

[54] REVERSIBLE BYPASSABLE APERTURE
CARD READER

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[73] Assignee: The United States of America as
represented by the Secretary of Commerce

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[21] Appl. No.: 42,650

[52] U.S. Cl. 271/3, 271/DIG. 9
[51] Int. Cl. B65h 3/06
[58] Field of Search 271/3, 4, 7

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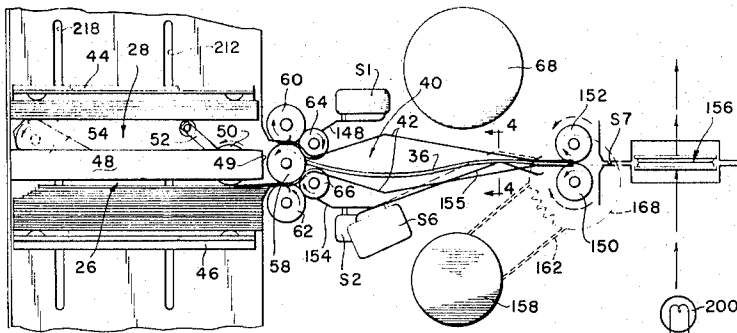
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[57] ABSTRACT

A pair of parallel card hopper are spaced from a projector film gate. A reversible drive roller and two idler pinch rollers, defining two reversible, oppositely transporting nips, are positioned near the hopper for transporting a card from either hopper and later delivering it to the other hopper. A second reversible drive roller and idler pinch roller, defining a third, reversible-go, or no-go nip, are positioned near the film gate for transporting the card from one of the first two nips into the film gate, and then retrieving it from the film gate and delivering it to the other nip, or for preventing the card from entering the film gate, causing the trailing edge of the card to follow the first reversible drive roller from the one nip to the other.

