

March 13, 1962

A. E. GRAY ETAL
SORTING MACHINE

3,024,904

Filed May 13, 1959

14 Sheets-Sheet 1

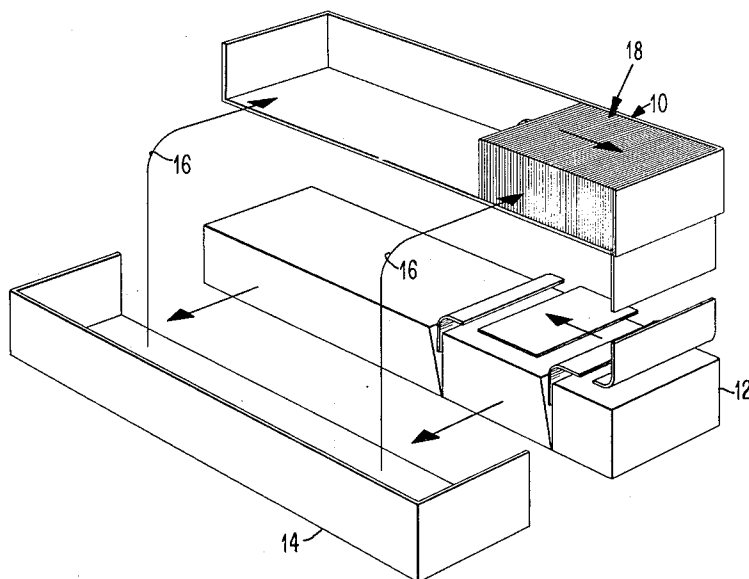


FIG. 1

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ATTORNEY

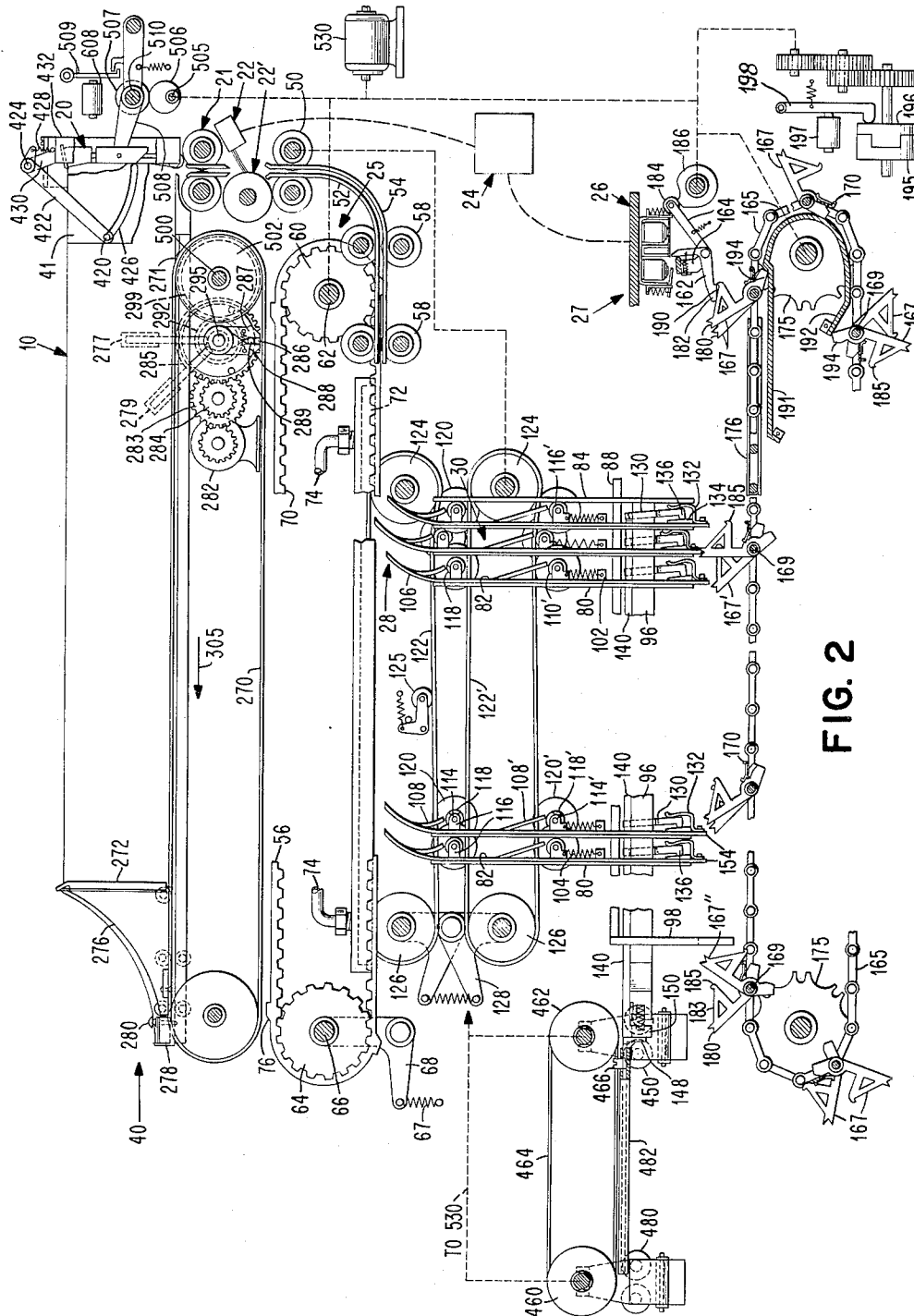
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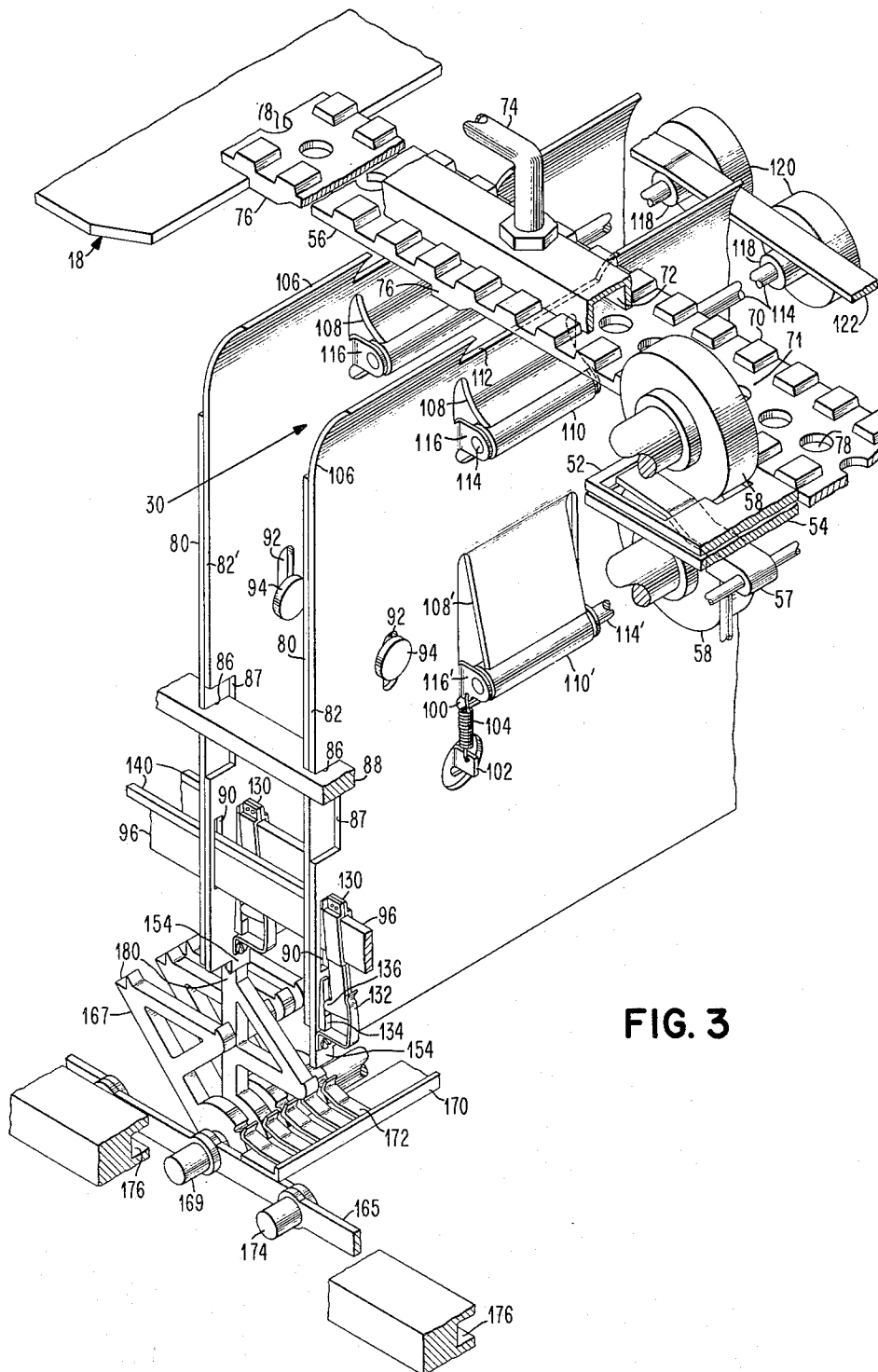
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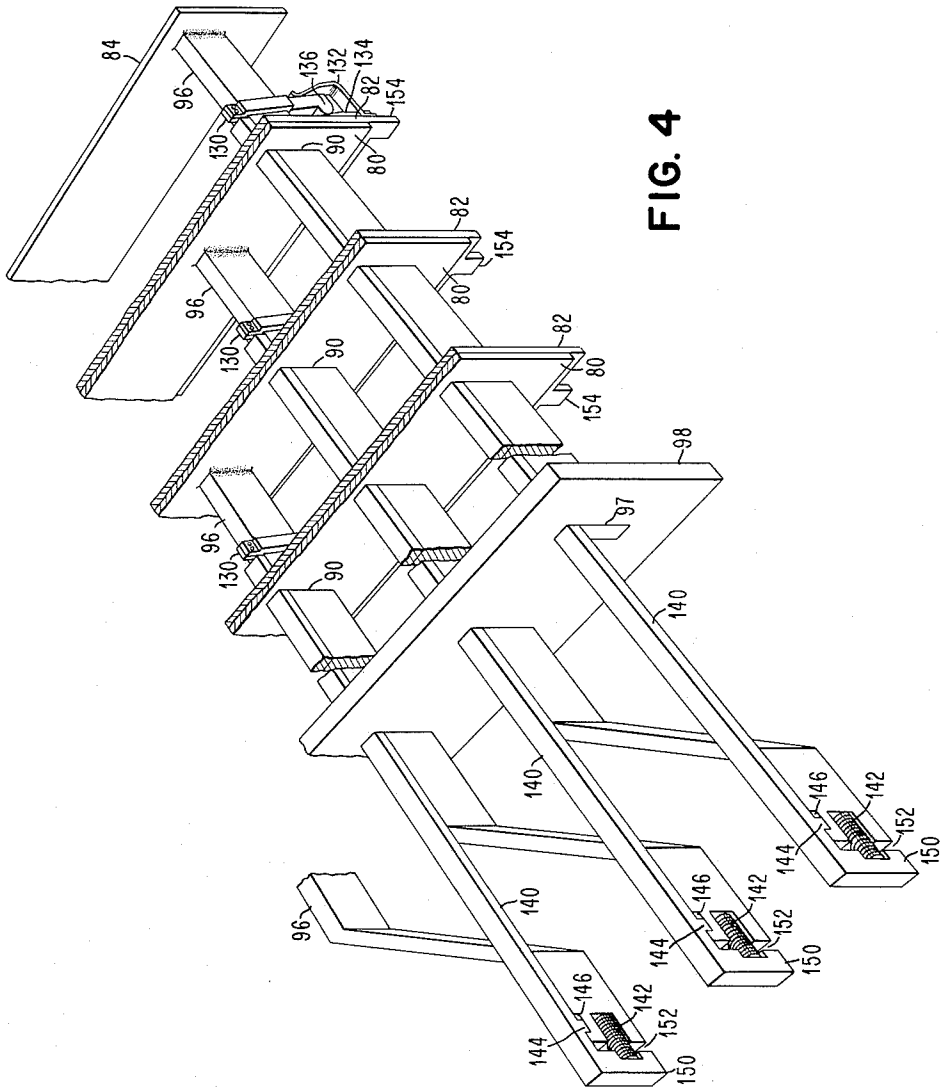
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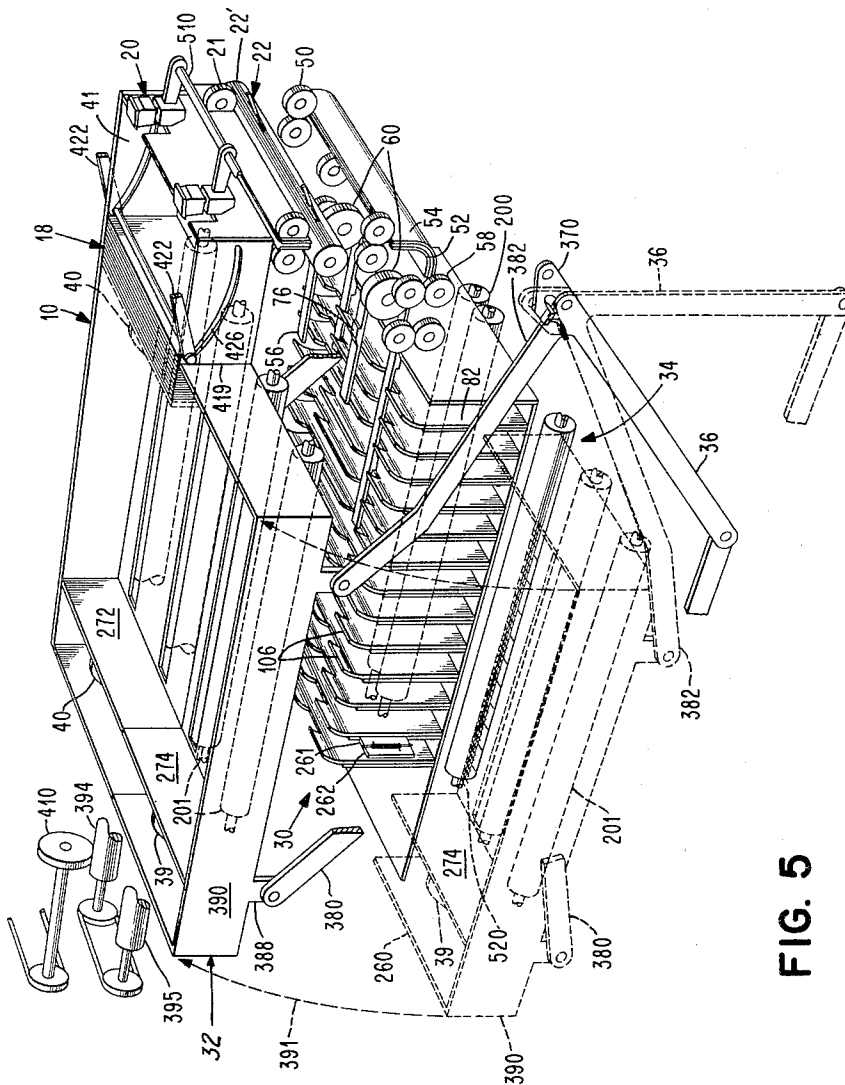


