, which releases the latch 60 and allows rotation of motor M1 without movement of carrier 26. Contact R5.5 closes in the picking circuit of relay R6, but contacts R13.3, R14.3 and R1.7 remain open. Contact 5.6 closes in the holding circuit of relay R7, but contact R7.1 remains open, because contact R6.2 cannot close to pick relay R7. Contact R5.7 opens to prevent the sensor SEN.A picking relay R2. Contact R5.8 opens to prevent energisation of solenoid S1.

The bin 100 rises and the sensor SEN.B picks the relay R12 to close contact R12.1 in the picking circuit of relay R2, to open contact R12.2 in a picking circuit of relay R3 and to open contact R12.3 in another picking circuit of relay R3. Up limit switch SW3 is closed which picks relay R14. This breaks the hold circuit of relay R1 by opening contact R14.1. Relay R2 can now be picked by closure of contact SW7.1 presently open. Solenoid S1 remains de-energised

despite closure of contact R1.4. Contacts R14.2 and R1.6 close to pick relay R3. Holding circuit to relay R3 is not made because contacts R5.8 and R14.4 are open. Relay 6 is not picked by closure of contact R14.3, because contact R13.3 is open.

Closure of contact R3.4 energises motor M1 to rotate the bin 100 until the switch SW5 is operated in position A. This picks the relay R13 by closure of contact SW5.1, and the relay R9 by closure of contact SW5.2. Contact R13.2 opens to release the relay R3 and stop the motor M1 by opening contact R3.1. Contact 13.1 closes to pick the relay R4 and contact R13.3 closes to pick the relay R6. Relay 9 is held by closure of contact R9.1. Contact R9.2 opens to release relay R10. Contact R9.3 closes, but solenoid S5 is not energised because contact R11.1 is open. Contact R6.1 closes hold relay R6. Contact R6.2 picks relay R7, which is held through closed contacts R5.6 and R7.1. Solenoid S4 is energised through closed contact R7.2 and begins to rotate the stapler device 186 towards the operative position. Contact R6.4 opens and prevents energisation of solenoid S5. Contact R6.5 closes and picks relay R8, which is held by closure of contact R8.1. Contact R8.2 closes to energise solenoid S3, which pivots the catcher 190 from the side position to the proper catching position. Contact R8.3 closes, but relay R3 is not picked as contact R12.2 is open. Contact R8.4 in a hold circuit of the relay R3 is opened. Contact R8.5 is opened to prevent picking of relay R4.

When the stapling device 186 reaches its operative position, the switch SW7 is operated. The relay R2 is picked by closure of contact SW7.1 and relay R6 released by opening of contact SW7.2. The motor M2 is energised to lower the bin by

closure of contact R2.1. Contact R6.2, in the pick circuit of relay R7, is opened, but relay R7 is held through closed contacts R5.6 and R7.1 to maintain energisation of solenoid S4 to hold the stapler device in operative position. Contact R6.4 closes in the circuit to solenoid S5. Contact R6.5 in the pick circuit of relay R8 opens, but the relay is held through closed contacts R11.2 and R8.1.

The bin 100 descends, leaving the corner of the first set of sheets to be stapled resting on top of the stapler upper jaw 204 (FIG. 6) and the other sets on top of the first set. The descent of the bin continues until the sensor SEN.B is passed and issues a signal to release the relay R12. Contact R12.1 opens to release relay R2 and stop descent of the bin by opening contact R2.1. Contact R12.2 closes to pick relay R3. Contact R12.3 also closes. Opening of contacts R3.1 and R3.2 prevent relays R1 and R2 from being picked. Closure of contact R3.3 in the hold circuit of relay R3 is not effective because contacts R5.8 and R8.4 are open. Closure of contact R3.4 energises the motor M1 to rotate the bin 100 to the position B.

As the bin 100 rotates, the switch SW5 opens. Relay R13 is released by open contact SW5.1. Contact SW5.2 is opened in the pick circuit of relay R9, which is held through closed contacts R9.1 and R10.2. The corner of the first set of sheets clears the stapler jaw 204 and descends on to the catcher 190 (FIG. 6).

When the bin reaches the position B, the switch SW6 closes and picks relay R10. This releases the relay R9 by opening contact R10.2 and the relay R10 is held through closed contacts R10.1 and R9.2. The motor M1 continues to

rotate and the bin is moved from position B towards position A. The switch SW6 in the pick circuit of relay R10 opens, but the relay is held.

The corner of the first set of sheets enters between the jaws 202 and 204 of the stapler and the sensor SEN.C issues a signal to pick relay R11. Contact R11.1 closes to operate single shot SSB to energise solenoid S5 through closed contacts R10.3 and R6.4. This operates the stapler to staple the corner of the first set of sheets. Relay R8 is released by opening of contact R11.2. Contact R8.2 opens to de-energise solenoid S3 and allow the catcher 190 to move to the side position. Contact R8.3 opens to release relay R3 and stop the motor M1 by opening contact R3.4. Contact R8.4 closes, but contact R11.4 opens to prevent holding of relay R3. Contact R8.5 closes, but contact R11.5 opens to prevent picking of relay R4. Switch SW5 is operated to close contacts SW5.1 and SW5.2 to pick relays R13 and R9. Contact R13.1 closes in the hold circuit of relay R4, ineffective because of open contact R11.5. Contact R13.2 opens in a pick circuit of relay R3, ineffective because of open contact R14.2, and contact R13.3 closes in the pick circuit of relay R6, ineffective because of open contact R14.3. Opening of contact R9.2 releases relay R10, and closure of contacts R9.1 and R10.2 holds relay R9.

Closure of contact R11.3 completes a circuit through a delay device which provides a 100 millisecond delay before the pick coil of relay R3 is activated. Thus, operation of the motor M1 is delayed to ensure that the bin 100 remains in position A for long enough to ensure proper stapling. The delay device may be a delay relay, a single shot multivibrator or similar device.

Delayed picking of the relay R3 energises the motor M1 through closed contact R3.4 and the bin is rotated from position A to position B. The sensor SEN.C goes down and releases relay R11 and the switch SW5 opens to release relay R13. With the catcher 190 in the side position, the stapled corner of the first set of sheets emerges from the jaws of the stapler and the stapled set descends into the bin, whilst the corner of the second set of sheets enters between the jaws.

The sensor SEN.C senses the presence of this corner and issues a signal to pick relay R11 as the switch SW6 closes. The solenoid S5 is energised as above described to effect stapling, and the motor M1 is stopped. The relay R10 is picked and held and the relay R9 released. The motor M1 is restarted after the delay of 100 milliseconds and the bin 100 is returned to position A, dropping the stapled corner of the second set off the jaws. These operations are then repeated as necessary, until a signal from sensor SEN.B indicates that the height of the paper stack in bin 100 is such that bin 100 must be lowered. This picks relay R12 and closes contact R12.1, thus picking relay R2 when the relay R3 is next released to close contact R3.2. Contact R12.3 is opened to disable the delay pick circuit to relay R3. When the sensor SEN.C picks the relay 11, the contact R11.4 opens and releases the relay R3. The solenoid S5 is energised by the single shot SSB and the stapler operated. Relay R2 is picked and energises the motor M1 to lower the bin 100 until the sensor SEN.B goes up and releases the relay R12. This releases the relay R2 to stop the motor M1 and closes the delay pick circuit to relay R3, so that the motor M1 is energised after the delay of 100 milliseconds to rotate the bin 100 from position A.

The operation then proceeds as before.

When the last set has been stapled, the sensor SEN.C does not issue a signal as the bin 100 approaches the position A and operates switch SW5 to pick relays R13 and R9. The solenoid S5 is not operated because the relay R11 is not picked, so that the stapler is not operated. The relay R4 is picked by closure of contact R13.1. This illuminates the light L1 by closing contact R4.2 and prevents enablement of the holding circuit of relay R3 by opening contact R4.1.