5 Claims, 13 Drawing Figures



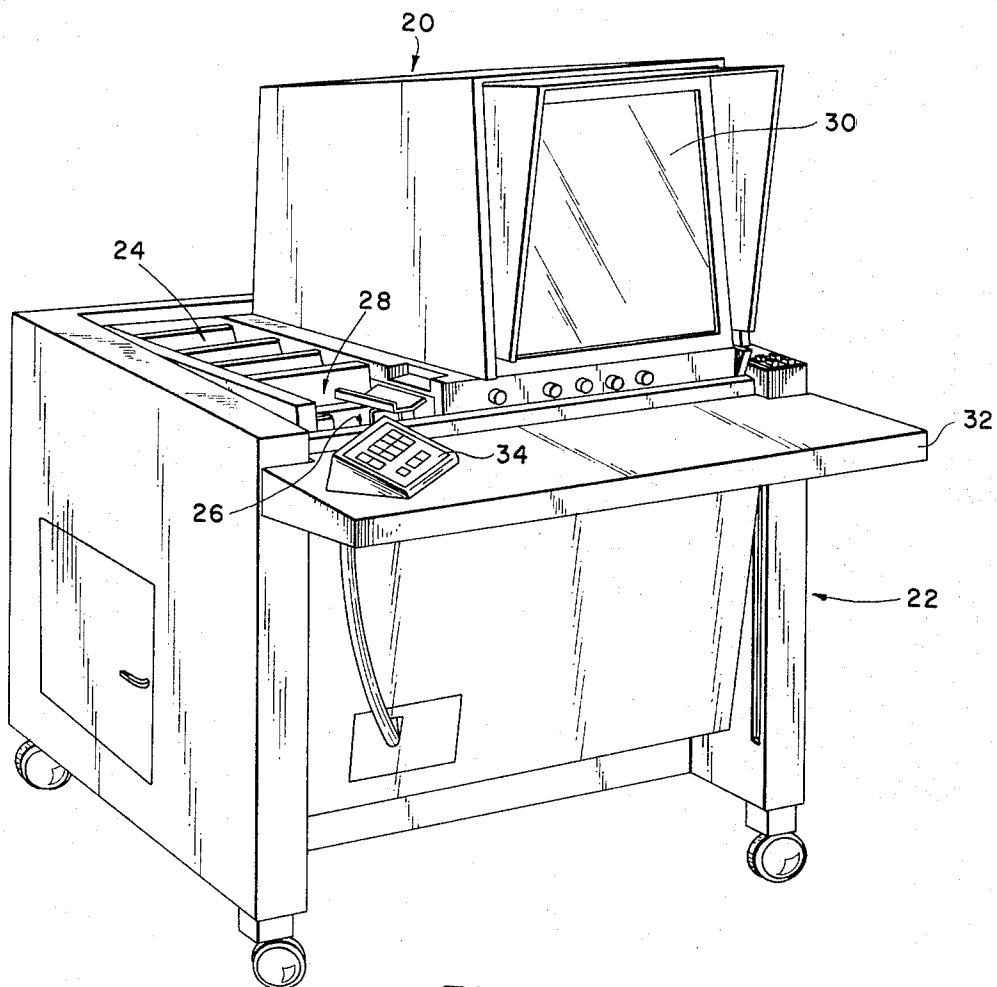


FIG. 1

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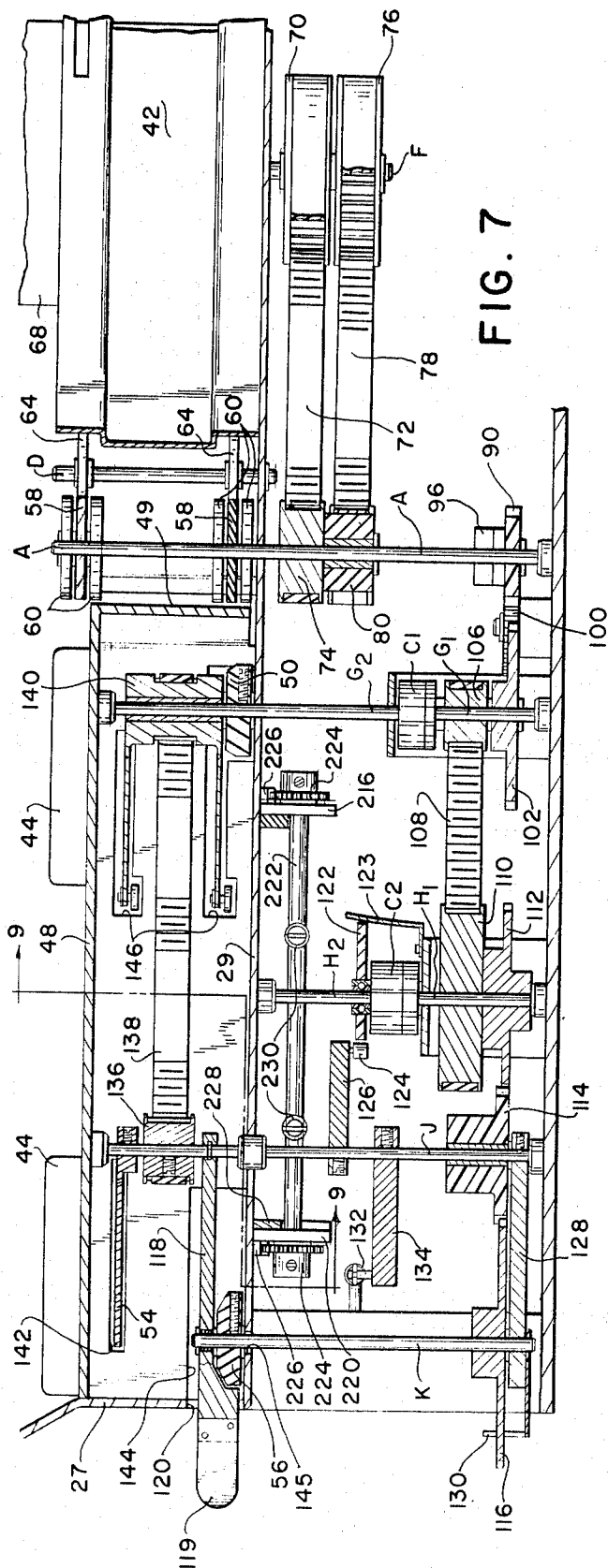