FIG. 5

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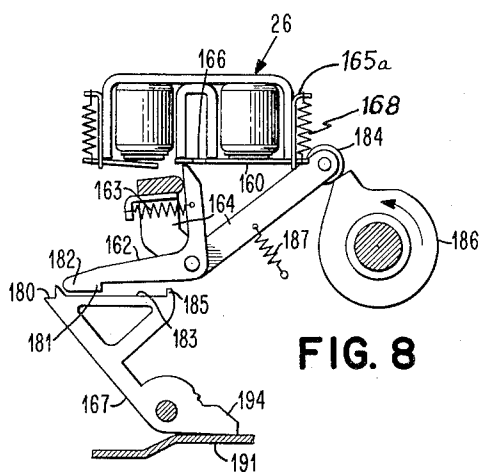


FIG. 8

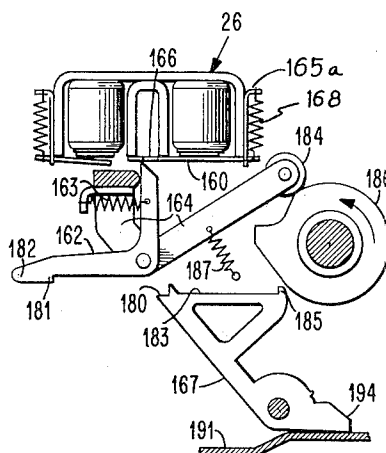


FIG. 7

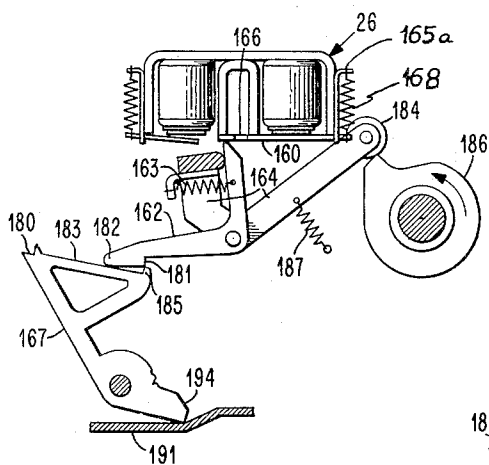


FIG. 9

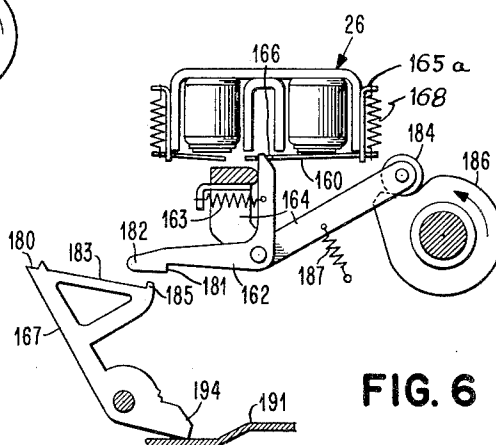


FIG. 6

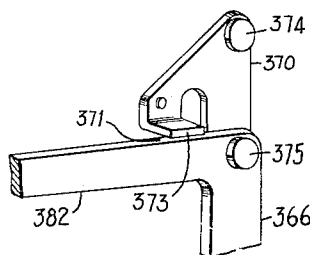


FIG. 17

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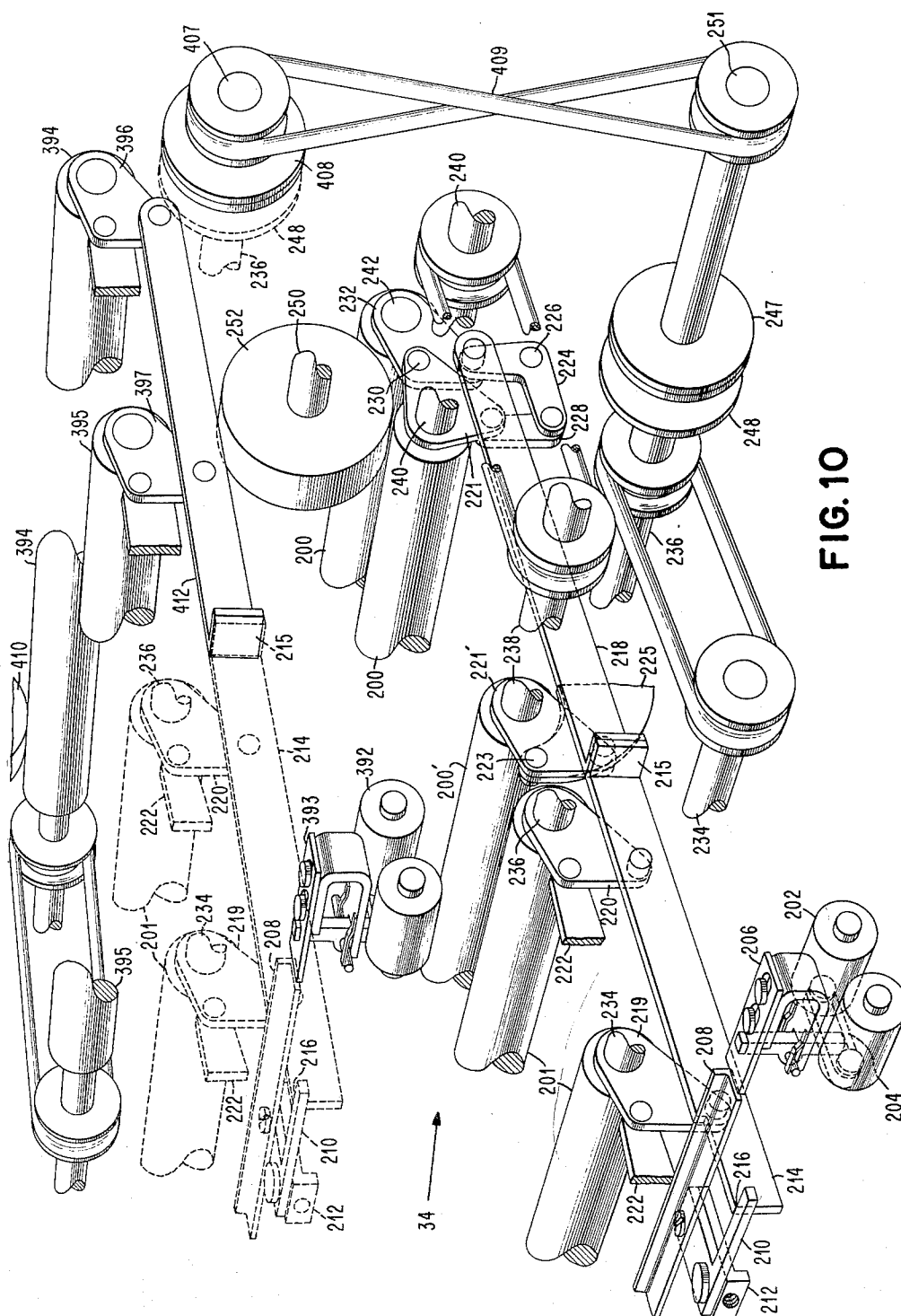
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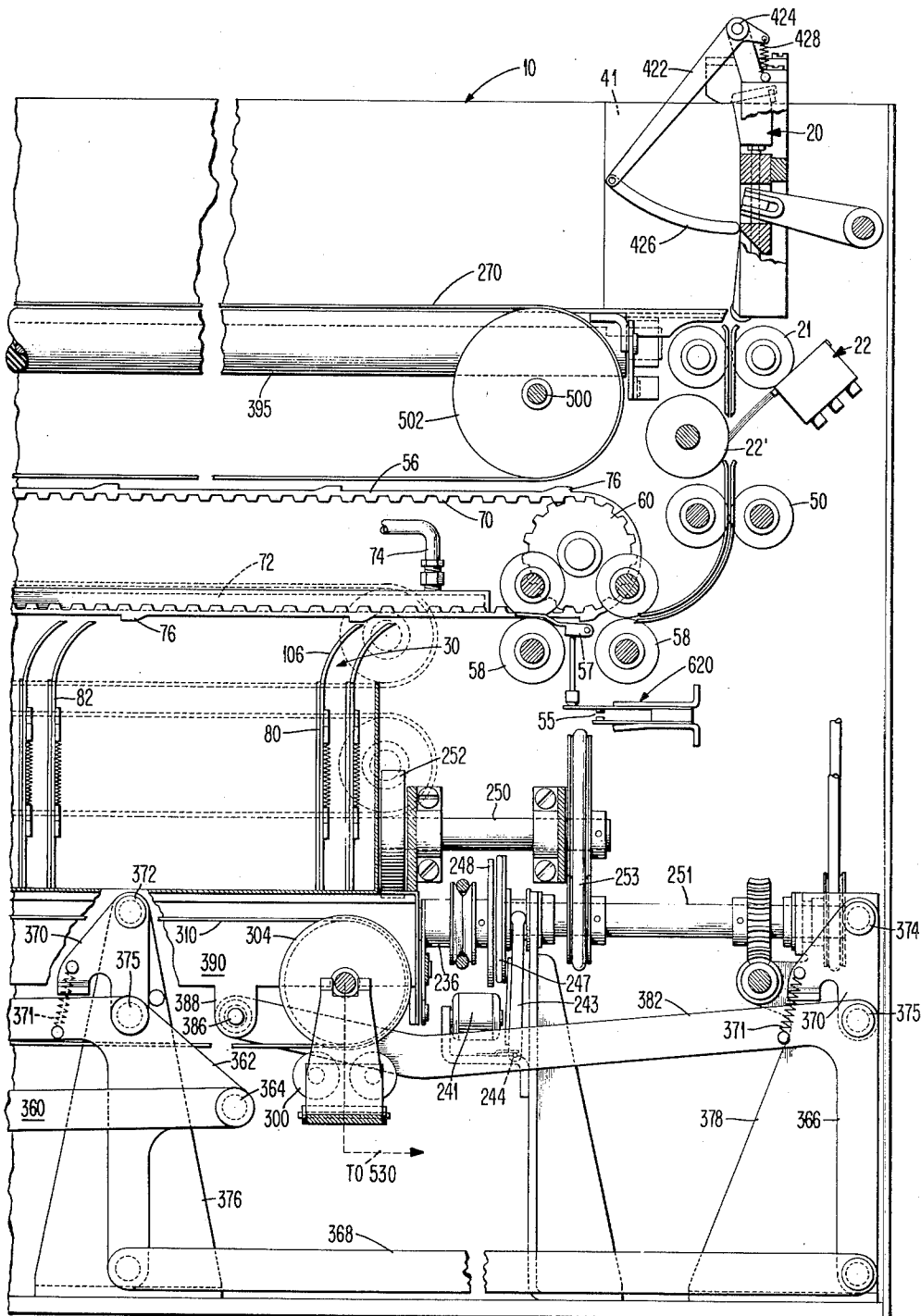


FIG. 11

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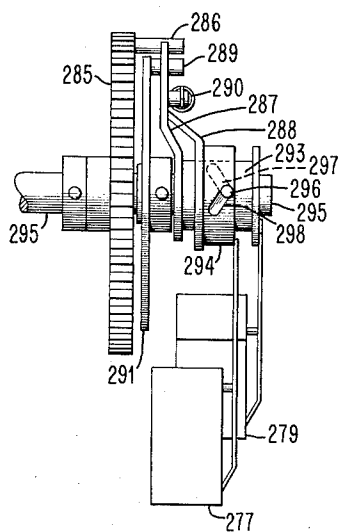


FIG. 14

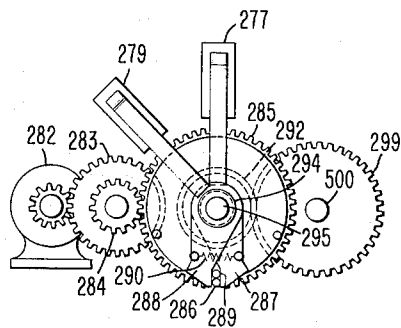


FIG. 13

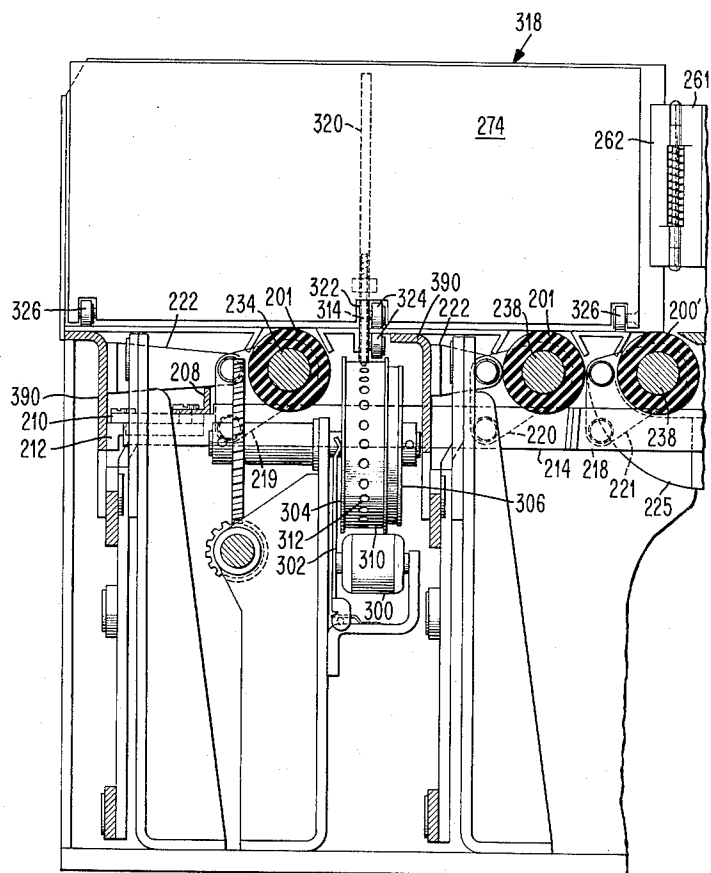


FIG. 12

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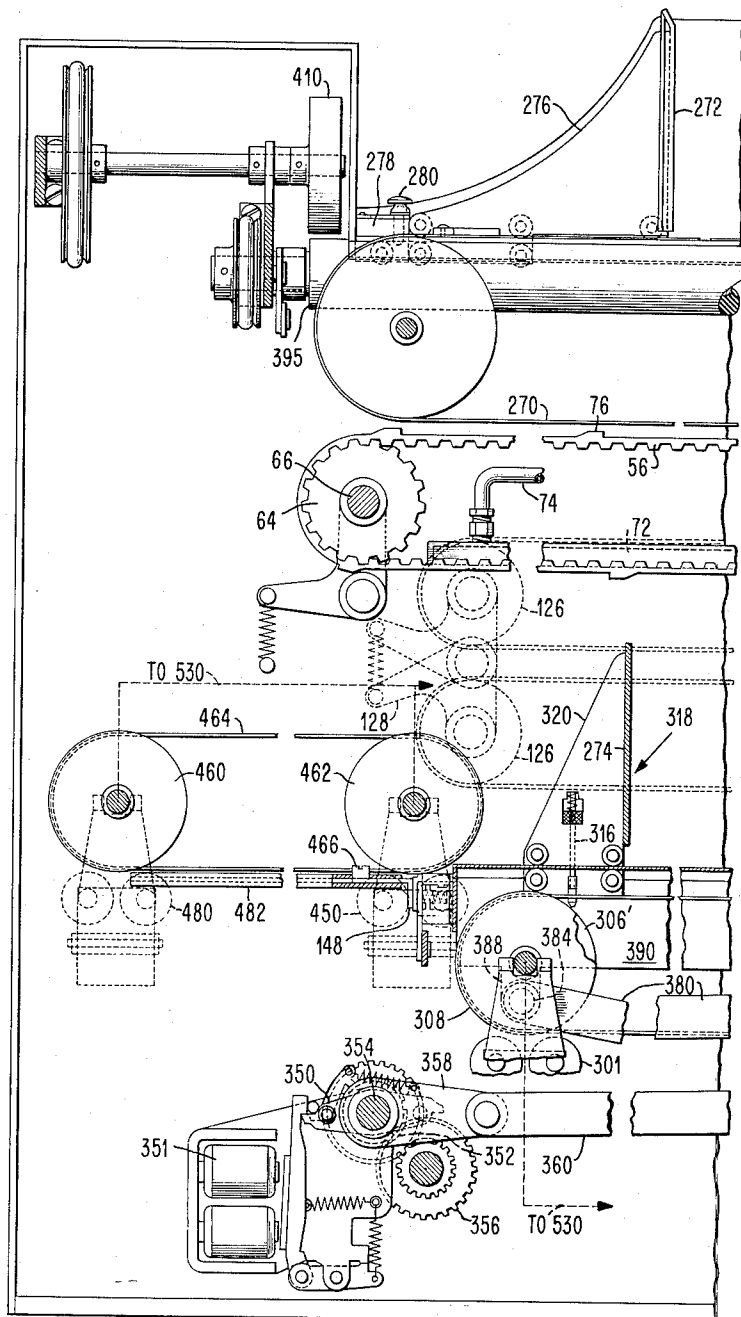