Thereafter, the offset stapling mode signal is removed, either manually or automatically, from the pick circuit of relay R5. Contact R5.6 opens to release relay R7. This opens the contact 7.2 to de-energise the solenoid S4, so that the stapler returns to its inoperative home position, releasing switch SW7. Contact R5.4 opens to de-energise the solenoid S2, which releases the latch 60 to engage the arm 56 when the motor M1 is next rotated. Contact R5.7 closes and, if the sensor SEN.A is obscured, the relay R2 is picked to lower the bin 100 until it is clear. Contact R5.2 opens to release the relay R4 and extinguish the light L1.

Thereafter, a homing procedure singal is input to single shot SSA, which picks the relay R1. The bin 100 is elevated, as described above, until the up limit switch SW3 is closed, picking the relay R14. As described above, the motor M2 is de-energised and the motor M1 energised to rotate the bin away from the position A. As the bin reaches the central position, the latch 60 engages the arm 56 and the carrier 26 is reciprocated, whilst the bin 100 moves to position B and back to the central position. When the carrier reaches the stops 32 and 34, the switch SW1 is operated to open contact

SW1.2 and release the relay R3. This stops the motor M1. The sensor SEN.A then picks the relay R2 through now closed contact R3.2 and the motor M2 lowers the bin 100 until clear of the sensor.

The homing procedure signal (FIG. 8A, line 805) may be a signal from the associated copier or like device (not shown), or from a down counter type device as disclosed in EP-0002317. This signal indicates to the logic control system in the offset collation mode that the sheet of the last set to be offset collated, has been inserted into the bin 100. This signal initiates a complete homing procedure as described above.

In the offset stapling mode and before offset stapling can take place, the injector disable solenoid S2 has to be activated to disengage the drive for the carrier 26 from the motor M1. The prestep relay R6 and two count relay R8 are used together at the start of the offset stapling mode to ensure that the first set or job is properly in the jaws of stapler device 186 before stapling takes place. The delay device (FIG. 8A, line 820) provides a 100 millisecond delay before the pick coil of injector motor relay R3 is actuated. This is to ensure that the set or job in the jaws of stapler device has been stapled before the bin 100 is rotated.

It will be appreciated that the sheets are fed serially to the collating bin in the same disposition, offsetting being achieved by movement of the bin. It will also be appreciated that the reciprocating injector/gripper devices may be replaced by circulatory injector/gripper devices operating in similar fashion to those of EP-0002317, but without the alternate skew disposition of the grippers.

CLAIMS

1. Apparatus for collating sets of sheets, which are received serially in groups of similar sheets, comprising means to stack the sheets of the first group received in individually offset fashion, thus demarcating each first sheet from adjacent first sheets, and means to insert individual sheets of the next group in the same offset fashion contiguous to individual first sheets and to insert, if necessary, individual sheets of subsequent groups in the same offset fashion contiguous to individual prior inserted sheets of the same set to form collated sets of sheets, characterised in that the means (38) to insert sheets transports all sheets in the same disposition relative to a sheet path (18) into a bin (100) for receiving the sheets, which bin is capable of oscillatory motion in a substantially horizontal plane and means (88, 94) to cause oscillation of the bin to effect offset stacking.

2. Apparatus according to claim 1, in which the bin (100) is also movable vertically.

3. Apparatus according to claim 1 or 2, including means (124) for separating adjacent stacked sheets at an appropriate location prior to insertion of a sheet.

4. Apparatus according to claim 1, 2 or 3, in which the means (38) to insert sheets is movable in reciprocatory fashion into and out of the bin (100).

5. Apparatus according to claim 4, in which the means (38) includes sheet gripping means (158, 160; 180, 182) operable to open at a position of the means (38) out of the bin (100)

to receive a sheet, to close to grip a sheet upon movement of the means (38) towards the bin, and to open to release a sheet at a position of the means (38) in the bin.

6. Apparatus according to claim 5, in which the means (38) includes a carrier (26) for the sheet gripping means (158, 160; 180, 182) movable between stops (32, 34; 48, 50) and means (53, 138; 146, 168) to cooperate to effect opening of the sheet gripping means with the carrier against the stops.

7. Apparatus according to any preceding claim, including means selectively to render inactive the means (88, 94) to cause oscillation of the bin.

8. Apparatus according to any preceding claim, including means (52, 60, 56) selectively to render inactive the means (38) to insert sheets.

9. Apparatus according to claim 8 as appendant to claims 2 and 3, having a stapling station (16) including a stapling device (186) disposed adjacent one corner of the bin (100) and displacable to a position to receive offset sheets of sheets for stapling, the means (88, 94) being operable to oscillate the bin to present successive sets of sheets to the stapling device (186) and means (55) to operate the stapling device when a set of sheets is in position.

10. In sheet collating apparatus, a method of collating sets of sheets, which are received serially in groups of similar sheets, comprising the steps of transporting and inserting sheets in the same disposition relative to a sheet path into a bin for receiving the sheets, oscillating the bin in a substantially horizontal plane to stack the sheets of the

first group received in individually offset fashion, thus demarcating each first sheet from adjacent first sheets, transporting and inserting individual sheets of the next group in the same disposition contiguous to individual first sheets, oscillating the bin in a substantially horizontal plane to stack the sheets of the next group in the same offset fashion as the sheets of the first group, and thereafter, if necessary, transporting and inserting individual sheets of subsequent groups and oscillating the bin in the same manner, to form collated sets of sheets.