FIG. 7

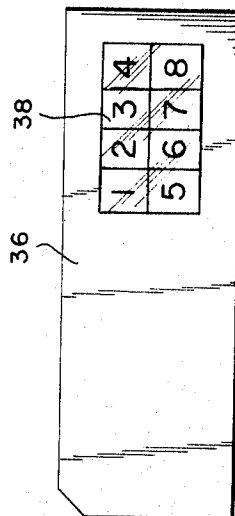


FIG. 2

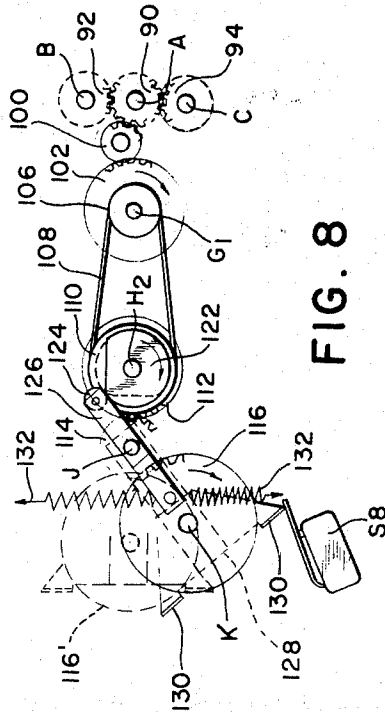


FIG. 8

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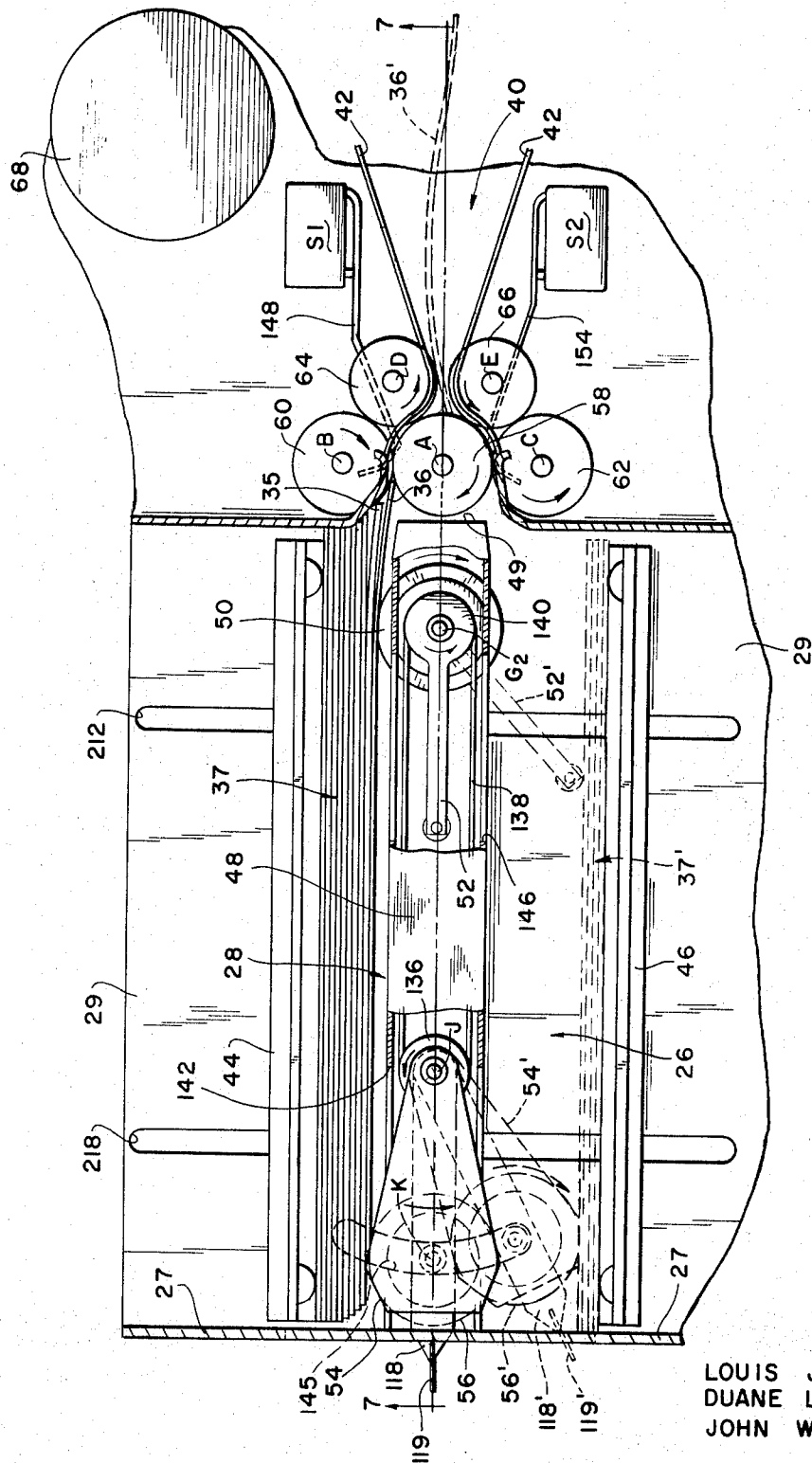