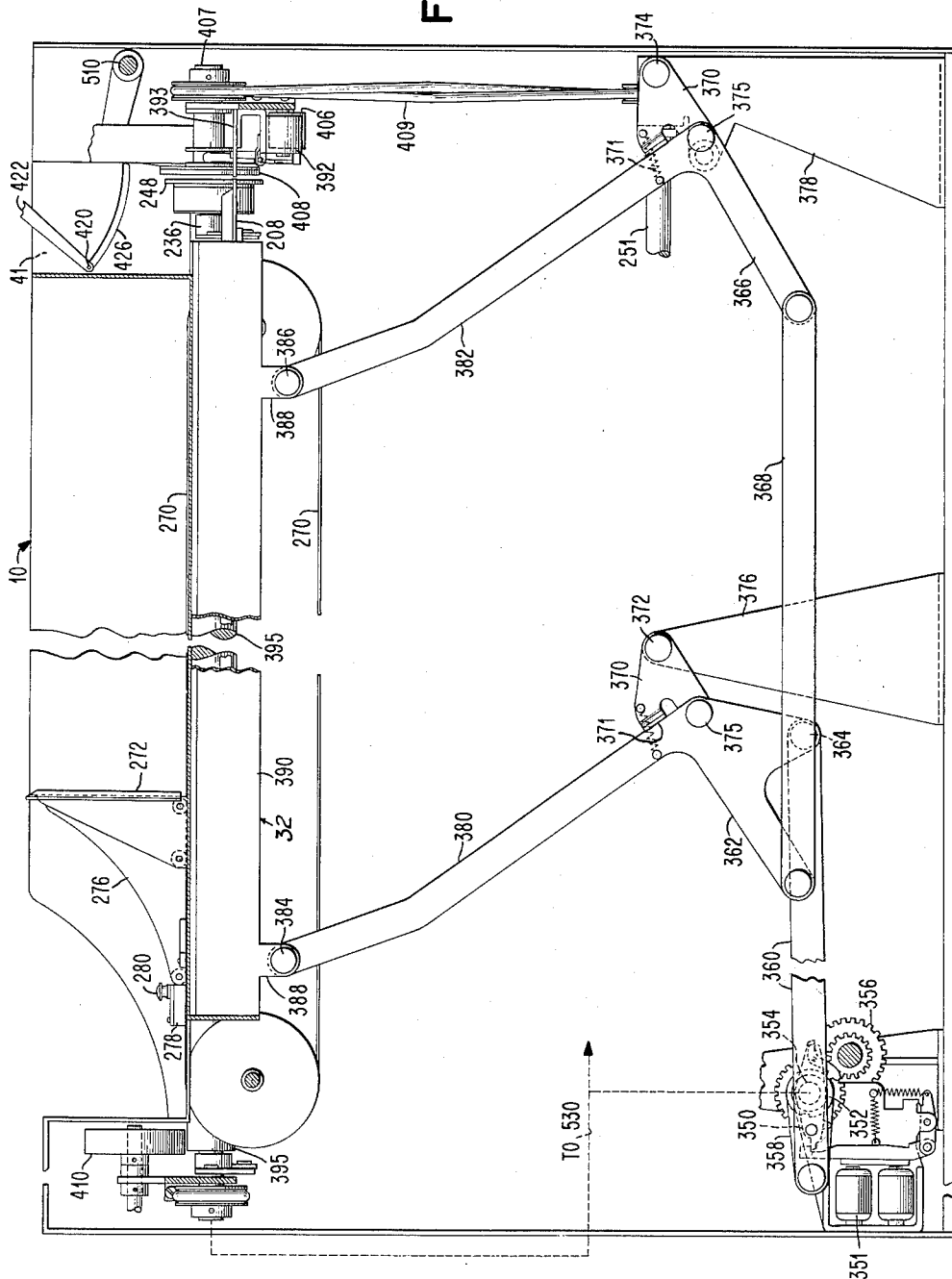
FIG. 15

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FIG. 16



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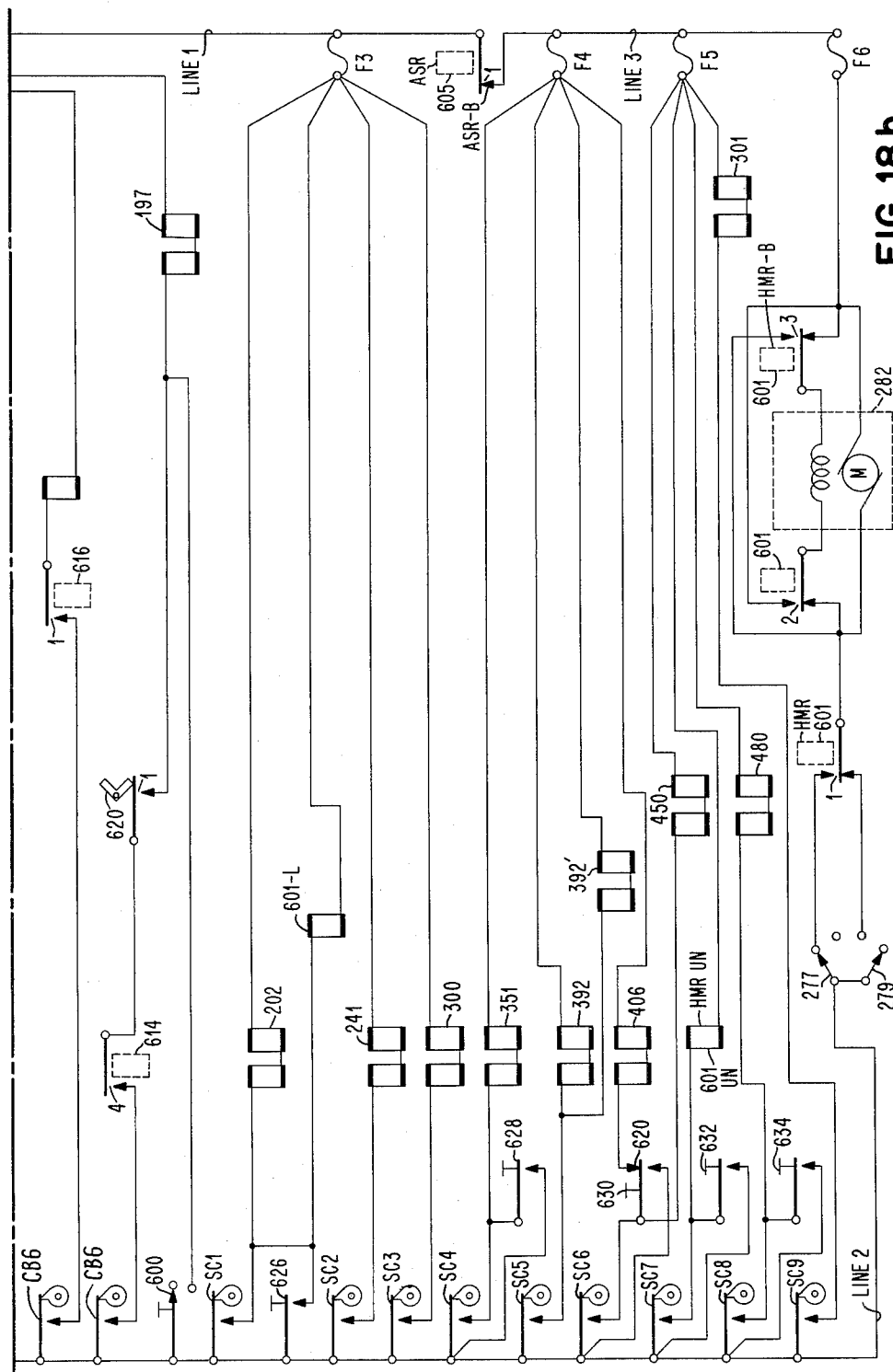


FIG. 18b

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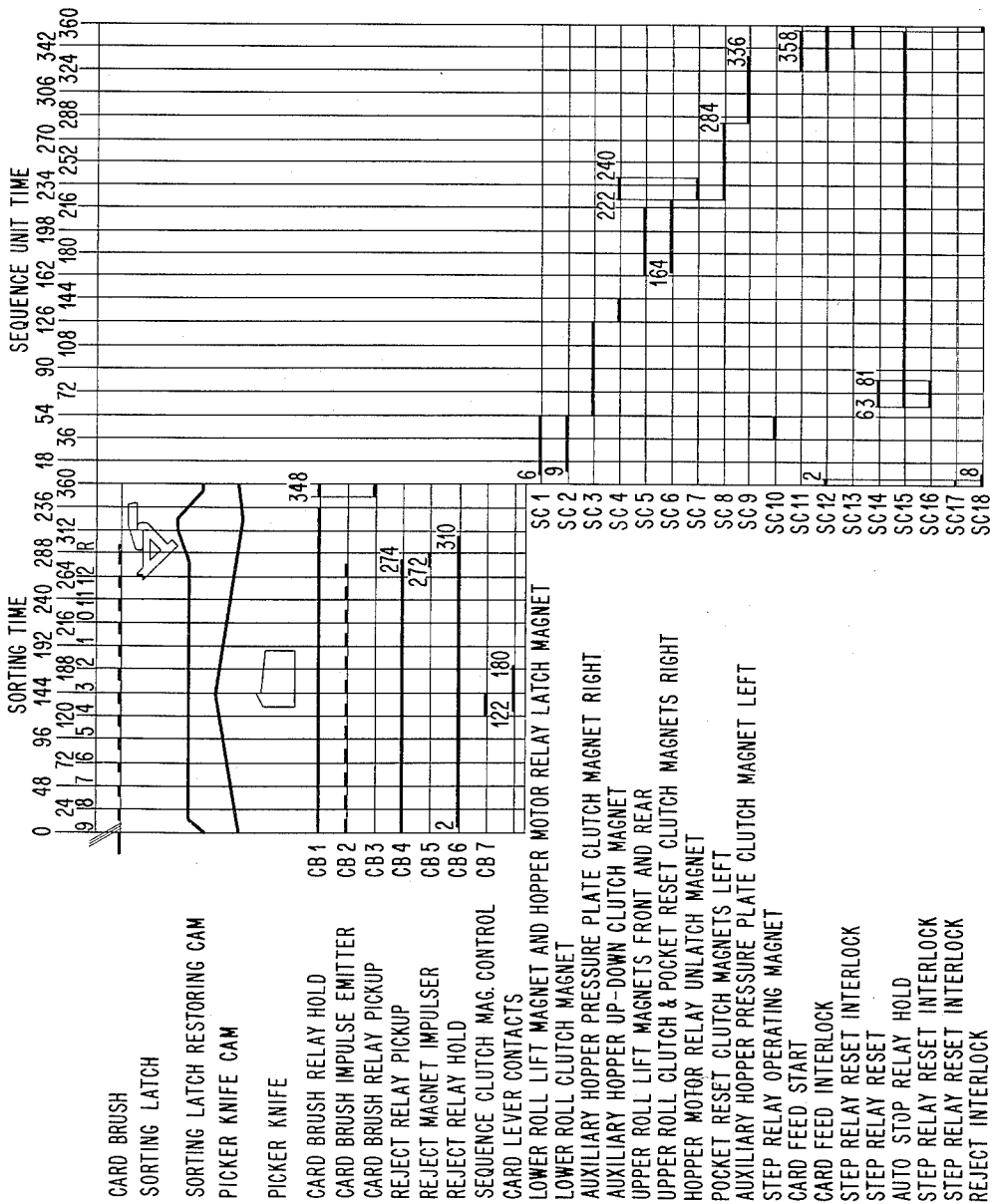
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FIG. 19



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SORTING MACHINE

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Filed May 13, 1959, Ser. No. 813,037

12 Claims. (Cl. 209-74)

This invention relates to a sorting machine, and, in particular, to a fully automatic sorting machine for sorting punched cards.

A sorting machine generally comprises a hopper which contains a deck of cards to be sorted, and a picker knife arm which picks off a card from the deck and delivers it through a throating device into a set of feed rolls. The cards contain perforations representing bits of information. The cards are passed through sensing means, such as electrical sensing brushes, which sense the openings in the cards. When a perforation in the card passes under the brush it enables the brush to complete a circuit and a signal or impulse is sent to a sorting magnet which then operates a particular chute blade to deflect the card into a particular pocket. As each card passes under the brushes, the signal transmitted to the sort magnets determines the pocket into which the card will ultimately be delivered. Whenever more than one sort is required to obtain the desired information, the brushes are reset to another position in order to select the other desired information as represented by the columns of perforations on the cards.

When the machine has finished one sorting step of a group of cards, the cards must be returned from the pockets to their initial position in the hopper and the machine reset for the next sort. Present practice requires an operator to remove the sorted cards from the pockets and return them to the hopper while maintaining the cards in sequence, and to move the brushes, or other sensing means, to the next column to be sorted.

Although a fully automatic machine has been recognized as a desirable feature for sorting machines, various card transporting problems have made it difficult to attain.

During a sorting operation, the pockets in present machines do not generally receive the same amount of cards. For example, a smaller number of cards are sorted into one pocket while a larger number may be sorted into another pocket. Normally, if a pocket becomes filled, the machines are designed to stop so as to prevent jamming of cards. Therefore, there is a requirement that the machine have the attention of an operator to remove the cards from the pockets that become almost filled in order to enable the machine to sustain its operation, although the total number of cards sorted does not fill the total capacity provided of all of the pockets.