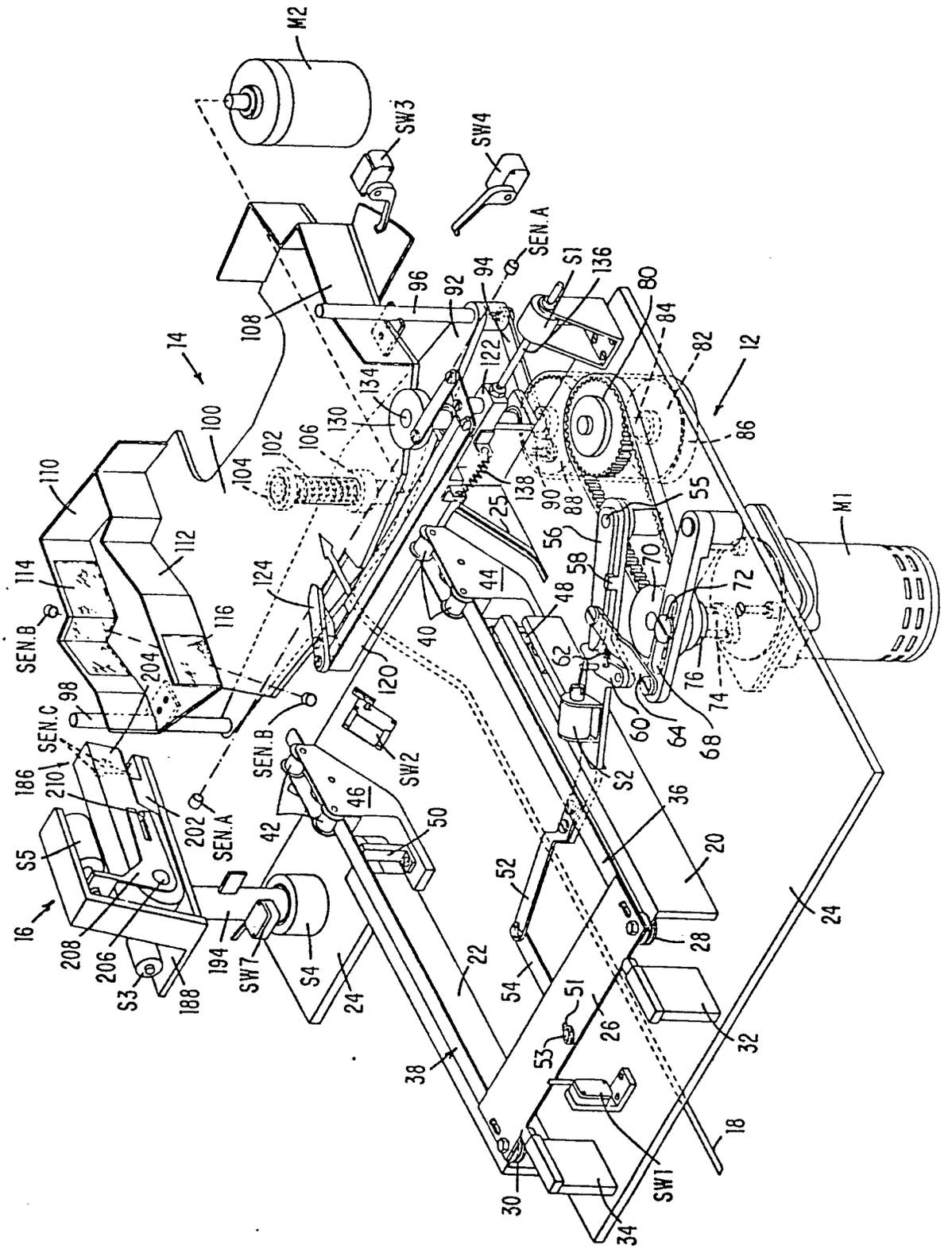

M2
SW3
SW4
SEN.A
S1
136
80
84
82
12
14
108
96
92
94
122
134
130
106
102
104
100
110
112
114
SEN.B
116
124
204
98
SEN.C
186
210
202
SEN.A
SEN.B
120
SW2
46
42
50
S5
16
208
206
S3
188
194
SW7
S4
24
22
38
30
34
SW1
18
52
54
51
53
26
32
36
20
28
24
S2
60
64
68
74
76
72
70
58
48
44
40
62
56
25
138
90
88
55
86
M1

FIG. 1

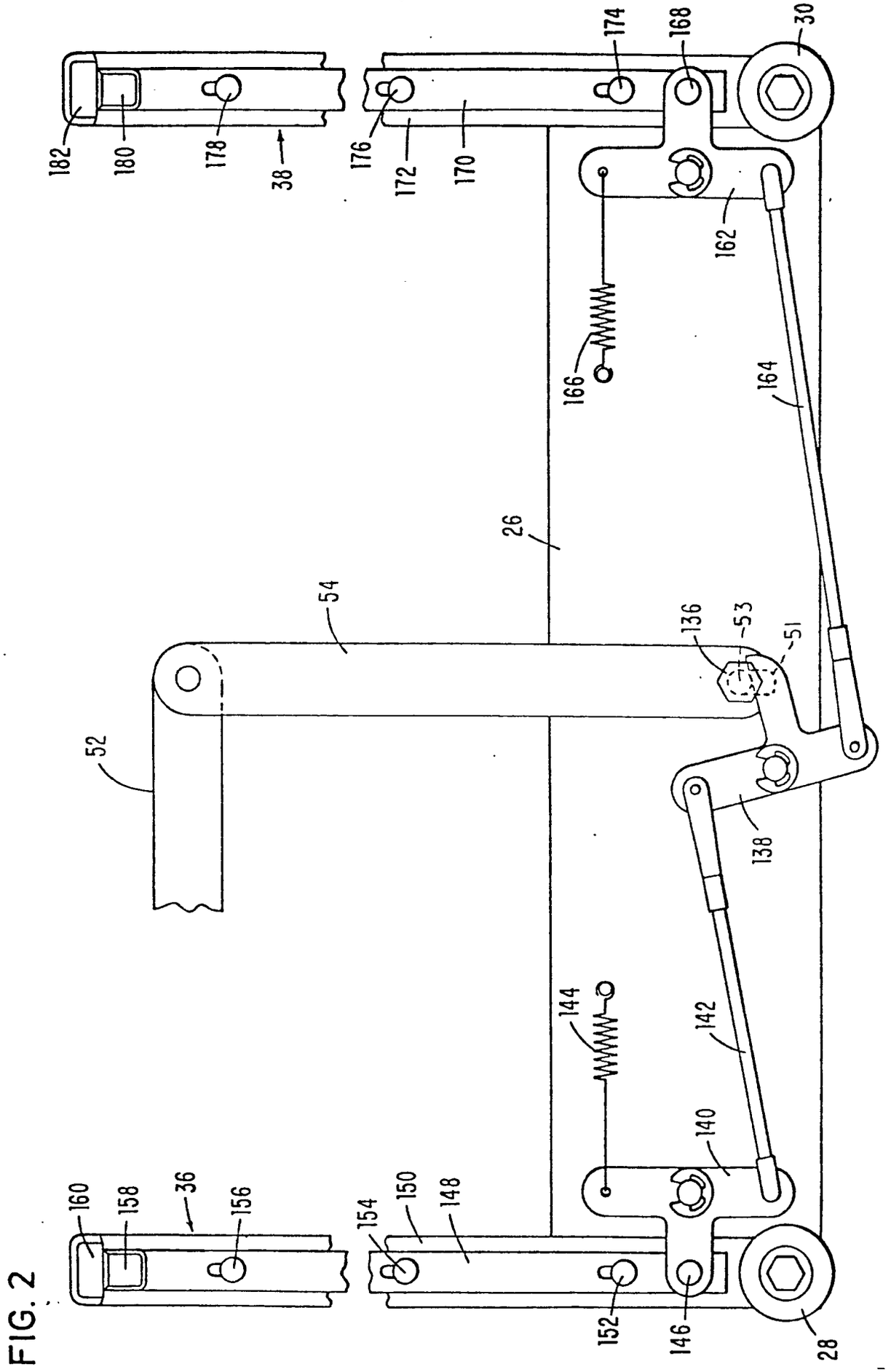

182
180
178
38
176
172
170
174
168
30
162
166
164
26
54
136
53
51
52
138
144
142
140
160
158
36
156
154
150
148
152
146
28