FIG. 5

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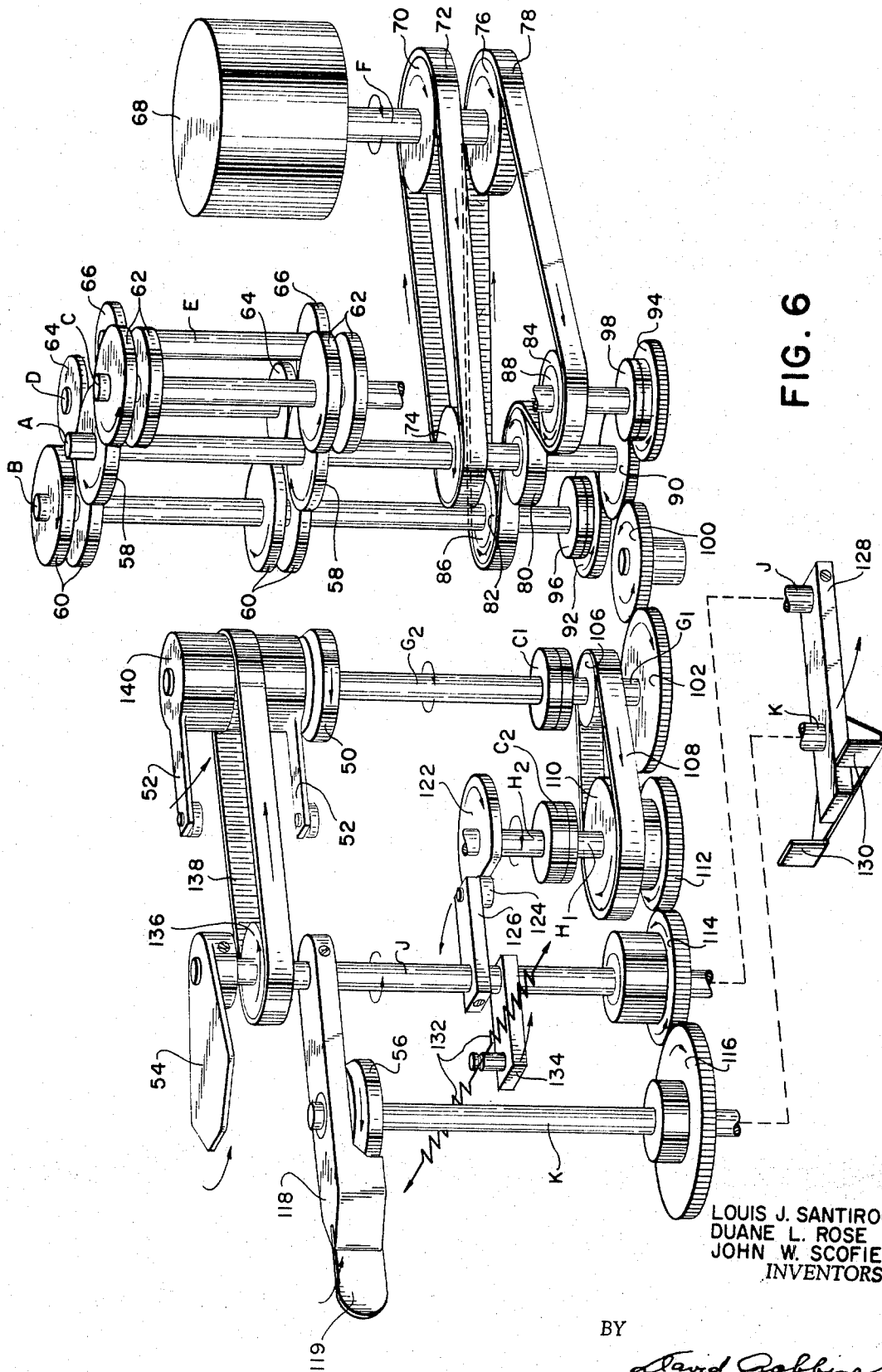


FIG. 6

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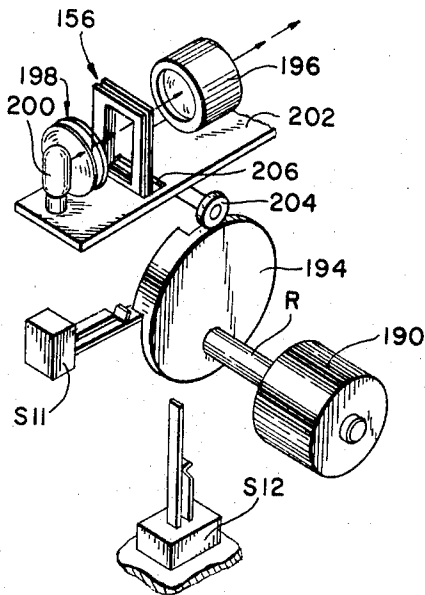