Previously, the card stock was fed horizontally toward a picker knife with the cards standing on one of their edges, and then picked off by the picker knife which operated vertically. Although a constant weight was exerted on the stack, the weight was not uniformly distributed. The constant weight did not account for the yield or warp that the cards inherently have, which changes with decrease of the number of cards, and, therefore, resulted in a limitation on the speed at which the machine could operate. Thereafter, the design of the sorting machine was changed so that the stack of cards was vertically placed in the hopper with the cards laying on their flat side and the picker knife operating horizontally. This was done to permit the operator to more readily add more cards to the stack while the machine was operating. Also, the weight of the cards plus other additional weights permitted a higher speed

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of card feeding. With this type of feeding, the cards are sorted into groups into separate sort pockets. However, with this arrangement, it is difficult to automatically remove the cards from the pockets and still maintain the cards in proper sequence so as to automatically deliver them to the main hopper.

It is, therefore, an object of this invention to automatically remove sorted cards from the pockets of a sorting machine in such a manner as to maintain their sequence while returning them to the hopper for the next sorting step.

It is also an object of this invention to provide a hopper for an automatic sorter in which the cards are stacked to rest on their edge and yet urged toward the picker knife by moving the cards transversely to this edge, and also provide pockets into which the cards are sorted in a manner to rest on the edge and an auxiliary hopper into which the cards are transferred by moving them along their edge and from there moving the cards from the auxiliary hopper into the main hopper along this same card edge.

It is another object of the invention to provide automatic means to shift a sorting circuit from one brush to another brush, or from one line or column of sensing to another line or column, for each additional sort regardless of the number or order of the lines or columns, in order to automatically sort out cards containing the desired information.

It is a further object of the invention to maintain the sequence of the sorted cards by sorting the cards in the pockets in such a manner as to lay on their edge, and maintain the groups of sorted cards in close proximity to prevent them from falling on their sides while being transported.

It is another further object of this invention to feed cards in the hopper in a direction transverse to the plane of the card with the cards standing on their longest edge while the picker knife is operating to deliver the cards in a direction coinciding with the plane of the card, and to provide a card transport means to overcome the friction that was previously exerted on the edge of the cards as they were moved over the bed of the hopper, to thereby maintain a substantially uniform pressure of the cards at the picker knife and throat area so as to be capable of picking cards at higher speeds without unacceptable card damage.

It is a still further object of this invention to provide an automatic sorter in which the cards are sorted into pockets, which automatically expand to accept each additional card entering a pocket, and as each pocket is expanded in size, the succeeding pockets are shifted to a new card receiving position so as to make the cards transportable and maintained in sequence when the cards are transported from the pockets.

It is yet another object of this invention to provide a sorting mechanism having a plurality of expandable sorting pockets in which the overall length of the pockets increases by an amount substantially equal to the increase in size of one of the pockets, which increase in size is equal to the thickness of the card that is about to be received by that pocket so that the cards are more readily transportable, by automatic means, to a hopper.

It is yet another further object of this invention to provide an automatic sorting machine with expandable pockets for receiving cards which simultaneously deflect the cards into the pocket and automatically increase in size, and to provide means for retracting the pockets to their original size after a sort is completed and the cards removed from the pockets so that the pockets are in position to again receive cards which have been automatically removed from the pockets and returned to the hopper for the next sort.

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It is considered another object of this invention to provide automatically operated pressure plates in both the auxiliary hopper and main hopper, the pressure plates maintaining the cards in upright position so as to enable them to be transported and moved.

It is also another object of this invention to provide a card transporting mechanism for transporting the stack of cards into the main hopper at a position spaced from the picker knife, and to provide means for positioning the stack adjacent the picker knife.

Briefly stated and in accordance with one aspect of this invention, we provide an automatic means for returning the cards from the pockets of a sorting machine to the hopper in order to be resorted, where the cards are sorted into pockets having a plurality of dividers which are expandable so as to maintain the cards in close proximity to enable them to be transported, transporting the cards into a tray which is transported adjacent the hopper for removal into the hopper, and to provide card transport means in the hopper to engage the card stack in the hopper to insure proper feeding of cards at the picker knife.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

FIG. 1 is a schematic diagram showing the path of the cards as they are sorted into the pockets, and transported from the pockets to the main hopper for the next sort.

FIG. 2 is a view showing details of the card feed and sorting mechanism including the expandable pockets.

FIG. 3 is a perspective view partially showing the timing belt, expandable pockets and pocket selecting mechanism.

FIG. 4 is a perspective view showing the restoring mechanism for the expandable pockets.

FIG. 5 is a perspective view showing the card transport mechanism for transporting the cards from the expandable pockets to the main hopper.

FIGS. 6-9 show various positions of the cam latches and pocket opening levers.

FIG. 10 is a perspective view showing how the rolls are raised and rotated to transport the cards.

FIG. 11 is a view partly in section showing the mechanism for raising the card transport tray to the main hopper.

FIG. 12 is a view partly in section showing the means for driving the auxiliary hopper pressure plate.

FIG. 13 is a view showing the drive for the main hopper pressure plate.

FIG. 14 is a side view showing how the main hopper pressure plate exerts a pressure on the card deck which is maintained within a narrow range.

FIG. 15 is a view showing the card transport mechanism at its low position.

FIG. 16 is a view showing the card transport tray in its up position adjacent the main hopper.

FIG. 17 is a view showing a portion of the card transport tray mechanism.

FIGS. 18a and 18b are views of the circuit diagram for operating the machine.

FIG. 19 is a timing chart showing the sequence of operations.

Referring to FIG. 1, a schematic diagram is shown of the path of travel of the cards. In general, cards 18 are fed from a hopper 10, into an expandable pocket mechanism 12 and from there moved into a card transport means 14 to transport the cards back to the hopper 10 as shown by the arrows 16. The cards 18 are stacked side-by-side on one of their long edges, as shown in FIG. 1.

Referring now to FIG. 2, the cards are fed downwardly transversely of their long lower edge so as to be singly

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picked by the picker knife 20, and fed by feed rolls 21 past sensing means 22 which sends a signal to a distributor 24. The cards then pass into a timing card transport means 25 for maintaining the cards in timed sequence and which will hereinafter be more fully explained. The distributor 24 is a part of a selector mechanism 27, the distributor being timed with card movement to send a signal from a single brush at the appropriate time to a pair of magnets 26 so as to actuate one of the chute blades 28 and deflect the card into one of the expandable pockets 30. There are as many pairs of magnets as there are pockets. The cards are thereafter automatically removed from the pockets into a card tray transporting system (FIG. 5) by a card roll device generally designated at 34 (see also FIG. 10). The transporting system comprises a card tray or auxiliary hopper 32 (FIG. 5) and linkage means 36 for automatically transporting the tray and cards from a position adjacent the pockets 30 to a position adjacent the hopper 10 where they are automatically removed into the main hopper 10 at a location spaced from the picker knife 20 for continuing the sorting process. The cards 18 are then moved toward the picker knife 20 by an automatic pressure means 40 to fill the gap 41. Automatic pressure means 39 is provided in the auxiliary hopper for maintaining the cards in an upright position and compact. Also, the automatic pressure means 40 is provided in the main hopper for maintaining substantially uniform pressure on the cards and thereby exert a substantially constant pressure at the picker knife as the cards are removed from the hopper.

The timed card feed, the expandable pocket system, selector mechanism, the clutched sequence cam unit, the card tray transport system for emptying the pockets and reloading the hopper, including the variable pressure means for supporting the cards in the auxiliary hopper and for maintaining pressure on the cards in the main hopper, the timed mechanical drive means, and electrical circuit will now be individually described.

Timed Card Feed

An important consideration in sorting cards in a sorting machine is that of timing. In other words, the operations to be performed on the card must take place in sequence. For example, the timing of the delivery of the card to the sensing means 22 is important to actuate the proper chute blade 28 so as to deflect that card into that chute at the exact moment that the card arrives at the pocket. Otherwise, additional sensing means would be required in order to determine where the particular card that you were sensing is located in the machine. By accurately timing the card from the instant it is placed into motion by the picker knife, the various operations can be timed to take place.

Therefore, in order to feed cards in timed relationship and to actuate the appropriate chute blade to deflect the card into its proper pocket, picker knife 20 delivers cards according to a timed relationship (FIG. 2). The cards are fed past sensing brushes 22 by feed rolls 21, 50 and between the guide plates 52 and 54. Referring to FIGS. 2 and 3, and in order to still maintain the cards in timed relation with the remainder of the machine, two pairs of feed rolls 58 together with the guide plates 52 and 54 form a guide path for feeding cards onto two timing belts 56 (see also FIG. 5). Extending through the guide path is a card lever mechanism (FIG. 11) which closes contacts at 55 when cards feed past and depress the lever 57. The contacts will remain closed until the last card of a sort has passed. The card lever is sufficiently long to overlap the gap between the cards so as to maintain the contacts closed during a complete sort. The contacts will thereafter reopen under their own spring tension. The purpose of the card lever mechanism will be more fully explained under the section entitled, "Circuit Description and Timing Chart." The

timing belt 56 is kept in proper timed relationship by being supported by and driven by sprocket wheels 60 and shaft 62 (also FIG. 2). It is intended that the drive for shaft 62 be connected to the same drive means as the picker knife to maintain the timing relationship. The other end of the timing belt 56 is supported on and passed around sprocket wheels 64 which are rotatably mounted on a shaft 66, which shaft is rotatably mounted in a pair of spring biased arms 68. For purposes of this invention, a pair of sprocket wheels 60 (FIG. 5) and 64 is used. The spring 67 (FIG. 2) enables the spring arms 68 to maintain each belt 56 in a tight condition at all times. The teeth 70 that mate with the sprocket wheels 60 and 64 are positioned near the marginal edges of the belts thereby providing a smooth surface 71 (FIG. 3) in the center portion of each belt so that each may ride against the under side of a vacuum channel 72. Vacuum can be supplied to the channel in any well-known manner such as a conduit 74 for each belt 56.

Since it is important to insure proper timing of the card throughout the sensing and feeding operations, a series of lugs 76 are provided on each belt 56 which extend across the belt and are spaced equally around the periphery of the belt. The lugs 76 are spacedly positioned so as to main the cards in timed relation with the picker knife, feed rolls, reading brushes 22, etc., from the time that the card is picked from the hopper. In addition to maintaining the cards in the proper location and timed relationship to the other timed operation, the lugs 76 also assist in pushing the cards into the proper sorting pocket 30, the details of which will be more fully hereinafter explained.

In order that the belts 56 can positively retain and support the cards when the cards are brought around to the underside of the belt 56, openings 78 (FIG. 3) are provided in the central portion of each timing belt between each pair of lugs and positioned so as to be aligned with the vacuum channels, and in that manner serve as vacuum ports to support the cards against the belts.

The Expandable Pockets

Reference is now made to FIGS. 2, 3 and 4 which show an expandable pocket system for stacking the sorted cards in the least amount of space so as to make them more readily transportable. Each pocket 30 is defined by two plates 80 and 82, two such plates forming a divider as best shown in FIG. 3. In order to provide a plate from which all of the other plates move or expand, a reference plate 84 (FIG. 2) is provided and is mounted so as to be stationary. A U-shaped notch 86 (FIG. 3) is provided in the plates 80 so as to ride on side rail 88. The other sides of the plates 80 also contain notches 86 to permit the side rail 88 to support the plates 80. The plates 82 contain elongated notches 87, the purpose of which will be more fully hereinafter explained. Now, the plates 82 also are provided with rectangular openings 90, but these openings 90 are elongated to permit the plates 82 to move vertically whenever the plate is energized upwardly. This will permit the plate 82 to extend up into the path of the card so as to strip the card from the belts to deflect the card into the pocket 30. Not only do the plates 82 have elongated notches 87 so as to ride on rails 88 along with the plates 80, but they are also slidably supported on the plates 80 so as to move vertically with respect to the plate 80 since they form the deflecting chute blades for deflecting the cards. For this purpose we provide elongated slots 92 (FIG. 3) in the plate 82, there being at least two for each plate. Studs or the like 94 are shown mounted in the slots 92 and are fastened to the plates 80. We have shown the second plate 82 in its upward position as shown at 82'. The plates 80 and 82 are slidably mounted on the rails 88 to enable the

pockets to increase in size, so as to make room for the cards as they are deflected into the pockets.

Since the pockets formed by the plates 80 and 82 are in an expanded condition when all of the cards have been sorted, the plates must be restored to their original or contracted position before the start of each sort. Therefore, after the cards are removed from the pockets and returned to the hopper, we provide thin pocket restoring bars 96, one pair fastened to the plate reference 84 and each remaining pairs fastened to separate plates 80. Each plate 80 has a pair of such bars fixed to it, which bars then extend through the openings 90 in the remaining plates 80 and 82 from right to left as viewed in FIGS. 2 and 4. The bars 96 are slidably mounted at their other ends in a stationary support plate 98 (FIG. 2). It is to be noted that the outermost pair of bars 96 are fixed to the plate 98 at 97. This results in the pair of bars 96 connected to each plate 80 or 84 being shorter than an adjacent pair of bars by the width of a contracted pocket. The significance of this will be explained in greater detail hereinafter.

In order that the plate 82 for each pocket can be deflected or urged upwardly into the path of the cards, and also to be returned to its original position, a pair of brackets 100 (FIG. 3, only one being shown) is fixed to the movable plate 82 and a pair of brackets 102 (only one being shown) is fixed to the stationary plate 80. A pair of springs 104 (only one being shown) is mounted between these two brackets 100 and 102 so as to urge the plate 82 downward below the card feed path to a retracted position. In order to provide a means for deflecting the card into the pocket, the upper portion of each plate 82 is curved to the right, as shown at 106 in FIG. 3. The curved portion 106 also contains two deflector tongues 108 which extend down into the pocket to direct the cards over rollers 110 which will be hereinafter more fully explained. Still referring to FIG. 3, it is noted that the upper curved portion 106, which deflects the card into the pocket, would normally interfere with the timing belts 56 when the plate 82 is in its upward position. In order to avoid any interference, a recess 112 is shown at this location in the plate 82 so as to avoid engagement with the belt 56.

Referring to FIGS. 2 and 3, and as pointed out previously, the cards are assisted into the pockets 30 by the lugs 76 in addition to the curved portion 106 on the deflector chute blade 82, and the deflector tongues 108. However, since the timing belt is operating at a high speed, a more positive means is provided for pulling the card down into the pockets. Gravity alone, with the assistance of the lugs 76, deflector blades 106 and deflector tongues 108, are insufficient to pull the card down and away from the timing belt 56, or to strip it from the belt 56 in a sufficiently small time. Therefore, in order to more quickly pull the cards down and away from the belt 56, we provide the two friction rollers 110 which are mounted on shafts 114 which are in turn mounted for rotation in ears 116 struck outwardly from the plates 82. As best seen in FIG. 3, each shaft 114 also carries a pulley 118 and a fly wheel 120 which permits the shaft 114 to spin for some time after it is removed from engagement with high speed belt 122 which will be more fully explained.

To further assist the cards being pulled down into the pocket 30, we provide deflector tongues 108', friction rollers 110' mounted on shafts 114' which carry a pulley 118' and fly wheel 120' (FIGS. 2 and 3). Another high speed belt 122' is provided for rotating the rollers 110'.