FIG. 2

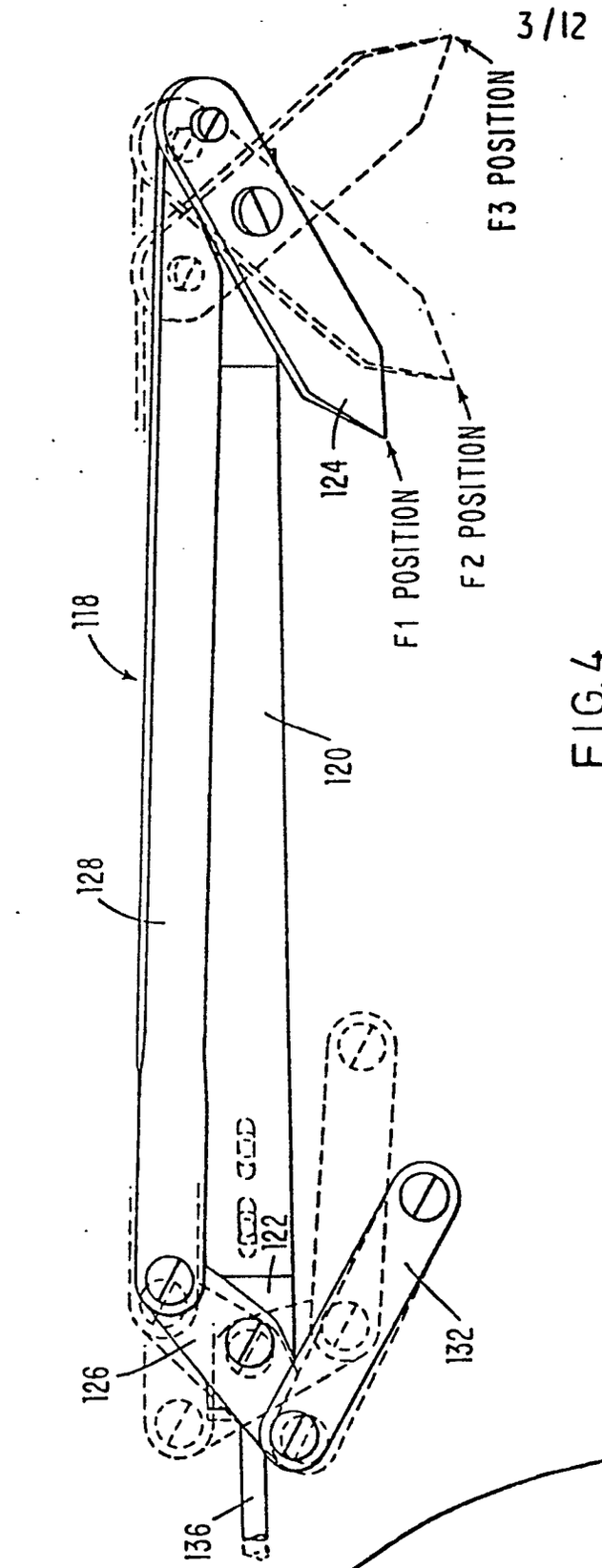

F3 POSITION
F2 POSITION
F1 POSITION
124
118
120
128
122
126
132
136

FIG. 4

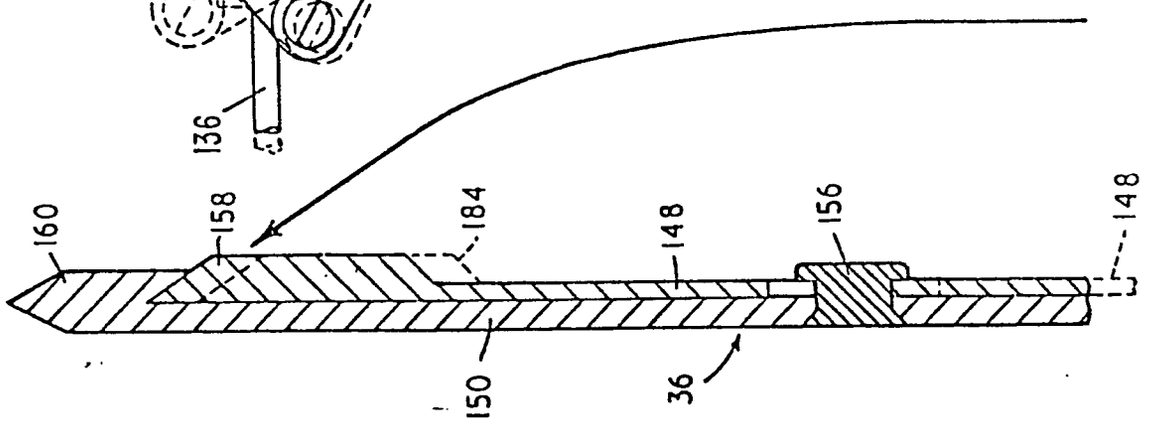

160
158
184
148
156
148
150
36

FIG. 3

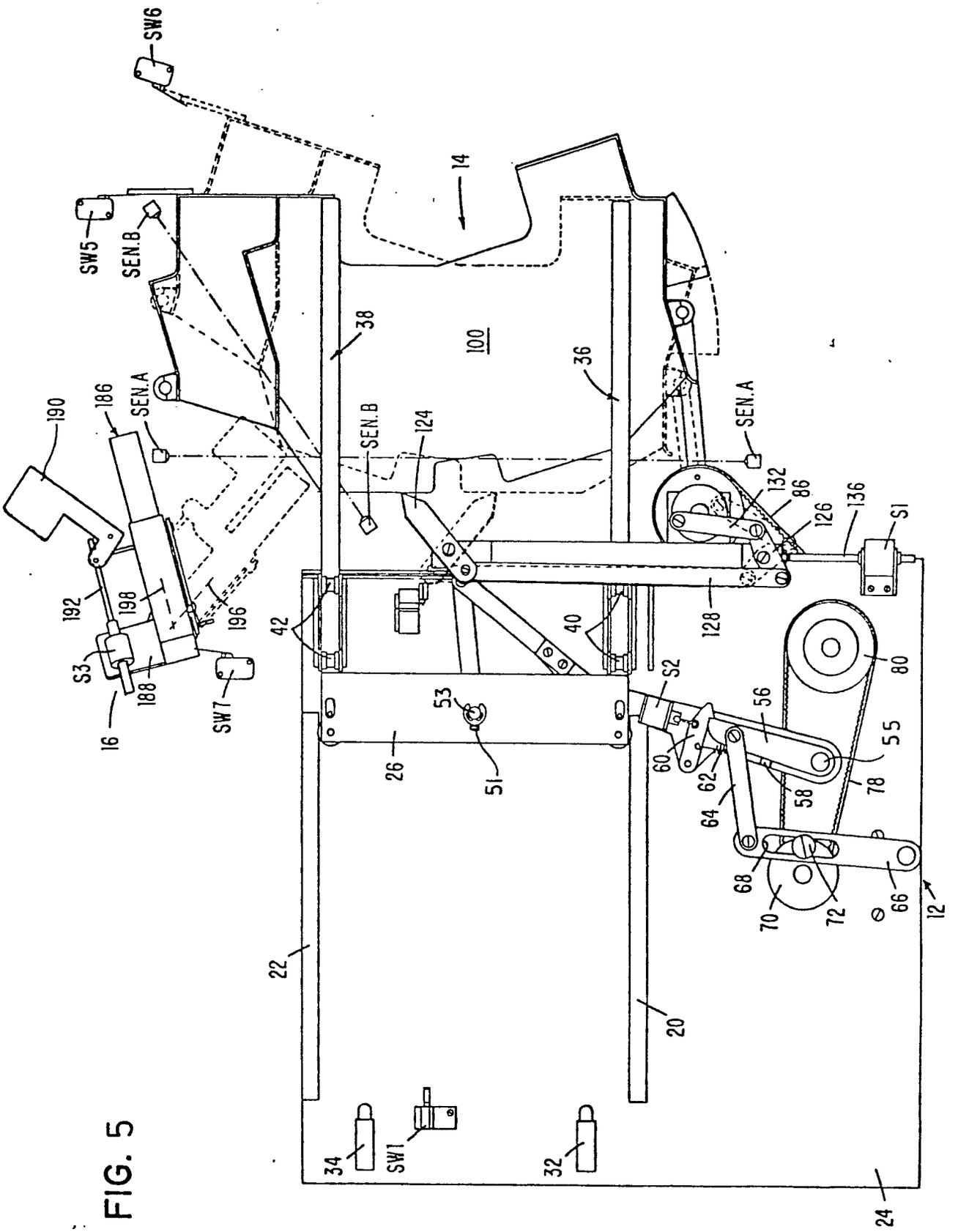

SW6
14
SW5
SEN.B
38
100
36
SEN.A
190
186
SEN.A
SEN.B
124
SEN.A
132
86
126
136
S1
192
198
196
42
40
128
80
S3
188
SW7
16
53
S2
56
26
51
60
62
55
78
58
64
68
66
12
70
72
22
20
34
SW1
32
24