FIG. 11

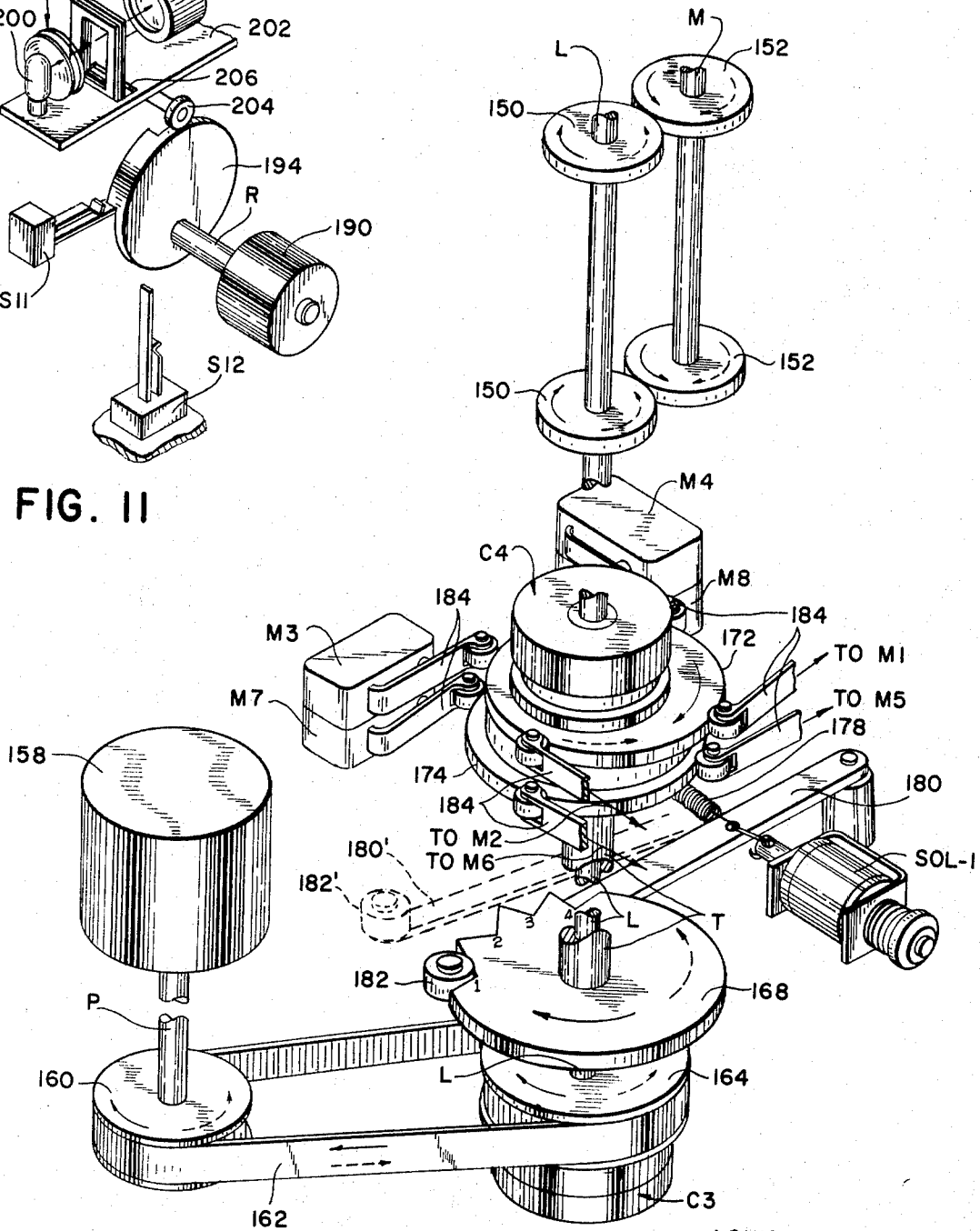


FIG. 10