In order to set the two sets of friction rollers 110, 110' (FIG. 2) in rotational motion so as to pull the card down after the card has been sensed and the proper plate 82 has been energized into position to deflect the card, two flat belts 122, 122' are mounted for high speed rotation on two pairs of pulleys 124 and 126.

In addition, pulleys 126 are mounted on belt tightener spring bell crank arms 128 so as to maintain the belts in a tightened condition at all times.

Therefore, when the cards are sensed and a signal is received to actuate the plate 82 to deflect the card into a particular pocket, the plates 82 are pushed up to strip the card from the vacuum belt 56 and the pulleys 118, 118' are brought into contact with the high speed belts 122, 122' thereby causing the shafts 114, 114' to spin and cause rollers 110, 110' to pull the card down into the pocket. In addition, the inertia of the fly wheels 120, 120' will keep the shafts 114, 115' spinning for some time after the plates 82 have been returned to their normal position to insure complete removal of the card from the belts.

When more than one plate 82 is energized so as to be pushed up, one of the pulleys 118 may push up on the belt 122 so that the other pulleys would not be in contact with the belt 122. To insure that there is some contact, means are provided to hold the belt 122 down so as to insure engagement of the pulleys 118 and the belt 122. This can be accomplished by a flat guide plate extending across the belt for holding the belt down, or by using spring-biased rolls. For this particular embodiment, we prefer to use auxiliary spring rolls 125 acting on belt 122 to insure contact between the pulleys 118 and belts 122 when more than one plate 82 is pushed up simultaneously. The same type rolls can be used for belt 122'.

As the cards are deflected into the pockets, they are stacked in each pocket on their edge rather than on their flat side so as to make it convenient for them to be removed from the pockets and then transported up into the hopper. Also, the cards are maintained in their upright position, so as not to fall over, by the dividers 80, 82 being automatically sized to the number of cards in each pocket. The pocket increases in size only after a signal has been received that it is to receive another card. When this happens, not only is that pocket increased in size by the thickness of the card, but all of the other pockets thereafter are shifted by the same amount to a different card receiving position. Also, if simultaneously one card is entering a pocket while an earlier pocket is about to receive a card, the former pocket will not only increase in size but will also shift its card receiving position. It is also possible for an earlier pocket to be receiving a card so as to shift the position of a later pocket while that later pocket is increasing in size to receive a card designated for that pocket. As shown in FIGS. 2, 3 and 4, and particularly FIG. 3, this is accomplished by providing a clutching lever 130 around each restoring bar 96. The clutching lever 130 is urged into cramping relation with the restoring bars 96 by springs 132 and cam 134. Whenever a signal is received from sensing a particular card that it is to be deflected into a particular pocket, plate 82 of that particular pocket is urged upwardly carrying with it the cam 134. As cam 134 is carried upwardly, it moves against the nose 136 of the clutching lever 130 which forces the plates 82 and 80 to the left and is cumulative when more than one plate is pushed up. Since the clutch lever 130 straddles the restoring bar 96 (FIG. 3) and is slidably mounted thereon, it will be in a cramped or latching position whenever the cam is urged against the nose of the clutching lever. The cam being fastened to the plate 82, pushes against the nose 136 and moves the plate 82 to the left. The pocket will be increased in size to receive the card just prior to the card entering the pocket rather than afterward. Therefore, when the plate 82 returns to its normal position, it will also carry along with it the cam 134 so that the spring 132 will urge the nose 136 of the clutching lever 130 to follow the cam 134 to its lower position and thus release the clutching action of the clutching lever 130 against the restoring bar 96. The spring 132 will now

slide the clutching lever 130 to the left along the restoring bar to a new clutching position.

As each pocket increases in size, the pockets which follow in sequential order shift their card receiving positions by that same amount. This is accomplished by having the cams 134 always in engagement with the noses 136 of clutching levers 130 and the other plates 80 slidably mounted on the bars 96 which are supported at their other ends by the support plate 98 (FIG. 2).

In order to aid the releasing of the clutch levers 130 and restoration of the plates 80 and 82 to their original retracted position, a clutch release rod 140 (see also FIG. 4) is positioned on the top of each restoring bar 96. These rods are of various lengths and extend from the left end of each restoring bar to within a short distance from the upper end of each clutching lever 130. Referring more particularly to FIG. 4, these rods pass through the slots 90 in the plates for the restoring bars 96 and are free to move a short distance to the right when pressure is applied against their left ends. Springs 142 are provided so as to urge the clutch release rods 140 normally to the left. In order to restrict the movement of the clutch release rods 140 by the springs 142, lugs 144 nest in the notches 146 in restoring bars 96. After the cards are removed from the pockets 30 and it is desired to restore the pockets to their normal contracted starting position, pressure is applied to the left end of the clutch release rods 140 by a bail 148, as shown in the lower left portion of FIG. 2. This causes the clutch release rods 140 to move to the right and release all of the clutching levers 130. Further movement of the bail 148 and clutch release rods 140 brings the L-shaped portion 150 (FIG. 4) of the rods against the ends 152 of the restoring bars 96. Further movement of the bail 148 against the restoring rods 96 moves the plates or dividers 80, 82 to restore the pockets to their normal position.

In order that each plate 82 be capable of being moved in a vertical direction when a card is sensed and the particular pocket for that card determined, each plate 82 is provided with two ears or tabs 154 which project downward. The pair of ears for each plate is offset from the ears of an adjacent plate (as best seen in FIG. 4) so that they do not lie in the same path. This enables the plates to be actuated by a particular pocket opening lever, which will be hereinafter more fully explained, so that only one plate will be actuated for each card.

Selector Mechanism

In order that a card be deflected into a particular pocket when that card approaches the particular pocket, sensing brushes 22 (FIG. 2) are provided for sensing impulses from the card and to direct the impulses to the sorting distributor 24 which energizes the sorting magnets 26 at the appropriate time. There are two sorting magnets 26 designated for each plate 82. Therefore, for this particular embodiment there will be twenty-six such magnets although the number will depend upon the number of plates 82 and pockets used. Each sorting magnet 26 has associated with it an armature 160 (FIGS. 6-9) which is attracted to it when a pulse is received. Release latches 162 are pivotally mounted and spring biased by spring 163 toward a bail 164. A slot 166 is provided in the armature 160 so as to be engaged by the release latch 162. Therefore, when the armature 160 is attracted to the magnet 26, the release latch 162 will rock against the bail 164 to prevent relatching until the magnet is subsequently de-energized. It will be noted that each armature 160 is pivotally mounted in the sorting magnet assembly on a fixed arm 165a and is biased away from the magnet coil by a spring 168. The release latch 162 follows the bail 164 when the follower 184 rides up the high portion of the cam 186, provided the magnet is energized. However, when the magnet is not energized, the armature 160 will latch up the release latch 162 so that the latter cannot follow the movement of bail 164 as it responds to the

follower 184 and cam 186. The various combinations of energizing and de-energizing of the magnet 26 and the latching and unlatching of the release latch levers 162 permit controlled movement of the lever 162 and pocket opening levers 167. This will be described in more detail hereinafter.

In order for the release latch 162 to transmit the signal it receives to the plate 82 of the pocket so as to actuate it upwardly and thereby deflect the card into the pocket, a sprocket drive chain 165 (FIGS. 2 and 3) is provided which is slightly wider than the card and so aligned as to travel below the pockets and also below the sorting magnets 26. The sprocket drive chain 165 is provided with lever means which is actuated by the releasing latches 162, which lever means in turn operates on the tab 154 of the plate 82. This lever means is in the form of pocket opening levers 167.

The pocket opening levers 167 are mounted on shafts 169. For this embodiment there are twenty-six levers 167 in each row, or thirteen pairs on a shaft 169 to coincide with the number of pockets 30, sorting magnets 26, and latches 162. Fixed to the links adjacent the pocket opening levers is a spring support 170 (FIG. 3) extending the width of the chain. The spring support 170 supports the pocket opening lever detent springs 172 and acts as a stop for the pocket opening levers 167 when they are restored to their original position. The links of the chain 165, not connected by shafts 169, are connected by chain pivots 174 which do not extend all the way through the levers but merely extend through the adjacent links. As the chain pivots 169 and 174 leave sprocket wheel 175, they enter a guide slot 176 which prevents pressure exerted on the pocket opening levers from displacing the levers.

In order that a pocket opening lever 167 find the plate 82 for a designated pocket so as to deflect the card into that pocket, the pocket opening levers 167 are first carried past the latches 162 by the movement of the chain 165. Reference is now made to FIGS. 6-9 which show different positions of the pocket opening levers 167 and release latches 162. It is noted that there are thirteen pairs of magnets 26 in a row, whereas there are several rows of pocket opening levers 167, there being thirteen pairs in each row (see FIG. 2). Also, a row of pocket opening levers passes the row of magnets at the same time that the magnets are responsive to an impulse received from a card that is read. The impulse may take place at one of thirteen different time locations, twelve on the card and one following. Therefore, the magnet representing a selected pocket must be impulsed before the pocket opening lever reaches that magnet. The intermediate dwell portion on the cam 186 is designed to permit this to take place. Also, it is important to note that each row of pocket opening levers slightly leads the card after it is read (see FIG. 2) so that when the pocket opening lever finally finds the correct pocket it will energize its plate 82 in time to receive that card.

Referring to FIG. 6, the pocket opening lever 167 is shown leaving the release latch 162. At this time, the follower 184 is riding on the low side of the cam and the magnet 26 is de-energized so that the armature 160 latches up the release latch 162 so that it cannot engage the pocket opening levers unless and until the magnet is energized. As the next row of pocket opening levers approach the row of magnets, the pair of magnets, representing the index point sensed in the card, is impulsed (FIG. 7). The cam is designed to have a substantially long intermediate dwell portion to accommodate the time it takes to read the card, for example, the thirteen index point. The magnet may be energized during any portion of the intermediate dwell so that the release latch 162 can drop against the bail 164. The magnet is energized for only a short period of time merely to unlatch the lever 162 to permit it to follow the bail 164. However, the armature cannot relatch the latch 162, even

though the magnet is de-energized, until bail 164 restores latch 162 into alignment with notch 166; this will occur only when follower 184 rides onto the low point of the cam 186 (see FIG. 6).

Meanwhile the intermediate cam dwell portion is designed to position the bail 164 so that the latch lever will clear the notch 180 on the pocket opening lever 167. The impulse from the magnet is therefore stored in the latch 162 until it is transmitted to the pocket opening lever 167.

The cam 186 is designed so that the high portion is timed to act on the bail and latch 162 when the nose 182 is located between the notch 180 and abutment 185 (FIG. 8). The latch 162 drops along with bail 164 so that the nose 182 is in position to catch onto the abutment 185. The latch 162 will drop with the bail 164 even though the magnet is now de-energized since it is unlatched. The armature 160 cannot yet latch the lever 162 since the lever 162 is beyond the slot 166 in the armature.

There is a row of latches 162, and a row of magnets 26, and although there are a plurality of rows of pocket opening levers, only one pair of pocket opening levers will be actuated as a result of each pulse.

Reference is now made to FIG. 9, where the selected pair of release latches 162 are shown transmitting the stored impulse from the latch 162 to the pocket opening lever 167 by the hook 181 acting on the abutment 185. Engagement of the hook 181 and abutment 185 causes the pocket opening lever 167 to rotate clockwise bringing the notch 180 into position to engage the particular tab 154 that lies in its path. As the lever 167 rotates clockwise, the intermediate camming portion 183 will engage the nose 182 of the latch 162 resulting in the disengagement of the hook 181 and the abutment 185. That plate 82 which contains the tab 154 that matches the selected pocket opening lever 167 will be raised.

When follower 184 rides into the low portion of the cam 186, the release latch 162 will enter slot 166 and be latched up in the position shown in FIG. 6 until the magnet is impulsed again. Overthrow of the levers 167 is prevented by contact of the tail 194 of lever 167 and cam 191. The frictional force of detent springs 172 (FIG. 3) on the levers 167 will now hold the levers 167 in an operative position to engage the tabs 154 on plates 82. At the same moment that hooks 181 disengage from the abutment 185, the follower 184 starts to drop off of the high point of the cam and onto the low point for causing the latches 162 to be relatched to the respective armatures. Any number of levers 167 can be used for actuating the plates 82 depending upon the timing and speed with which the cards are delivered.

The sprocket chain 165 carries the levers 167 in synchronism with the card under the timing belts 56. This is to enable the levers to actuate the proper plate 82 to deflect the card into the proper pocket at the proper instant. The notch 180 on a pair of two pocket opening levers 167 will now actuate the mating tabs 154 on the plate 82, which lies in their path, for the pocket corresponding in number to the index point that has been sensed on the card by the brushes and transmitted to the sorting magnets.

In further describing the operation of the levers 167 and the tabs 154 (FIG. 3), when the notches 180 engage the tabs 154, the chain link 165 will again cause the levers 167 to rotate clockwise with respect to the pivot shaft 169 as the shaft passes under the actuated plate 82. The pocket opening levers 167 will thus force the plate 82 upward, and the upper curved portion 106 of the plate will pass above the end of the card, stripping it from engagement with the timing belt. The lugs 76 will urge the card downward between the deflector tongues 108 and the adjacent plate 80. The card will then come between the spinning friction rolls 110 and the plate 80 where it will be further urged into the pocket before the friction rolls stop spinning. As the pivot 169 passes plate 82,

the spring 104 will return the plate to its normal position and the lever 167 will rotate to the position as shown at 167' at the left side of FIG. 2. The sprocket chain link 165 will carry the levers 167 in this position until they reach the restoring cam 192 (FIG. 2) which is at a point in the cycle before the levers pass under the sorting magnets 26. The tail 194 of the lever 167 will ride on the cam 192 rotating the lever to its normal position before being actuated by the sorting magnets, and holding this position until it reaches the setup position under the latch 162 to start the sequence all over again.

Clutch Sequence Cam Unit

Since this machine is fully automatic, a sequence of operation control unit is used to time the various functions. The unit consists of a number of contact cams on a one-revolution clutched shaft geared down to a slow r.p.m., for example, 3 r.p.m. Each cam is designed to engage a switch at a particular time in the cycle when a particular operation is to be performed. The cams are shown in FIGS. 18a and 18b and are timed to open or close switches in accordance with the timing chart, FIG. 19. Referring to FIG. 2, the sequence cam unit 195 is shown in clutching engagement with a retractable drive member 196. The retractable member is drivably connected to the motor 530. A magnet 197 is provided to actuate an armature 198 to disengage or engage the drive member 196 from the sequence cam unit 195.