FIG. 5

FIG. 6

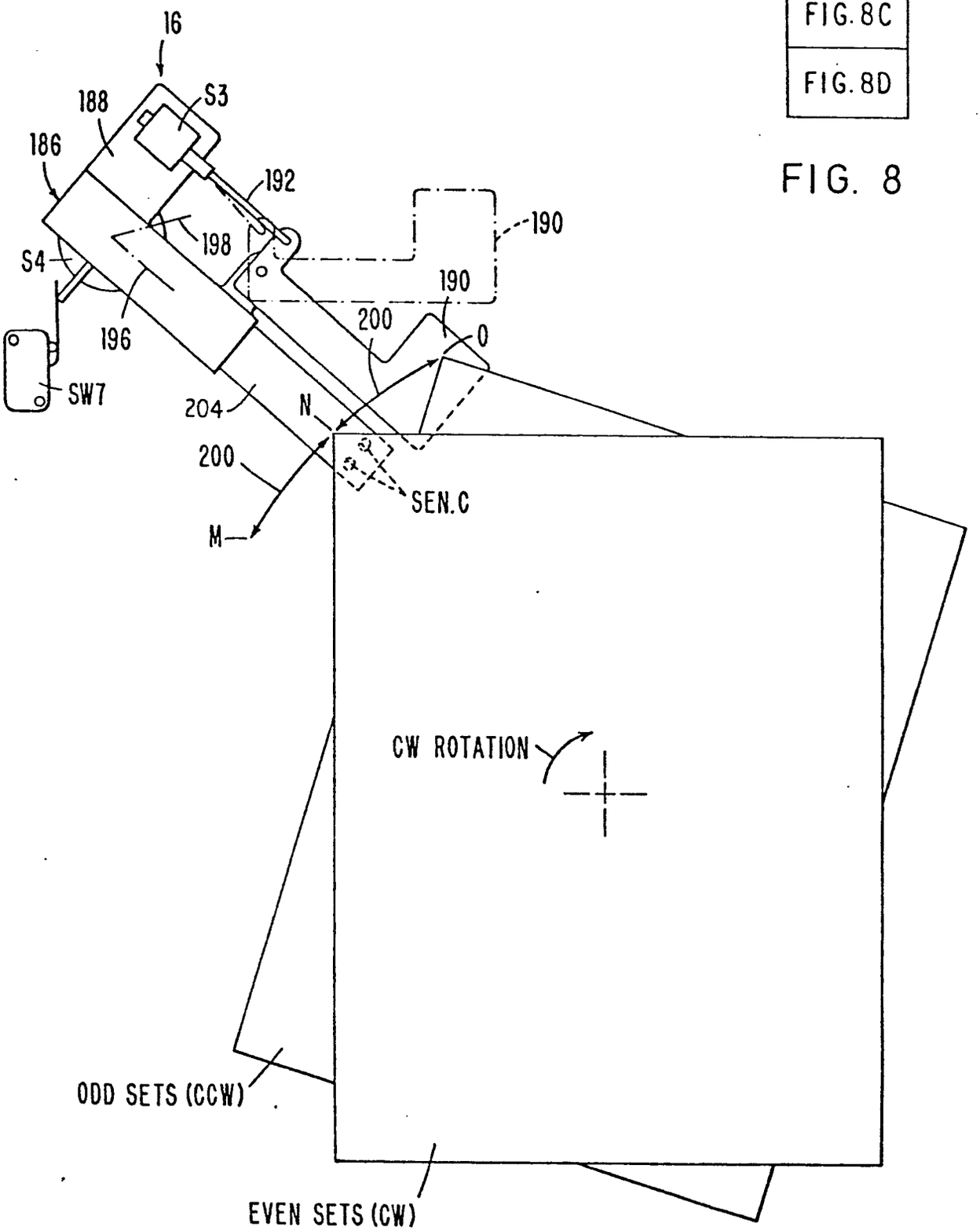


FIG. 8A
FIG. 8B
FIG. 8C
FIG. 8D

FIG. 8

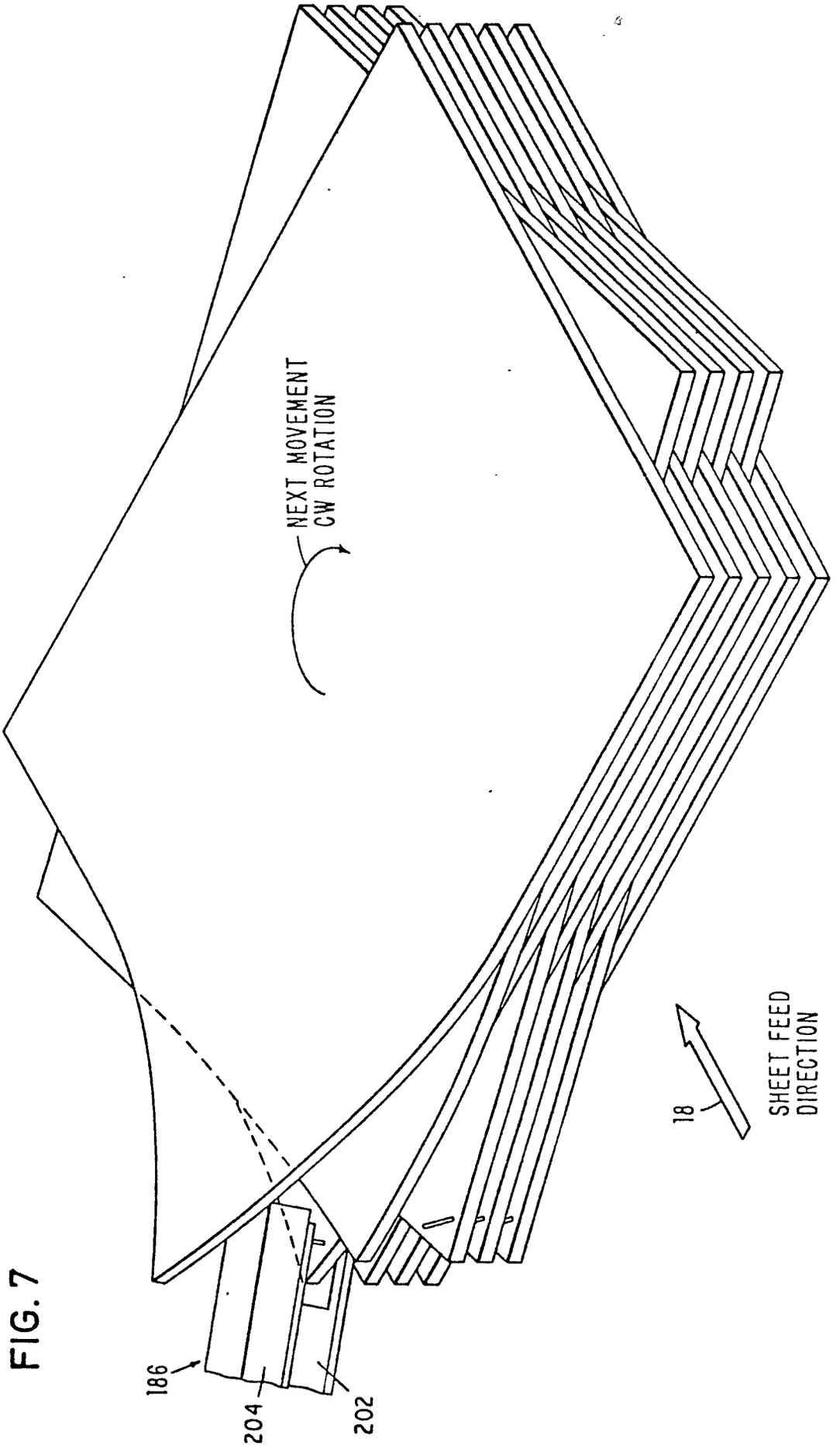

NEXT MOVEMENT
CW ROTATION
SHEET FEED
DIRECTION
18
186
204
202

FIG. 7

FIG. 8A

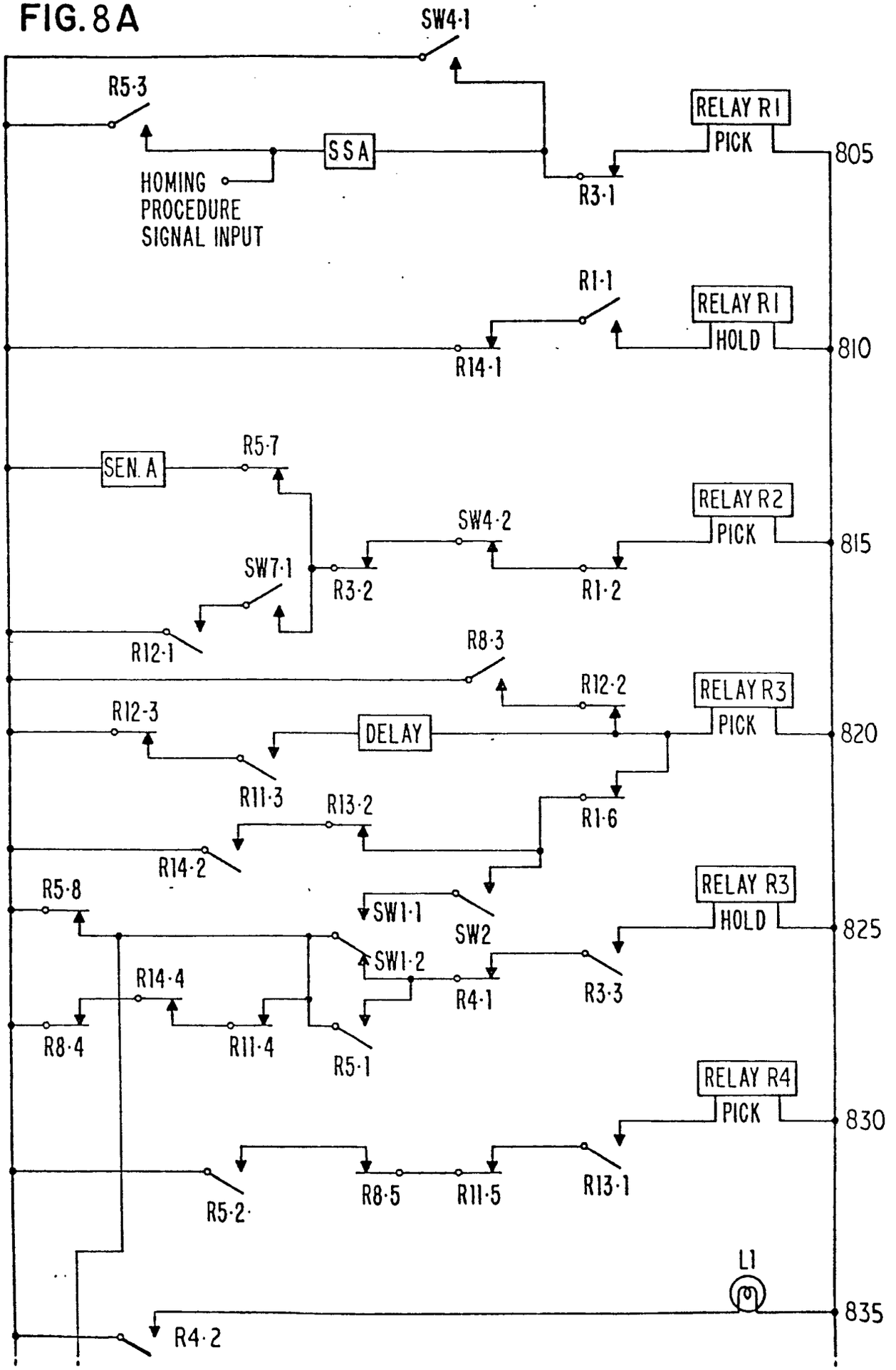

SW4-1
R5-3
RELAY R1
PICK
805
SSA
HOMING
PROCEDURE
SIGNAL INPUT
R3-1
R1-1
RELAY R1
HOLD
810
R14-1
SEN. A
R5-7
RELAY R2
PICK
815
SW4-2
SW7-1
R3-2
R1-2
R12-1
R8-3
R12-2
RELAY R3
PICK
820