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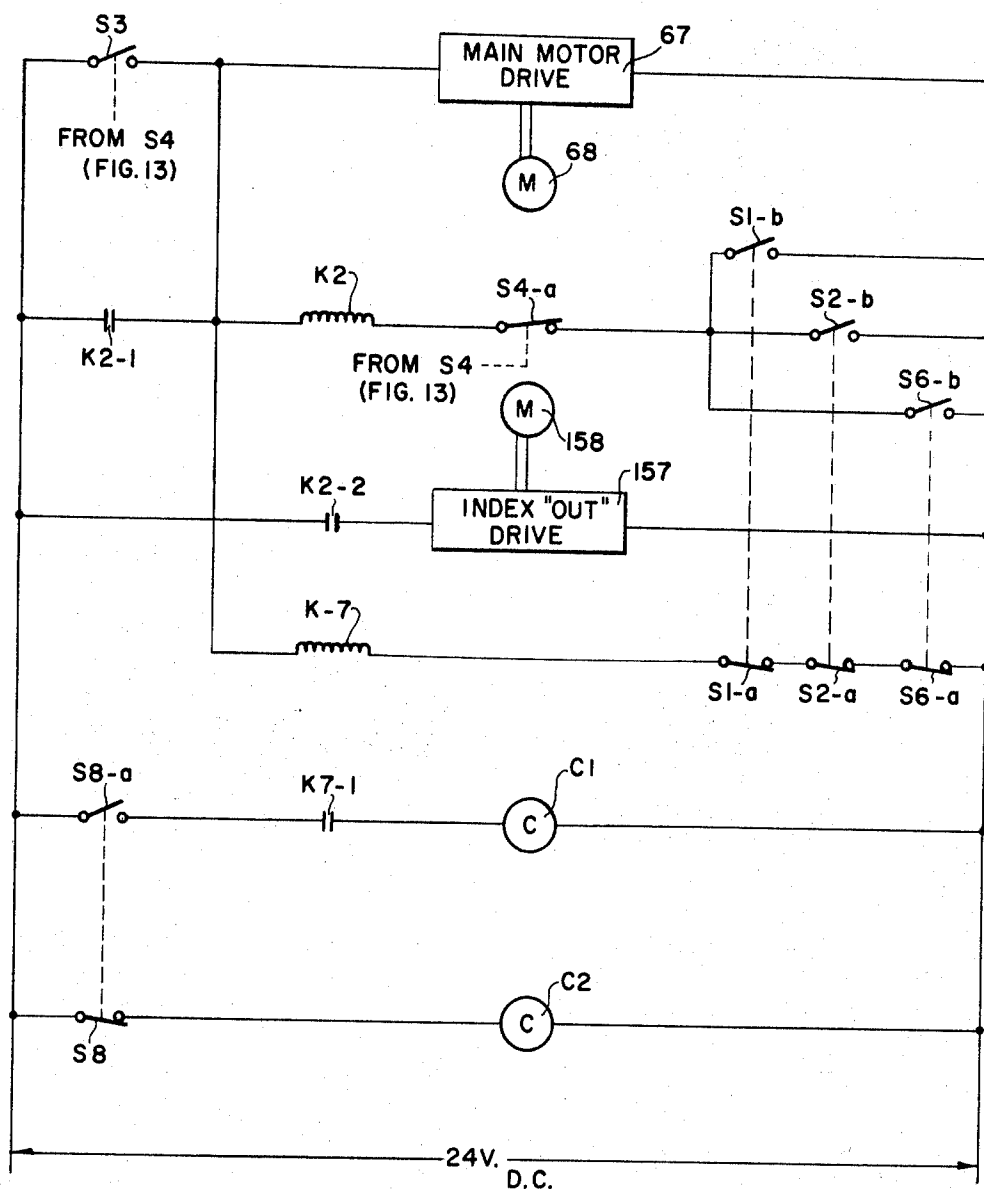