Pocket Emptying and Hopper Reloading

The last card sorted in any one sort impulses the magnet 197 to actuate the sequence unit 195 to start the cycle for emptying the pockets and for reloading the hopper 10 (FIG. 5). This will be described in greater detail in the wiring circuit description. However, mechanically this is accomplished by lifting a plurality of rolls 200, 200' which lie under the pockets 30 and which are normally out of contact with the cards in the pockets but which may be raised into a position where they engage the cards (FIG. 10). When these raised rolls are rotated, the cards are rolled out of the pockets onto raised rolls 201 in the auxiliary hopper. However, before raising the rolls and removing the cards from the pockets, the sequence unit first opens a circuit breaker to cause the picker knife 20 to stop actuating when the last card has passed the sensing means 22. Next, the sequence unit energizes a magnet 202 whose armature 204 pivots counterclockwise so as to push a slide member 206. Only one side of this mechanism is shown and will be described since the other side is the same. The slide 206 abuts the end of an angle link 208 so as to actuate it. The angle link 208 is pivotally mounted at each end to a bell crank lever 210. The bell crank lever 210 is pivoted on bracket 212. The other end of the bell crank lever 210 abuts the end of link 214 at 216. The rear end 215 of link 214 abuts the front end of link 218. The link 214 is pivotally mounted to swinging bearing supports 219 and 220. The supports 219, 220 are individually pivoted to similar brackets 222. The link 218 is also connected to a bell crank 224 pivoted at 226. The other end of the bell crank 224 is pivoted to a link 228 which in turn is connected to a swinging bearing support 221. The support 221 is also pivoted at 230 to a support plate (not shown) and a bearing support 232. A swinging bearing support 221' is pivoted at 223 to a bracket 225. Again, only those parts at one side of the machine are shown but identical parts are located at the other side. The swinging bearing supports 219, 220, 221', 221 and 232 carry the shafts 234, 236, 238, 240 and 242. These shafts support the rolls 200, 200' and 201. The outer periphery of these rolls is slightly below the card bed when the magnet 202 is deenergized so as not to be in contact with the cards. When the magnet 202 is energized, the rolls are raised sufficiently to lift the cards off of the bottom of the pockets and move them out onto the raised

rollers 201 in the auxiliary hopper, the details of which will be more fully hereinafter explained.

The above description was directed to the manner in which the pocket rolls 200 and auxiliary hopper rolls 201 are raised so as to lift the cards from the respective card beds. The following is a description of how the rolls are energized to rotate after they have raised the cards so as to remove the cards from the pockets into the auxiliary hopper. Momentarily, after the roll lifting solenoid 202 is energized, clutch magnet 241 (FIG. 11) is energized. Magnet 241 attracts its armature 243 so as to pivot about 244 urging the driving clutch disc 247 against the driven clutch disc 248. Disc 248 is mounted on the end of shaft 236 so as to rotate the shaft 236 when it is friction-driven by the continuously rotating disc 247. Shaft 234 is belt-driven from the shaft 236 (FIG. 10). Auxiliary hopper rolls 201 are rotated by shafts 234 and 236. In order to drive the pocket rollers 200, a continuously running shaft 250 is provided and centrally located above shafts 240 and 242, which shaft 250 carries a driving drum 252. When the shafts 240 and 242 are raised, the rolls 200 on these shafts contact the driving drum 252 which cause them to rotate. Shaft 238 is belt-driven from shaft 240 in order to drive the remaining pocket roller 200'. The rolls 200, 200' and 201 are now raised and rotating counterclockwise so as to engage the cards in the pockets and thereby roll all of the cards out of the pockets into the auxiliary hopper 32 (FIG. 5).

Since each group of cards, after having been removed from the pockets into the auxiliary hopper, would normally be spaced from an adjacent group, we provide each plate 32 with a projection 261 (FIGS. 5 and 12) from the front of the pocket which carries a spring-hinged member 262 extending between the card groups. This prevents the card groups from falling over as they pass into the auxiliary hopper. The member 262 moves against the spring when the cards are compacted.

Adjustable pressure plates are provided to act on the cards in both the main hopper 10 and auxiliary hopper 32.

Referring to FIGS. 2, 5 and 13, the hopper automatic pressure means includes a main hopper pressure plate 272 which exerts pressure on the cards to force them into position so that the picker knife can pick them off. Therefore, in order to transport the cards from the auxiliary hopper to the main hopper, it is necessary to position the pressure plate 272 out of the way and then return it to its proper position to prevent the cards from falling over, and to feed the cards to the picker knife. In order to do this, the sequence unit 195 will cause a latch relay 601 (in circuit diagram FIG. 18b) to pick at the same time that the rolls 234, 236, 238, 240 and 242 are raised. This relay will cause the main hopper pressure plate motor 282 to drive reduction gears 283, 284, 285 so as to drive outer pin 286 (FIGS. 2, 13 and 14). Gear 285 is free to rotate on shaft 295. Outer pin 286 will cause the arm 287 to rotate counterclockwise as viewed in FIG. 13. Arm 287 is linked to arm 288 by spring 290. As the arm 287 moves counterclockwise, the spring 290 exerts a tension on arm 288. Arm 288 is in contact with pin 289 fastened to disc 291 and causes disc 291, fastened to gear 292 and shaft 295, to rotate. Gear 292 drives gear 299 to drive a shaft 500 and a pair of tapes 270 (FIG. 2). The arms 287 and 288 are fastened to collars 293 and 294 respectively (FIG. 14). Collar 293 is free on shaft 295 except for pin 296 in the helical slot 298. Collar 294 is free on collar 293 except for the pin 296 in the helical slot 297.

If for any reason a greater drag is placed on shaft 500 or gear 292 than can be overcome by spring 290, the two arms will separate angularly and cause the collar 293 to move axially outwardly opening the microswitch 277 thus stopping the motor. Counterclockwise rotation of shaft 295 will be converted to clockwise rotation of shaft 500 by gears 292 and 299 to ultimately drive the lower reaches

of tapes 270 to the left as indicated by arrow 305 as viewed in FIG. 2.

When the motor 282 is energized, the pin 286 is actuated to drive the arm 287 which in turn pulls arm 288 through spring 290 so as to exert pressure on pin 289 and thereby rotate disc 291 which is connected to the tape 270 through gears 292, 299 and pulley 502. This drives the pressure plate 272 against the stop at 280 so as to provide sufficient room in the hopper to receive the cards from the auxiliary hopper. When the pressure plate hits the stop, the belts and pulleys are stopped and the arms 287 and 288 separate and open the microswitch 279 to stop the motor 282.

After the cards are received in the main hopper, and in order for the pressure plate 272 to exert pressure on the cards, the motor 282 is energized to operate in the opposite direction by the sequence cam unit and relay 601 (FIG. 18b). When this occurs the arms will return to their normal position against the pins. The gears 283, 284, 285 actuate pin 286 against arm 288 to drive arm 287 through spring 290 so as to exert pressure on pin 289 mounted on disc 291. The disc 291 through gears then drives shaft 500 and pulleys 502 in the opposite direction. When the pressure plate exerts a predetermined amount of pressure on the cards as determined by the strength of spring 290, again the arms 287, 288 will separate thereby opening the other microswitch 279.

Referring now to FIGS. 2 and 13 and in order to move the pressure plate 272 to the right to exert pressure on the stack of cards and a uniform pressure at the picker knife, we provide around each pair of pulleys the tapes or endless steel belts 270, there being two such belts one at each end of the cards. Pressure plate 272 is permanently fastened to its belts by riveting or the like. Belts 270 pass through slots 271 in the hopper bed and extend above it. The belts 270 transport the cards while they are on their edge so as to minimize friction and thus aid in providing more uniform pressure of the cards against the picker knife. To the left of a pressure support plate 276 (FIG. 2) for the plate 272 is a settable stop block 278, having a spring loaded pin 280 for manually locating the stop block and plate 272 to size the main hopper, the purposes of which will be more fully hereinafter explained under the heading "Operation." When the hopper motor 282 is operated, the steel belt 270 will slide the pressure plate 272 to the left until it is stopped by the stop block 278, at which time the microswitch 277 will stop the motor. The main hopper is now cleared and ready to receive the cards from the auxiliary hopper.

As noted above, the auxiliary hopper, also, contains a pressure plate 274 which is automatically operated and is ready to close the gaps between the cards as soon as they are removed from the pockets into the auxiliary hopper. These gaps are formed by the dividers between the groups of cards. In order to move the pressure plate to close the gaps between the cards, reference is made to FIGS. 11, 12 and 15 for a description of the auxiliary hopper pressure plate 274. The sequence unit now causes the auxiliary hopper pressure plate clutch magnet 300 (FIG. 12) to be energized, attracting its armature 302 which in turn urges the pulley 304 against the continuously rotating clutch disc 306. Around the pulleys 304 (FIGS. 11 and 15) and 308 is an endless steel belt 310 having a series of holes 312 (FIG. 12) equally spaced over its entire length and centered between the two edges. Engaged in one of the holes 312 is a pin 314 supported by spring plunger 316 (FIG. 15) located in an auxiliary hopper card pressure plate assembly 318 in the auxiliary hopper 260. The rear of pressure plate assembly 318 has a support plate 320 which projects downward through a slot 322 in the bed of the auxiliary hopper (FIG. 12). Supported on this plate are four rollers 324, two above and two below the bed plate. Mounted at each end of the pressure plate 274 are two other rollers 326. These rollers and the support plate

keep the pressure plate in position and permit it to be slid horizontally with little effort.

Rotary motion applied to the clutch plate 306 is transmitted by the belt 310 and the pin 314 to the pressure plate 274 causing it to move to the right (FIG. 15) exerting pressure against the stacks of cards in the hopper. The cards will be slid to the right thereby closing the gaps between the card groups. The hinged members 262 (FIG. 12) will fold back as the gaps are closing allowing the cards to pass.

In order to reverse the direction of motion of the belt 310 so as to move the pressure plate 274 in the opposite direction, magnet 301 (FIG. 15) is energized in the same manner as shown and described for magnet 300 (FIGS. 11 and 12). The clutch discs are mounted for rotation in the reverse direction to drive the belt 310 in the reverse direction.

Referring to FIGS. 15, 11 and 16, means are provided for lifting the auxiliary hopper from adjacent the pockets, FIGS. 11, 15, to adjacent the main hopper, FIG. 16. The sequence timer unit is constructed so as to trip the auxiliary hopper up-down half revolution clutch 350 into engagement with a continuously running disc 352 on shaft 354. Gears 356 reduce the speed at which the shaft 354 is turning. Arm 358, fixed to the clutch 350, will make a half revolution about the shaft 354. Pivoted to the end of arm 358 is a link 360. The other end of link 360 is pivoted on a bell crank 362 at 364. The short end of the bell crank 362 is linked to a similar bell crank 366 by a link 368. The two bell cranks are pivoted on links 370 which in turn are pivoted at 372, 374 to brackets 376 and 378 fastened to the base of the machine. The long arms 380, 382 of the bell cranks are connected at 384, 386 to extensions 388 of the frame 390 of the auxiliary hopper 32 (see also FIG. 5 for the direction of motion). This arrangement of mounting of the bell cranks and linkages provides more nearly vertical movement of the driven clutch disc 248, (FIGS. 11 and 16) as shown by the dash-dot line 391 (also FIG. 5). This also provides for better extraction of the pin 314 from the steel belt 310 (FIG. 12). Although only two bell cranks are described, actually four are used to provide level support and travel of the auxiliary hopper.

The action of the clutch 350 will cause the link or arm 358 to move from the position shown in FIGS. 11 and 15 to the position shown in FIG. 16 (also shown in FIG. 5) thereby rotating the bell cranks 362 and 366 clockwise about their pivots as shown in FIG. 16 on the links 370 until the gap 371 between the bell cranks and the offset end 373 of the links 370 is closed (see FIG. 17 for one gap, the other being the same). When the gap is closed, the bell cranks and links rotate as an assembly about the pivots 372, 374 raising the auxiliary hopper as shown in FIGS. 5 and 16 to a position parallel to the card feed hopper.

The gap 371 is provided to permit the long arms 380, 382 of bell cranks 362 and 366 to first pivot about pivots 375 and after closure of gap 371 to pivot about pivots 372 and 374. The shifting of pivots from 375 to 372, 374 results in substantial vertical movement of the auxiliary hopper and associated parts. This is important so as to maintain the clearance between the clutch discs 247 and 248 so as not to interfere during movement of the auxiliary hopper.

Referring to FIG. 5, the auxiliary hopper is now in position for the transfer of cards to the main card feed hopper. The sequence unit will now cause the magnet 392 (FIGS. 10 and 16) to be energized. Magnet 392 causes the slide 393 to push the angle link 208 to the left to raise the auxiliary hopper rolls 201 and the right end of the main hopper rolls 394, 395 by the operation of the link 214 operating against the link 412, pivoting the swinging bearing supports 396, 397 in the same manner as explained previously. Also, the left end of the main

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card feed hopper rolls 394, 395 are raised by a separate magnet 392' (see FIG. 18b) which is wired in parallel with magnet 392 and controls structure (not shown) similar to that described for raising the right end of said hopper rolls.

Referring to FIGS. 10 and 16 and in order to rotate the auxiliary hopper rolls 201, the sequence unit is designed so as to then energize the clutch solenoid 406 momentarily after energizing the roll lift solenoid 392. Clutch solenoid 406 urges the driving disc 408 against the driven disc 248 on the shaft 236. Clutch disc 248 is driven counterclockwise by shaft 251 when it is in the down position, whereas clutch disc 248 is driven clockwise by shaft 407 when it is in the up position which is in turn driven by cross belt 409 from shaft 251.

When the main hopper rolls 394 and 395 are raised, roll 394 contacts a continuously rotating drum 410 which causes it to rotate clockwise. Roll 395 is belt-driven from roll 394. Rotation of the rolls 201, 394, 395 in a clockwise direction will roll the cards from the auxiliary hopper into the card feed hopper.

As stated previously, the main card feed hopper pressure plate stop block pin 280 (FIG. 16) was previously set to size the length of the hopper to coincide with the auxiliary hopper length which will be more fully hereinafter explained.

Reference is made to FIGS. 5 and 16 which show the auxiliary hopper 32 raised, the two pressure plates 272, 274 in line and the right end of the auxiliary hopper in line with the opening 419 in the card feed end of the main card feed hopper. Rod 420 supported by two arms 422 which are mounted on a shaft 424 is urged against the left end of the curved slot 426 by the two springs 428 (FIG. 2). The shaft 424 is shown turning in two brackets 430 fastened to the picker knife guide plate 432. The rod 420 prevents the card stack from falling over as the cards are rolled into the card feed hopper. The pressure exerted by plate 272 on the cards is sufficient to overcome the pressure exerted by springs 428, so as to force the cards through the gap 41 into card picking position.

The sequence unit then energizes the pocket reset clutch magnet 450 (FIGS. 2 and 15) at the same time that it energizes the upper roll clutch magnets 406 so that the pockets are restored to contracted position in synchronism with the movement of the cards from the auxiliary hopper to the card feed hopper. The clutch magnets 450 drive a friction clutch constructed in the same manner as friction clutch 408 for driving the rolls. This causes a pair of pulleys 460, 462 (FIG. 2) to rotate counterclockwise. Around the pulleys 460, 462 are two belts 464. A sliding bail 148 is fastened to the two belts by screws 466 and is slideable in guide rails 482. Rotation of the pulleys 460, 462 causes the bail 148 to contact the left ends of the pocket restoring bars 140 and restore the pockets to normal contracted position as explained previously under the portion "Sorting Pockets."

In order to reposition the bail 148 out of the way to permit pocket expansion during the next sort, the magnet 480 (FIG. 2) is energized by the sequence time unit, to operate a friction clutch mechanism to drive the pulleys 460 and 462 in a clockwise direction. This restores the bail 148 to the left end of the guide rails 482.