R12-3
DELAY
R11-3
R13-2
R1-6
R14-2
R5-8
RELAY R3
HOLD
825
SW1-1
SW2
SW1-2
R14-4
R4-1
R3-3
R8-4
R11-4
R5-1
RELAY R4
PICK
830
R5-2
R8-5
R11-5
R13-1
L1
835
R4-2

FIG. 8B

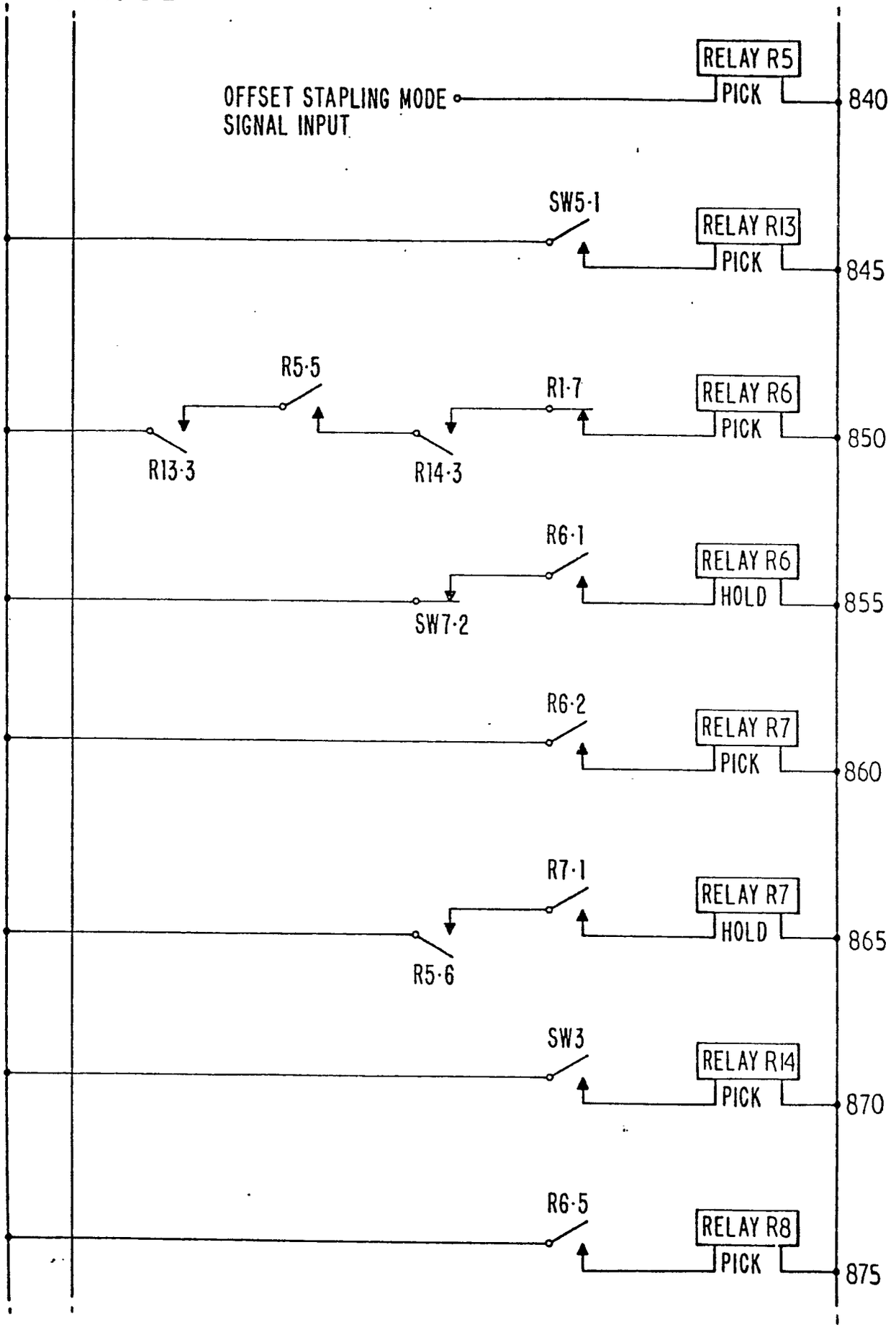

OFFSET STAPLING MODE SIGNAL INPUT
RELAY R5 PICK
840
SW5-1
RELAY R13 PICK
845
R5-5
R1-7
RELAY R6 PICK
850
R13-3
R14-3
R6-1
RELAY R6 HOLD
855
SW7-2
R6-2
RELAY R7 PICK
860
R7-1
RELAY R7 HOLD
865
R5-6
SW3
RELAY R14 PICK
870
R6-5
RELAY R8 PICK
875