FIG. 12

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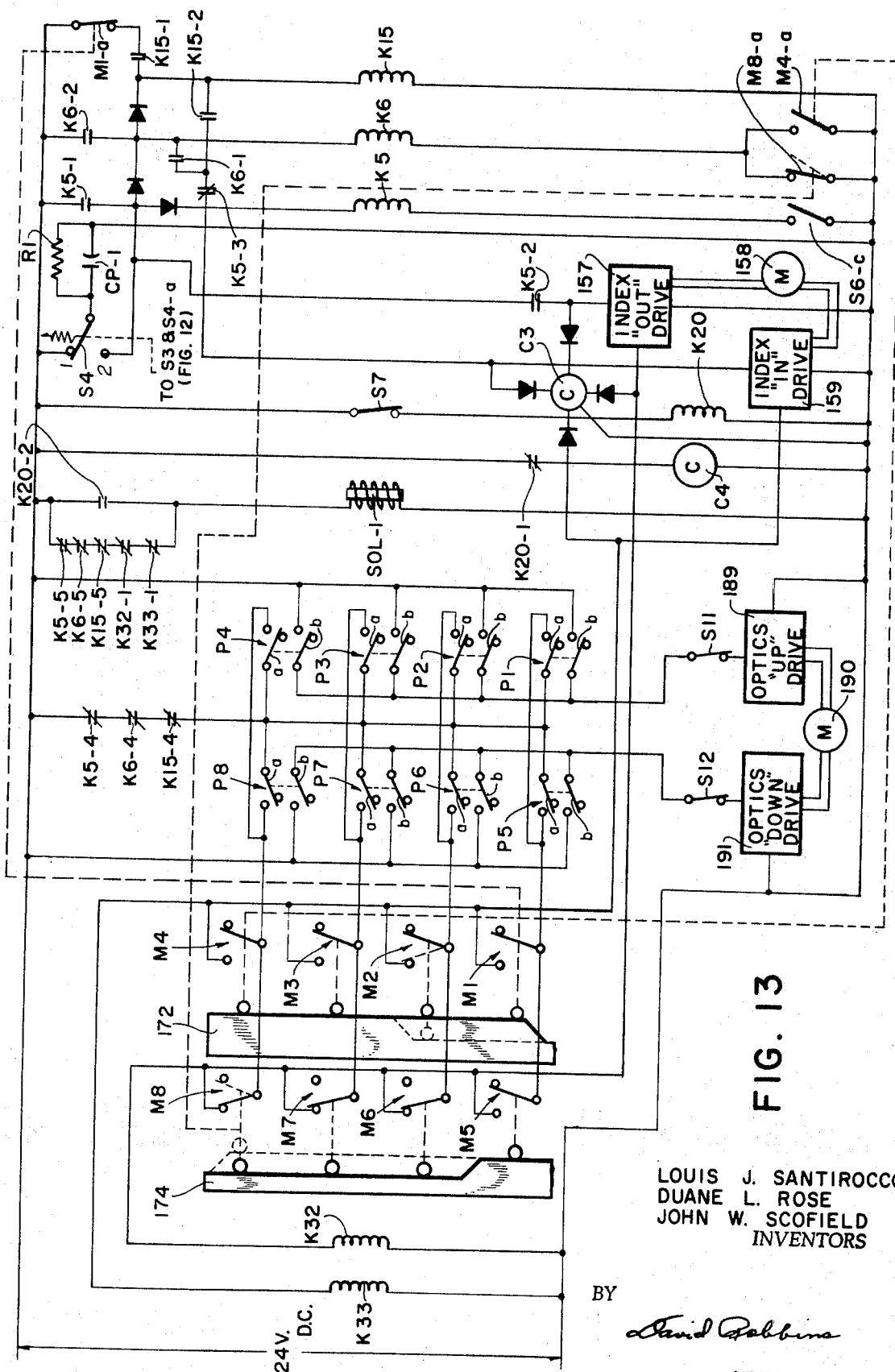


FIG. 13

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REVERSIBLE BYPASSABLE APERTURE CARD READER

CROSS-REFERENCE TO RELATED APPLICATION

Reference is made to commonly assigned copending U.S. patent application Ser. No. 42,649, entitled PROJECTED IMAGE VIEWER SUPPORT, filed June 12, 1970, in the names of Louis J. Santirocco and Richard C. Lathrop.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to apparatus for transporting cards from a first station to a second station. More particularly, the invention relates to apparatus for feeding cards from a supply station one at a time and for selectively transporting them to either a receiving station or a projecting station in a projection viewing apparatus.

2. Description of the Prior Art

Card feeding and transporting mechanisms of the type for moving a deck of cards from one station to another station one card at a time are well known in the art. However, most prior art apparatus are not suitable for feeding aperture cards into the projecting station of a projection viewing apparatus due to a number of problems which are encountered as a result of the film chip which is carried in the card aperture. The cards should be handled so that the film chips will not rub against each other, against the surfaces of adjacent cards or against handling surfaces to minimize the possibility of scratching the chips. Additionally, an aperture card is inherently subject to a certain amount of deformation because of buckling of the film chip due to its sensitivity to temperature changes. Most prior art card feeding and conveying apparatus are limited in operation in that they are subject to malfunction by jamming if a card which has been folded, mutilated and/or spindled is introduced into the feed and transport mechanism. There is therefore a possibility that in utilizing apparatus designed specifically for regular data processing cards to feed and transport aperture cards, damage could result to the aperture cards and the film chips carried thereby.