Referring now to the upper portion of FIG. 2, the motor 530 drives the picker knife cam shaft 505 and its cam 506 against follower 507 to oscillate arm 508 when the magnet 608 unlatches the armature 509. The magnet 608 (FIG. 18a) is operated by the sequence unit to start the picker knife feeding cards. The picker knife 20 will remove the cards from the hopper 10, one at a time, and push them downward into the feed rolls 50 which feed them through the sensing unit 22 and under the timing belts 25. As each card is removed from the hopper, the spring 290 on the arms 287, 288 urges the disc 291 by means of the pin 289 in a counterclockwise direction. This motion is transmitted to the hopper pressure plate

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272 which feeds the stack towards the picker knife until the arm 288 and collar 294 permit the microswitch 277 to close its contacts and start the motor 282. The opening and closing of the microswitch contacts will thus keep a fairly even pressure exerted against the card stack until all the cards have been fed from the hopper.

Timed Mechanical Drive Means

Referring to FIG. 2, motor 530 is provided as the main drive source for driving the various components. For example, the picker knife cam shaft 505 is driven through suitable gears, and cams to oscillate the picker knife 20 in timed relationship with the motor 530. Similarly, the shafts for feed rolls 21, 50 and 58 are driven by the motor 530 through appropriate gearing to maintain the timing relationship. The card transport timing belts 56 are driven through sprocket wheels 60 and shaft 62 by suitable gearing connected to motor 530. The sprocket wheels 175 and cams 186 of the selector mechanism 27, for actuating the appropriate pocket for receiving the sensed card and for shifting the pockets after they received each card, are driven by motor 530 through suitable gearing and shafting in order to again maintain the timing relationship.

Other components are clutched to the motor 530 by toothed clutches for maintaining appropriate timing, or by friction clutches. The clutching is obtained through the sequence cam time unit which energizes selected magnets at the appropriate time to operate the associated clutches in their proper sequence. The clutches engage continuously rotating members for putting into motion the desired component. For example, the clutch 248 connected to transport rolls 201 is positioned adjacent continuously rotating driving disc 247 (FIGS. 10 and 11) so that when the sequence timing unit energizes the magnet 241 the friction clutch 248 will be engaged by the driving disc 247. The continuously rotating disc 247 is connected to the motor 530 through suitable gearing. Similarly, the pulleys 460, 462 for restoring and resetting the bail 148 for operation of the pockets 30, are operated in the same manner by the sequence timing unit at the appropriate time. When the magnet 450 (FIG. 2) is energized, it actuates a clutch on the pulley 462 (similar to clutch 248, FIG. 11) to contact a continuously rotating disc and thereby rotate the pulleys counterclockwise. The pulleys are rotated clockwise by the magnet 480 actuating a friction clutch on the pulley 460 to engage a continuously rotating disc. Similarly, the sequence unit energizes the magnets 300 or 301 to actuate the appropriate clutches to move the pressure plate 274 in one or the other direction. Further, the auxiliary hopper up-down half revolution clutch 350 is actuated by magnet 351, to engage continuously running disc 352, by the sequence cam timer unit.

Operation

In order to program the machine, the brushes 22 (FIG. 18) are plugged to the program hubs 602 (FIG. 18a) for the columns to be sorted and in the order of sorting, i.e., first column to program one, second column to program two, etc. If less than ten columns are to be sorted, the next higher program position is plugged to the stop hub to prevent the machine from running through many needless cycles. Only ten program hubs 602-1 to 602-10 are shown, but additional ones may be added by including more step relays and associated circuitry.

In order to load the auxiliary hopper with cards, pin 316 (FIG. 15) in the auxiliary hopper pressure plate 274 is lifted, and the plate 274 slid to the left. The cards are then joggled and placed in the right end of the auxiliary hopper against the right end plate. The pin 316 is again lifted and the pressure plate 274 shifted to the right as far as it will go without exerting pressure against the cards.

The location of the auxiliary hopper pressure plate 274 is then read as shown by scale 520 (FIG. 5) on the hopper

bed, and the stop block 278 (FIGS. 15 and 16) is set in the main card feed hopper bed at the same index position on a similar scale (not shown) so as to position the main hopper pressure plate 272 to receive the cards from the auxiliary hopper. To move the block, the pin 280 is lifted and the block 278 set on the exact spot indicated. By now depressing the sequence start key 600, the sequence timing unit 195 will actuate the up-down clutch 350 to raise the auxiliary hopper to a point adjacent to the main hopper. Next, the rolls 200, 200', 394, 395 will be raised and the rolls rotated at the appropriate time by the sequence cam unit. The cards will then be transferred from the auxiliary hopper into the main hopper.

The motor 282 is then energized by the sequence time unit 195 to drive the pressure plate drive unit (FIG. 17) which exerts a substantially constant pressure on the pressure plate to move the deck of cards through gap 41 against the spring 428 (FIG. 2) into card picking position. The picker knife is then actuated to begin moving cards past the sensing station at 22. The sensed impulse is then transmitted to the sort impulse distributor 24 to actuate the appropriate pair of magnets 26 and in turn the selected pair of pocket opening levers 167. The pocket opening levers 167 actuate the selected pocket 30 into card receiving position to receive the card sensed.

Circuit Description and Timing Chart

The section captioned "Operation" explains the sequence of operations necessary to start the machine. When the switch 531 is closed (FIG. 18a) lines 1, 2 and 3 and the drive motor 530 are connected to the D.C. current supply lines, the drive motor 530 (FIG. 2) will cause the drive shafts for the picker knife cam 506, feed rolls 21, 50 and 38, high speed pulleys 124, sprocket 175, cam 186 and sequence time unit drive member 196 to rotate. The picker knife 20, the auxiliary hopper 32, and the sequence unit 195 will operate only when their control magnets are energized. The sort impulse distributor 24 (FIG. 18a) makes a half revolution for each cycle of the machine. The CB (circuit breaker) cams are continuously running and make one revolution for each machine cycle. The sequence cam unit, which operates the SC cams, is clutched to the main drive (as shown in FIG. 2) and makes one revolution for approximately twenty machine cycles. This speed permits the machine to perform the card transporting functions (other than the normal sorting functions) during one revolution of the sequence cam unit. The auxiliary hopper is clutched to a slow running shaft by the half revolution clutch 350 which is energized twice during each revolution of the sequence unit by an auxiliary hopper up-down clutch magnet 351. The hopper motor 282, for operating the pressure plates, operates under control of the hopper motor relay latching magnet 601L, 601UN, and two microswitches 277, 279. The timing chart (FIG. 19) shows the sequence of these operations.

After the cards have been placed in the auxiliary hopper 32, and the card pressure plates 272, 274 properly positioned, and after the hubs 602 are connected to the hubs 603 to sort the desired columns of information on the cards, the sequence start key 600 is depressed in order to transport the cards from the auxiliary hopper to the main hopper, which start key completes a circuit of line 1, fuse F2, sequence clutch magnet 197 (see also FIG. 2) sequence key contacts at 600 and line 2.

The sequence unit will now make one revolution opening and closing the contacts at the sequence cams SC. A contact at cam SC-1, at the proper time, will complete branch circuits to the roll lift magnet 202 and the hopper motor control relay latch magnet 601L: namely, via line 1, fuse F3, roll lift magnet 202, contact at cam SC-1 and line 2; and line 1, fuse F3, latch magnet 601L, contact at cam SC-1 and line 2.

The roll lift magnet 202 will cause the rolls 201 to be lifted to lift the cards off of the auxiliary hopper bed. At

the same time, cam SC-1 also results in moving pressure plate 272 out of the way so that the main hopper can receive cards. Therefore, the latch magnet 601 will transfer its contact points 601-1, 601-2 and 601-3 from the position shown in FIG. 18b, thus completing the circuits to the hopper motor 282 which circuits are composed of line 1, normally closed automatic stop relay points 605-1, line 3, fuse F6, contact 601-2 upper, motor field of motor 282, contacts 601-3 upper, 601-1 upper, microswitch 277, line 2; and line 1, normally closed contact 605-1, line 3, fuse F5, motor brushes and armature, 601-1 upper, microswitch 277, line, 2. The hopper motor 282 will now move the pressure plate 272 to the left against the stop block 278.

In order to normally cause the rolls 200 to rotate, the contact at the SC-2 cam will now close and energize the roll clutch lower magnet 241 (also FIG. 11) through the circuit line 1, fuse F3, roll clutch lower magnet 241, contact at cam SC-2, line 2. This will then actuate the armature and driving clutch 247 (FIGS. 10 and 11) and cause the rolls 200 to rotate, but since the cards are already in the auxiliary hopper, they will not move at this time.

In order to ready the sorting circuit to sort the desired columns of information on the cards, the contact at the SC-10 cam will now close to advance the step relay contactor wiper 606 (FIG. 18a) from the blank to the first position through circuit line 1, fuse F2, step relay operating magnet coil 607, SC-10, line 2.

The contact at cam SC-3 will close next to move the pressure plate 274 against the cards in the auxiliary hopper by energizing the auxiliary hopper pressure plate clutch magnets 300 to actuate the auxiliary hopper pressure plate friction clutch and pulley 304. However, the plate 274 having been manually positioned against the cards with the initial insertion of the cards in the auxiliary hopper, the pressure plate will not move at this time. Since this clutch is a friction clutch, it will slip during this operation. The closing of contact SC-3 forms a circuit of line 1, fuse F3, auxiliary hopper pressure plate clutch magnet 300, SC-3, line 2.

Contacts at cams SC-14, 15 and 16 will now close for normally stopping the machine and resetting the step relay. However, this will not occur at this time since the step relay contactor wiper 606 is not in a position to complete a circuit to the contacts at the SC-16 cam.

Contact SC-4 will now close to energize the auxiliary hopper up-down clutch magnet 351 at 350 (FIG. 18b) so as to raise the auxiliary hopper (also see FIGS. 15 and 16) as a result of circuit line 1, contact 605-1, line 3, fuse F4, clutch magnets 351, contacts at cam SC-4, and line 2. The clutch 350 will make a half revolution raising the auxiliary hopper with the cards to its upper position adjacent the main hopper.

When the auxiliary hopper reaches its uppermost position adjacent the main hopper, the contact at cam SC-5 will now complete circuits to the front upper roll lift magnets 392 and rear upper roll lift magnets 392' via line 1, normally closed contact 605-1, line 3, fuse F4, roll lift magnets 392 and 392', contact at cam SC-5, line 2. The rolls 201, will lift the cards from the auxiliary hopper bed, and the rolls 394 and 395 are raised in a position to receive the cards (see also FIG. 10).

Contact SC-6 will now complete circuits to the roll clutch upper magnets 406 to move the cards into the main hopper and the pocket reset clutch magnet 450 to reset the pockets to their contracted position through circuit line 1, normally closed contact 605-1, line 3, fuse F4, roll clutch magnet 496, pocket key 630, normally closed contact 620, contact at cam SC-6, line 2; and circuit line 1, contact 605-1, fuse F5, magnets 450, contacts at cam SC-6, and line 2. The roll clutch 408 and driving drum 410 will cause the cards to move from the auxiliary hopper 32 into the main card feed hopper 10. The pocket reset clutch magnet 450 will actuate the pulleys

460, 462 and bail 148 to cause the pockets to return to their normal contracted position.

When the cards are fully in the main card feed hopper, contacts at cams SC-4, 7 and 8 will close simultaneously. Contact SC-4 will energize the auxiliary hopper up-down clutch magnets 351 a second time and cause the clutch 350 to make a second half revolution lowering the auxiliary hopper to its normal down position through the circuit at cam SC-4 explained above. The contact at cam SC-7 results in the cards being urged against the picker knife by energizing the hopper motor control relay unlatching magnet 601UN to energize the motor 282. It is noted that the magnet 601L is used to transfer the points at 601-1, 601-2 and 601-3 and magnet 601UN restores these points. By dropping the contacts 601-1, 601-2 and 601-3, the circuit is transferred through microswitch 279 to actuate the pressure plate 272 in the main hopper to urge the cards against the picker knife. This is accomplished by circuit line 1, contact 605-1, line 3, fuse F-5, unlatching magnet 601UN, contacts at cam SC-7, line 2. Contact at cam SC-8 will now close to reset the pocket resetting bail by causing the pocket reset clutch magnet 480 to be energized restoring the resetting bail 148 to normal position through circuit line 1, contact 605-1, line 3, fuse F-5, pocket reset clutch magnet 480, contacts at cam SC-8, line 2.

After the auxiliary hopper is returned to its normal position, contact at cam SC-9 will now close to move the auxiliary hopper pressure plate 274 out of the way by causing the pressure plate clutch 306' (similar to 306) at the auxiliary hopper pressure plate clutch magnet 301 to be energized through circuit line 1, contact 605-1, line 3, fuse F5, clutch magnet 301, contact at cam SC-9, and line 2. This clutch will cause the auxiliary hopper pressure plate 274 to move to the extreme left end of the auxiliary hopper as viewed in FIG. 15.

In order to prevent the starting of the card feed while the sequence unit 197 is operating, the contact at cam SC-12 is open. Therefore, in order to feed cards, contact at cam SC-12 (FIG. 18a) will now close and remain closed, and contact SC-11 will close momentarily and complete circuits to the picker knife unlatching magnet 608 and the card feed relay 610 through circuit line 1, fuse F1, contact at cam SC-12, stop key contact 612 (normally closed), picker knife unlatching magnet 608, contact at cam SC-11, and line 2; and, line 1, fuse 1, contact at cam SC-12, stop key contact 612 (normally closed), card feed relay coil 610, contact at cam SC-11, and line 2.

The card feed relay point 610-1 will close to form a holding circuit for itself and the picker knife unlatching magnet as shown by circuit line 1, fuse F1, contact at cam SC-12, stop key 612, card feed relay coil 610, card feed relay contact at 610-1, card brush relay 614-1 (normally closed), and line 2. The picker knife will now feed cards past the sensing brushes 22.

The contacts at cams SC-12, SC-13, SC-17 and SC-18 are normally closed and open immediately when the sequence cam unit begins to operate. This prevents the continuously running cams, designated CB cams, from closing any circuits. Therefore, cams SC-12, SC-13, SC-17 and SC-18 are wired in series with their associated circuit breaker cams to prevent the circuit breaker (CB) cams from completing their particular circuits during operation of the sequence unit. This prevents the normal functions of the sorting operations while the sequence unit is operating to transport the cards from the pockets to picking position in the main hopper. Therefore, these sequence cam contacts SC-12, SC-13, SC-17 and SC-18 are closed when the sequence unit is not operating.

The sequence unit will now declutch since it has completed its cycle. The sorting operations will begin since the picker knife magnets 608 have already been energized as explained above by the contact at cam SC-11, and held energized by the card feed relay points 610-1. The ma-

chine will feed and sort cards from the hopper into the pockets 30 until the hopper is emptied.

The CB-2 cam is provided with projections 613 to close its contact and impulse contact roll 22' at the index points on the card while the card passes the sensing station. The impulses picked up by the brush 22 then are transmitted to the sort distributor 24 to operate the appropriate magnet 26 corresponding to the pocket for which the card was sensed to be delivered. In order to prevent impulses being transmitted to the sort distributor 24 by the brushes 22 if a card has failed to be fed into the sensing station, a test circuit is provided for determining the absence of a card prior to the sensing time. If a card is not present, a test circuit composed of contacts at CB-3 cam and card brush relay 614 will open contact 614-3 and will prevent the CB-2 impulsing cam from completing the circuit to the brushes. Card brush relay 614 will pick when the contacts at circuit breaker CB-3 close if there is no card between the contact roll 22' and brush 22-81 (FIG. 18a). This is due to circuit line 1, fuse F-1, pick-up coil relay 614P, brush 22-81, contact roll 22', common brush 615, contact at cam SC-17, contact at cam CB-3, and line 2. This circuit will cause the relay 614 to be picked up closing points 614-2 to form a holding circuit via line 1, fuse F-1, holding relay coil 614H, points 614-2, contact at circuit breaker CB-1, and line 2. However, if there is a card between contact roll 22' and brush 22-81, no circuit will be completed to relay 614. Therefore, relay point 614-3 will remain closed so that impulses from the contact at CB-2 will pass to the common brush at each index point of the card.