FIG. 8C

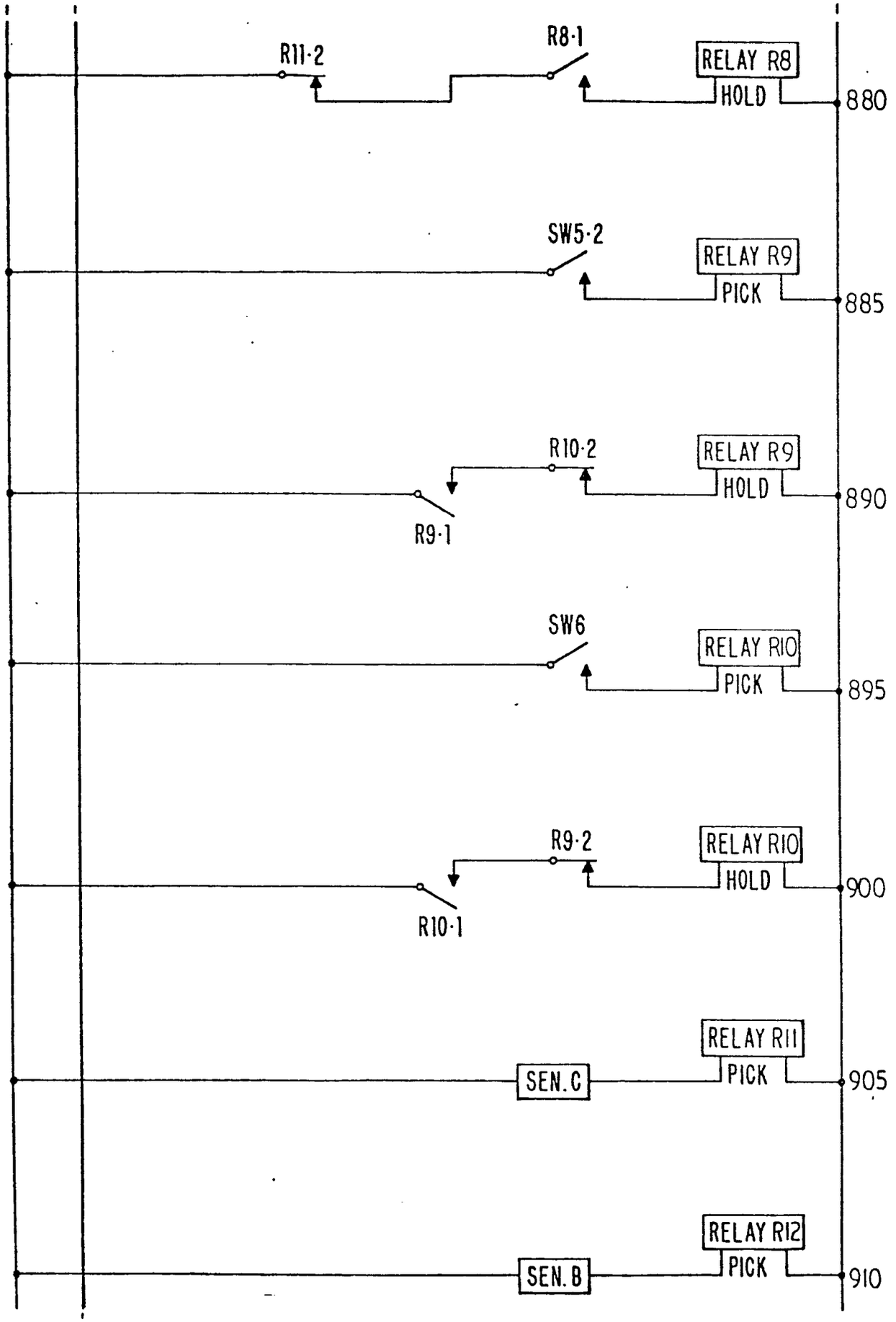

R11·2
R8·1
RELAY R8
HOLD
880
SW5·2
RELAY R9
PICK
885
R10·2
RELAY R9
HOLD
890
R9·1
SW6
RELAY R10
PICK
895
R9·2
RELAY R10
HOLD
900
R10·1
RELAY R11
PICK
905
SEN. C
RELAY R12
PICK
910
SEN. B

FIG. 8D

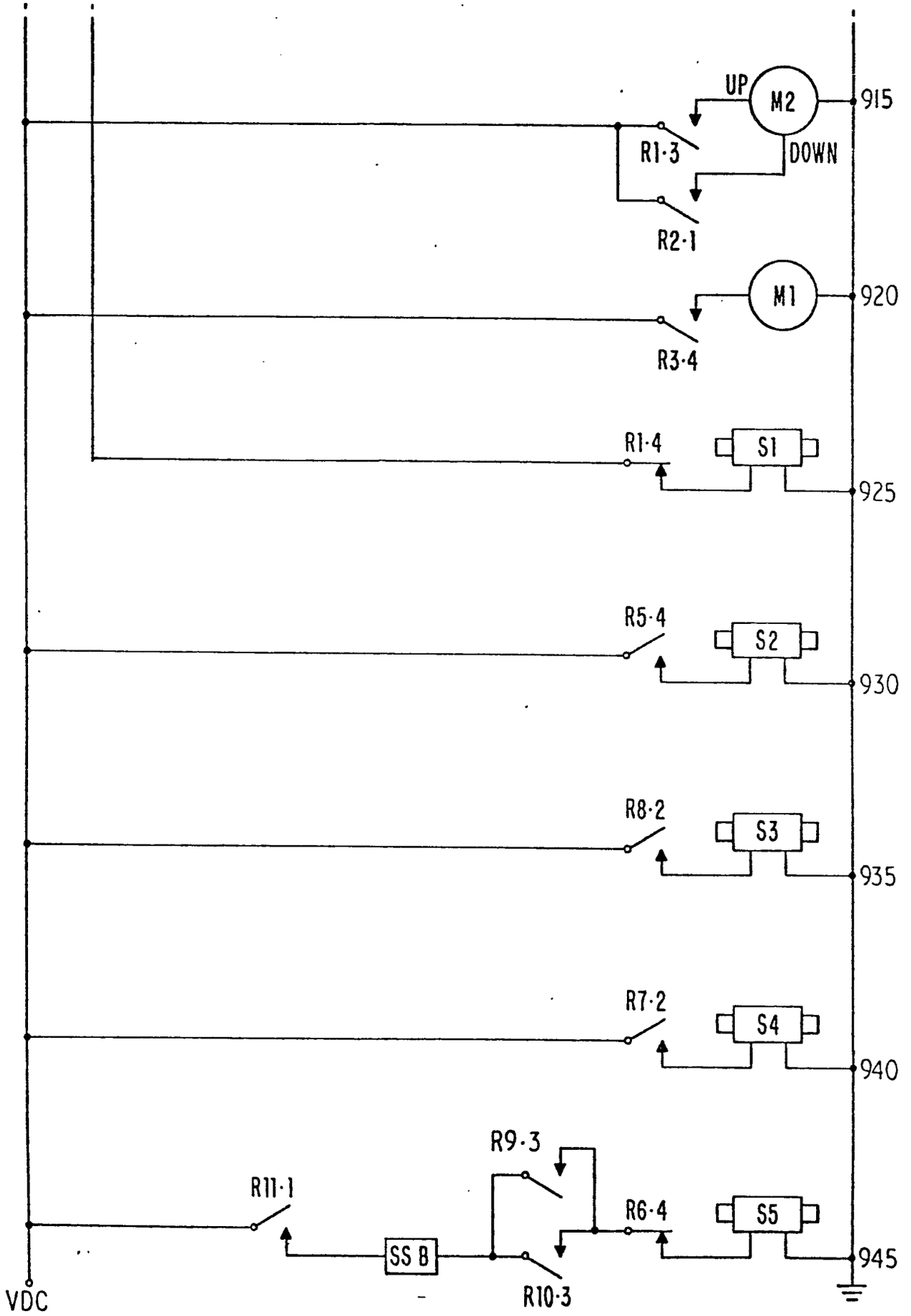

UP
M2
915
R1·3
DOWN
R2·1
M1
920
R3·4
R1·4
S1
925
R5·4
S2
930
R8·2
S3
935
R7·2
S4
940
R9·3
R11·1
R6·4
S5
SS B
945
VDC
R10·3

FIG. 9
(OFFSET COLLATION MODE)