As the cards feed through the sensing brushes 22, impulses will be directed to the sort impulse distributor 24 to distribute the impulses to the sort magnets 26 through circuit line 1, fuse F1, sort magnets 26 for pockets 0 through 9, 11, 12 and reject R, sort impulse distributor 24, circuit breaker cam CB-4, contact at cam SC-13, step relay contactor 606, plug wire, brush 22, contact roll 22', common brush 615, contact at cam SC-17, 614-3, CB-2, line 2. Every time a sensing brush 22 makes contact, when sensing a hole, to energize a sort magnet 26, the reject relay 616 will also receive an impulse to its pick-up coils through circuit line 1, fuse F2, reject relay pick-up coils 616, CB-4, contacts at cam SC-13, step relay contact 606, plug wire, brush, contact roll 22', common brush 615, SC-17, and relay points 614-3, CB-2, line 2. The reject relay armature of relay 616 will close relay points 616-1 (FIG. 18b) to complete a holding circuit of line 1, fuse F-2, reject relay 616 hold coils of relay 616, points 616-1, CB-6, line 2. The relay points 616-2 (FIG. 18a) will open to prevent the contacts of circuit breaker cam CB-5 from energizing the reject pocket sort magnets 618. If a card is not punched in a column being sensed, the reject relay 616 will fail to pick up and contacts at cam CB-5 will then energize the reject magnets 618 to sort the card into the reject pocket. This is accomplished by circuit line 1, fuse F-1, reject magnets 618, contacts at cam SC-18 (normally closed), relay points 616-2 (normally closed), CB-5, line 2. Contacts at cam SC-18 prevent energization of the reject magnets during sequence cycles.

After the last card leaves the sensing unit at brushes 22, the CB-3 contact will complete a circuit to the card brush relay 614 as explained above. Relay points 614-1 will open and drop the card feed relay 610 and the picker knife latch magnet 608. Relay points 614-3 will open the circuit from CB-2, to the sensing brushes. Relay points 614-4 will now close, together with the card lever contact 620 (see also FIG. 11) held closed by the last card, and will permit circuit breaker cam CB-7 to again energize the sequence unit clutch magnet 197 causing the machine to go through another sequence cycle. The same functions will be performed as before. The step relay 607 will be impulsed again shifting the contactor 606 from the first position to the second position. The

cards will be removed from the pockets 30 and put back in the main hopper 10 when the sequence cam unit energizes the various components as explained above. The card feeding will be restarted by actuating the picker knife and the sorting will continue on the second column selected. The machine will continue to sort and reload until the step relay contactor 606 reaches the contact plugged to the stop hub 622, or if not plugged, when it reaches the last or stop contact. This is an indication that all of the sorting has been completed. For example, in FIG. 18a, the hubs 602 are programmed so that four columns will be sorted, and the contactor will be on the contact plugged to stop hub 622 when the step relay contactor 606 reaches the fifth position. The machine will stop because the circuits completed by sequence cams SC-4 through SC-9 are now open at relay points 605-1. Contacts at cams SC-14 and SC-16 complete a circuit to the auto stop relay 605P and the step relay reset coils 624 making a circuit of line 1, fuse F-2, step relay reset magnet 624 and auto stop relay pick-up magnet 605P in parallel, contacts at cam SC-14, step relay contactor 606, and contacts at cam SC-16, line 2. The step relay 624 will reset to the blank position and the auto stop relay 605 will pick up, closing its relay points 605-2 to form a holding circuit of line 1, fuse F-2, auto stop relay holding coil 605H, relay points 605-2, contacts at cam SC-15, line 2.

The auto stop relay points 605-1 will open the line between fuses F-3 and F-4. This will prevent the sequence contacts at cams SC-4 through SC-9 from having effect as the sequence unit completes its cycle. The machine will now stop with the cards in the auxiliary hopper ready for removal.

In summary, a circuit is provided to determine when the last card of a sort has passed the sensing station so that the picker knife circuit can be de-energized and the sequence time unit can be energized to transport the cards from the pockets back to the main hopper. This is accomplished by the testing circuit through the CB-3 cam attempting to impulse the card brush relay 614 for each card. This provides a determination after each card as to whether it was the last card. If another card appears at the sensing brush 22-81, the card insulates the contact roll 22' from the brush 22-81 so that the card brush relay 614 cannot be impulsed. If a card is not at the sensing brush 22-81, then contact is made through the contact roll 22' to pick up the card brush relay 614. When the card brush relay picks up, it picks contacts 614-4 to close those contacts (FIG. 18b). Now, when the card brush relay 614 makes and picks contacts 614-4 as a result of an absence of a card at brushes 22-81, a card will still be present in the lower part of the machine in the feed rolls 5 at the card lever 620 (see also FIG. 11). Therefore, the card lever contact 620-1 is still closed when the CB-7 cam closes its contact. With contact 614-4 closed and contact 620-1 at card lever 620 closed, the CB-7 cam will impulse the sequence unit 197 to start the sequence of operations again of transporting the cards from the pockets to the main hopper.

The machine will stop, after the last card of the last sort passes the sensing brushes 22-81, since the contactor 606 will make contact with a terminal connected to the stop position at hub 622 (FIG. 18a). With the contactor 606 at its stop position, and when contacts at SC-14 and SC-16 close at the same time, a circuit is completed to the automatic stop relay 605 which picks contacts 605-1 (FIG. 18b) to prevent the sequence cam unit 195 from returning the cards to the main hopper and restarting the machine. Therefore, the machine will stop.

It is to be noted that without additional card lever sensing means in the card path, a card jam or failure to feed a card for any reason would indicate that the last card had been fed and the sequence cycle would be started. To prevent this condition use can be made of

the well-known procedures of placing card lever contacts at strategic points in the card path to control the various circuits to stop the machine without damage to the cards, disruption of the sequence of operations or starting a new sequence of operations by returning an incomplete sort to the main hopper. Since this is a well-known procedure and forms no part of this invention, further description of such a device has been omitted.

There are eight key contacts provided to start the various functions of the machine if they should be stopped for any reason, such as current failure, depression of the stop key, etc. They are the sequence start key 600, hopper left key 626, auxiliary hopper up-down key 628, pocket right key 630, hopper right key 632, pocket left key 634, card feed key 636, and the program reset key 638.

It is important to note that as a card is received by a pocket, that pocket will increase in size and each succeeding pocket will be shifted to a new card receiving position. When the cards have been sorted, the last card through will provide an impulse which will actuate the sequence unit, to stop card feeding by the picker knife and energize the pocket auxiliary hopper roll lift magnets 202 to begin transporting the cards back to the main hopper. This raises the rolls and cards in the pockets so that when the friction clutches rotate the rolls the cards will be moved into the auxiliary hopper. All of the operations will be repeated and the machine will stop with the cards in the auxiliary hopper where no more sorts are required.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In an automatic card sorting machine, the combination of a main hopper for the cards to be sorted, means for feeding the cards from the hopper, card sensing means, timing means for delivering the cards to the sensing means in timed relationship with the feeding means, a plurality of shiftable pockets, the pockets being defined by dividers for separating the cards into groups, means for transmitting an impulse from the sensing means to the dividers, one portion of the dividers being actuated in response to the impulse to actuate the divider into the path of the card so as to deflect the card into that particular pocket, expansion means for simultaneously actuating the dividers to expand the size of the pockets, an auxiliary hopper positioned adjacent the pockets, means for removing the cards from the pockets after they have been sorted and delivering the cards to the auxiliary hopper, means for transporting the auxiliary hopper adjacent to the hopper, and means for removing the cards from the auxiliary hopper to the main hopper.

2. An automatic sorting machine comprising a hopper in which the cards are stacked on their edge, comprising a picker knife for feeding cards from the hopper, means for urging the cards toward the picker knife in a direction transversely of the card edges, the picker knife being oscillatable in a direction in the plane of the card, sensing means for sensing the cards, pockets positioned parallel to the hopper, deflector means for stacking the cards on edge in the pockets, an auxiliary hopper for receiving the cards from the pockets, card removal means for removing the cards from the pockets into the auxiliary hopper so that the cards are stacked on edge in the auxiliary hopper, card transport means for transporting the auxiliary hopper adjacent to the hopper, and card removal means for removing the cards from the auxiliary hopper and stacking them on edge in the hopper.

3. An automatic sorting machine comprising a hopper

in which the cards are stacked on their edge, comprising a picker knife for feeding cards from the hopper, pockets positioned parallel to the hopper to receive the cards and stack them on the edge, the pockets having pocket expansion means expandable in a direction parallel to the hopper, an auxiliary hopper positioned parallel to the pockets to receive the cards from the pockets and to stack them on their edge, card transport means for transporting the auxiliary hopper parallel to and adjacent to the hopper, and means for moving the cards from the auxiliary hopper into the hopper and stacking them on edge in the hopper.

4. An electric circuit for an automatic sorter for sorting business cards which requires more than one sort to obtain the desired information from the cards, comprising sorting circuit means for sorting the cards including program means for sorting predetermined columns of information on the cards, sequence timing circuit means for transporting the cards after each sort back to their initial position for another sort until the desired information is obtained as determined by the program means, and testing circuit means impulsed during each card cycle, the testing circuit means also energizing the sequence timing circuit means when a sort is completed.

5. A sorting machine for sorting business cards which requires more than one sort to obtain the desired information from the cards, comprising sorting circuit means for sorting the cards including sensing means and program means for sorting predetermined columns of information on the cards, circuit breaker circuit means to impulse the sensing means at the index points on the card, and testing circuit means to open the circuit breaker circuit means when a card is not present at the sensing means, sequence timing circuit means for transporting the cards after each sort back to their initial position for another sort until the desired information is obtained as determined by the program means, and testing circuit means impulsed during each card cycle, the testing circuit means also energizing the sequence timing circuit means when a sort is completed.

6. An electric circuit for an automatic sorting machine for sorting business cards comprising sensing means for sensing the cards, comprising program means for controlling the sensing means with respect to the column to be sorted, testing circuit means impulsed during each card cycle to stop the sorting if a card is not present at the sensing means, stepping means for advancing the program means from one column to another column at the end of each sort, the testing circuit means also energizing a sequence timing circuit when a sort is completed, and stop means for stopping the machine and resetting the stepping means at the termination of sorting.

7. In an automatic sorter for sorting business cards which require more than one sort for obtaining the desired information, the combination of picker knife circuit means to start the feeding of cards from a hopper, sensing circuit means to sense the cards, program means for controlling the sensing means with respect to the column to be sorted, sorting circuit means responsive to the program means for selecting a magnet for the pocket that is to receive a card, stepping circuit means for advancing the program means from one column to another at the end of each sort, means for opening the picker knife circuit means to stop the feeding of cards, sequence timing circuit means for actuating card transporting means for transporting the cards after each sort from the pockets to the hopper, the sequence timing circuit means also energizing the picker knife circuit means to start the next sort, circuit breaker circuit means to impulse the sensing means at the index points on the card, testing circuit means during each card cycle to test if a card is present at the sensing means and to transmit an impulse to the circuit breaker circuit means if a card is not present at the sensing means, and stop means for stopping the ma-

chine and resetting the stepping means at the end of the last sort.

8. An automatic sorter for sorting business cards requiring more than one sort for obtaining the desired information comprising a hopper containing a card stack; a card feed mechanism for feeding cards; sensing means for sensing the desired information on the cards; sort pockets for receiving the sorted cards; an auxiliary hopper; roll means for removing the cards from the pockets into the auxiliary hopper; auxiliary hopper pressure plate means for exerting pressure on the cards to contract the card stack to eliminate gaps between the cards; card transport means for transporting the auxiliary hopper from the pockets to the hopper; additional roll means for removing the cards from the auxiliary hopper into the hopper; hopper pressure plate means for moving the cards to the card feed mechanism and exerting a substantially constant pressure on the card stack during card feeding; card feeding circuit means for starting and stopping the card feeding mechanism; program means for controlling the sensing means with respect to the column to be sorted; sorting circuit means responsive to the program means for selecting a magnet for the pocket that is to receive a card; means for sensing when the last card of a sort has passed through the sensing means; means for opening the card feeding circuit to stop the feeding of cards at the end of each sort; sequence timing circuit means for sequentially operating the roll means for removing the cards from the pockets into the auxiliary hopper, the auxiliary hopper pressure plate, the card transport means, the additional roll means, and the main hopper pressure plate means, and for energizing the card feeding circuit means to start the feeding of cards for the next sort; testing circuit means impulsed during each card cycle to test if a card is present at the sensing means; and stop means for stopping the machine and resetting the program means at the end of the last sort.

9. An automatic sorter for sorting business cards requiring one or more sorts for obtaining the desired information comprising a main hopper for the cards, a card feed mechanism for feeding cards, sensing means for sensing the desired information on the cards, sort pockets for receiving the sorted cards, card transport means for transporting the cards from the pockets to the main hopper for the next sort, program means for controlling the sensing means with respect to the column on the card to be sorted, stepping means for advancing the program means from one column to another column at the end of each sort until the program has been completed, sequence timing circuit means for actuating the card transport means at the end of each sort, and stop means for stopping the machine and resetting the stepping means at the termination of the last sort.

10. In a sorting machine of the type wherein record forms fed successively from a main hopper are sorted into a plurality of pockets: means for recirculating such forms through the hopper in a closed path, said means comprising means responsive to a signal for automatically removing the forms concurrently from all of the pockets, and means for transporting the removed forms concurrently and in unison in a generally compacted relation to the hopper automatically to refill the hopper for the next sort.

11. In a machine for automatically sorting record forms bearing coded information, the combination of a hopper containing forms, means for feeding forms successively from the hopper into a prescribed path, means for sensing the information from the fed forms, a plurality of form-receiving pockets, means controlled by the sensing means for diverting a form from said path into a particular pocket, a receptacle, means automatically responsive to depletion of all forms from the hopper to displace the forms concurrently from all of the pockets into the receptacle, means for moving the receptacle to a position adjacent the hopper, and means responsive to attainment of such position to displace all of the forms

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concurrently from the receptacle into the hopper for recirculation through the machine.

12. In a machine for automatically sorting record forms bearing coded information, the combination of a hopper containing forms stacked therein on edge, means for feeding forms successively from the hopper, means for sensing the information from the fed forms, a plurality of parallel form-receiving pockets in which forms are stackable on edge, means controlled by the sensing means for selecting which pocket is to receive each form, a tray, means operative upon exhaustion of all forms from the hopper to shift the forms concurrently edgewise

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into the tray, means for moving the tray to a position adjacent the hopper, and means operative upon attainment of such position to shift all of the forms concurrently edgewise from the tray into the hopper for stacking them on edge in the hopper for recirculation through the machine.

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