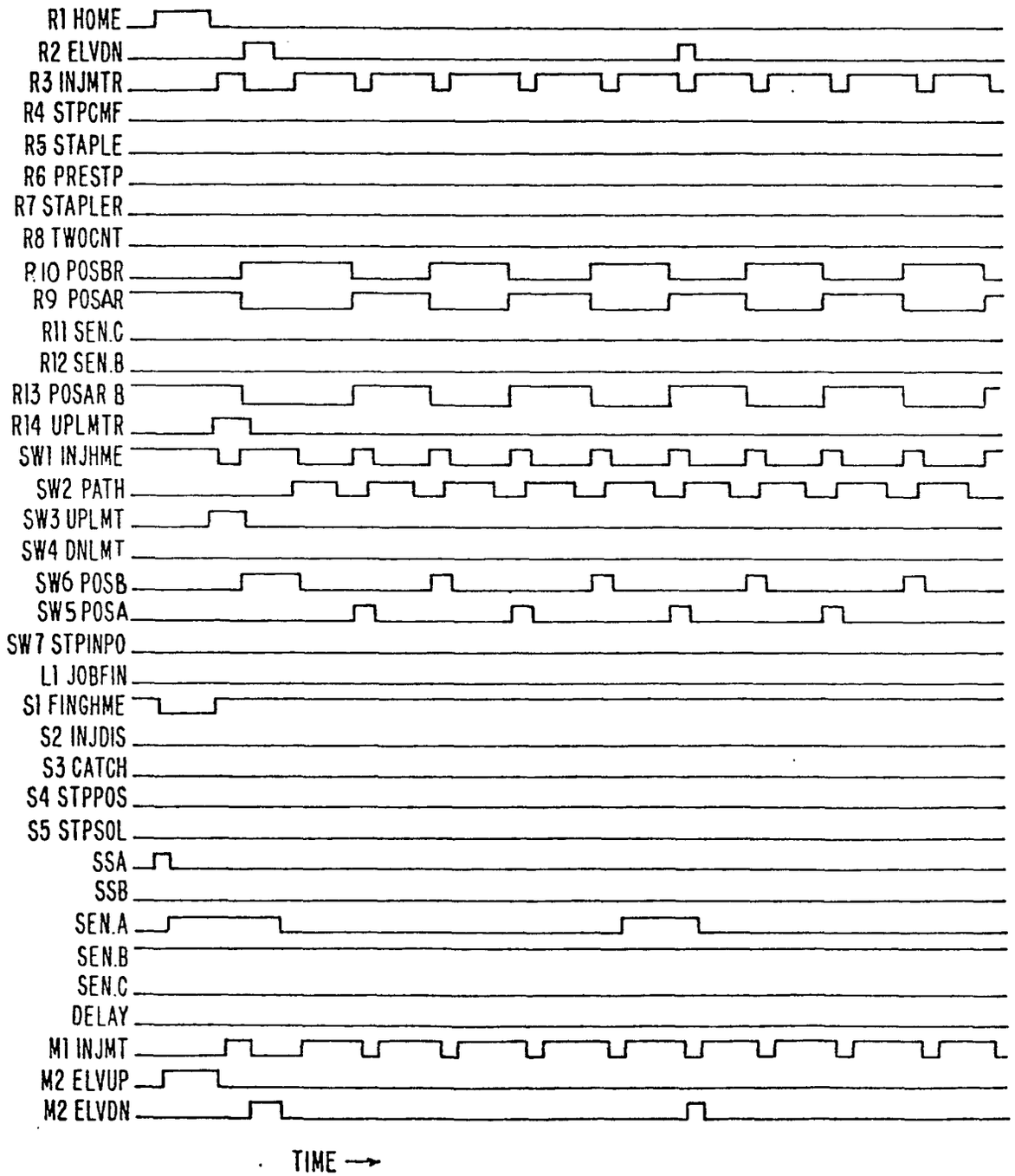
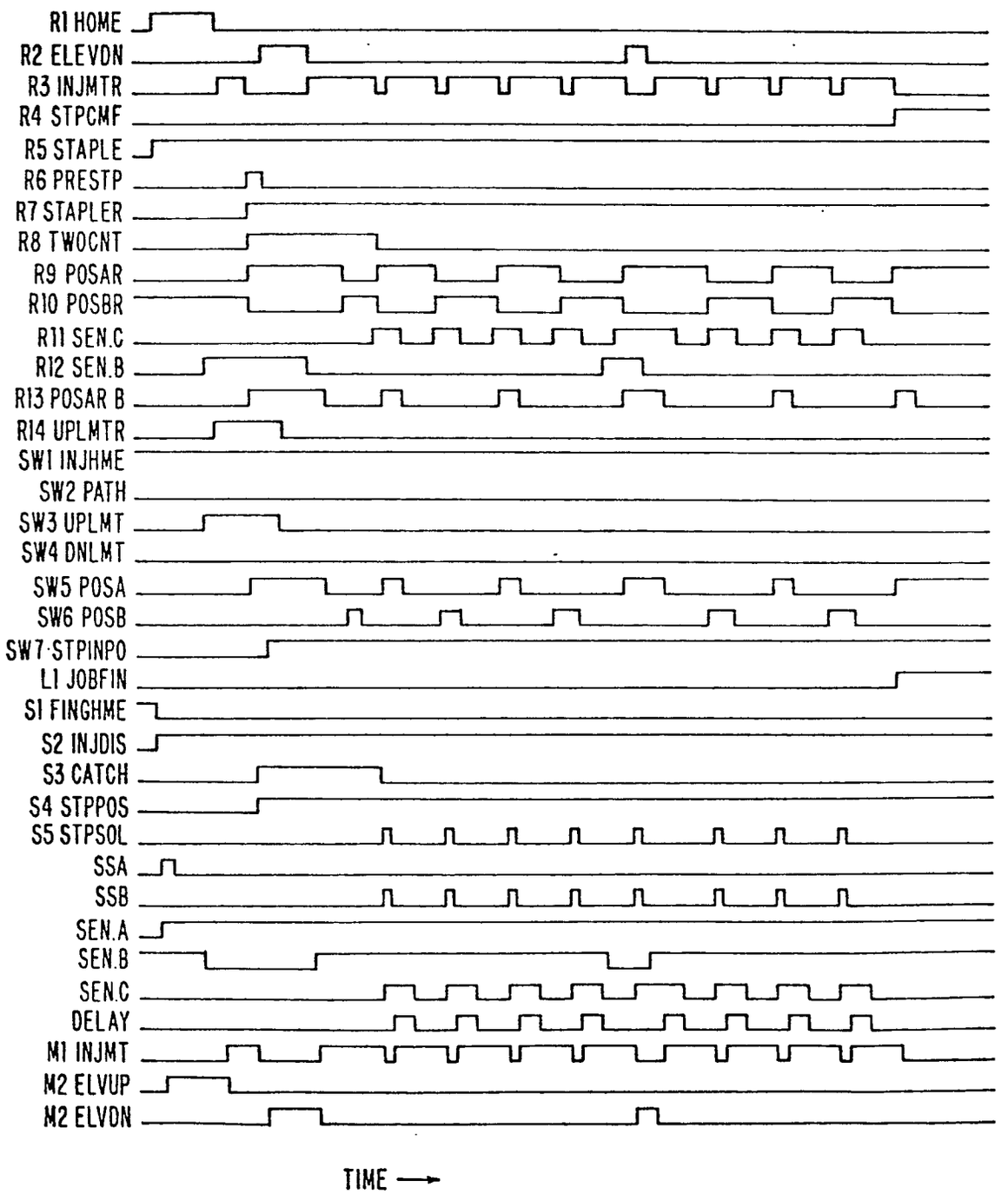


FIG.10
(OFFSET STAPLING MODE)



0026327
Application number

European Patent Office

EUROPEAN SEARCH REPORT

EP 80 10 5086.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A,D	EP - A1 - 0 002 317 (IBM)	
A	US - A - 3 774 906 (E.I. FAGAN et al.)	
A	DE - A1 - 2 628 909 (XEROX CORP.)	
A	DE - A1 - 2 733 521 (CANON K.K.)	

CLASSIFICATION OF THE APPLICATION (Int. Cl.)

B 65 H 31/24

TECHNICAL FIELDS SEARCHED (Int.Cl.)

B 65 H 31/00
B 65 H 31/24

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	17-12-1980	KLITSCH

EPO Form 1503.1 06.78