There are a number of additional problems which are encountered in attempting to adapt prior art machines for the handling of aperture cards. Most of the prior art devices are unidirectional, which means that if a particular card in which there is interest is passed over, the cards which already have been run through the machine must be removed from the receiving station and again placed in the supply station so that they can be run through the machine again in search of the particular card. The machine is incapable of being run in reverse to convey cards from the receiving station to the supply station.

Another problem encountered in prior art devices is the lack of a "pass" mode in which the cards in the supply or feeder station can be passed directly to the receiver station without being inserted into the projecting station of the projection viewing apparatus. Not only is this limitation costly in operation time, but the additional handling increases wear and tear to the aperture cards.

In U.S. Pat. No. 3,383,105, issued to R. R. Roberts and entitled CARD PICK-OFF APPARATUS, there is disclosed a card handling device for feeding an aperture card from a supply magazine to a scanning carriage of a xerography machine where the image recorded on the microfilm chip carried by the card is copied. After copying is completed, the aperture card is fed into a receiving magazine. Although the device is designed to eliminate scratching of the microfilm chip, it is unidirectional, i.e., it is incapable of being operated in reverse so that cards can be transported from the receiving magazine to the supply magazine. Also, the device disclosed does not have a capability for rapidly conveying the cards from the supply magazine to the receiving magazine without first transporting the card to the scanning carriage of the copying machine.

There is therefore a need for an apparatus which is capable of feeding and conveying cards in either a "pass" mode, i.e.,

directly from a supply station to a receiver station, or alternatively in a "feed" mode, i.e., from a supply station to the projecting station of a projection viewing apparatus. Such a device should also be bidirectional in both the "pass" mode and the "feed" mode. It should be capable of handling aperture cards with a minimum of risk of damaging the microfilm chip carried by the aperture card. The device should be capable of handling cards in various states of deformation without the risk that the device will become jammed thereby causing damage to additional cards.

There are many situations where it would be advantageous and time saving to have more than one image or page of information recorded on the same film chip carried by an aperture card. One such use is in the microfilming of patents which generally take the form of several pages which include a specification portion and an illustrative portion; it is desirable to include the entire patent on the microfilm chip carried by one data card for ease of referring to and examining the entire patent with a minimum of handling operations. Therefore, the present invention recognizes the need for a card feeding and conveying apparatus capable of moving or indexing an aperture card to various positions within a projecting station so that each of the images contained on a multiple image film chip can be selectively and separately projected.

SUMMARY OF THE INVENTION

Accordingly it is a principal object of this invention to provide improved apparatus for selectively transporting cards one at a time from one station to another station.

Another object of this invention is to provide apparatus for selectively and alternatively conveying cards one at a time in either a "pass" mode, i.e., from a supply station to a receiver station via an intermediate station, or in a "feed" mode, i.e., from the supply station to a projecting station of a projection viewing apparatus via the intermediate station and from the projecting station to the receiver station via the intermediate station.

A further object of this invention is to provide apparatus for selectively indexing multiple-image-carrying aperture cards in the projecting station of a projection viewing apparatus to permit separate projection of the multiple images carried thereby.

Still another object of the invention is to provide apparatus capable of handling cards in a manner so that there is a minimum of jamming even though the cards may be in a mutilated or deformed condition and so that there is a minimum of scratching of the microfilm chip carried in the aperture of the card.

These and other objects are met in accordance with the teachings of this invention by providing apparatus having means operative in a first mode for transporting a stack of cards from a feeder station one card at a time to a receiver station by way of an intermediate station, and in a second mode for alternatively and selectively conveying one card at a time from the feeder station to a projecting station by way of the intermediate station and from the projecting station to the receiver station by way of the intermediate station. In an illustrative embodiment of the invention there is also provided means for indexing a card in the projecting station as well as a capability for operating the apparatus bidirectionally to facilitate transporting cards in either of two opposite directions in both modes of operation.

The invention, and its objects and advantages, will become more apparent from the detailed description of the preferred embodiment presented below in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a pictorial illustration of a microfilm reader incorporating a card handling apparatus in accordance with the teachings of this invention;

FIG. 2 illustrates an aperture card of the type contemplated for use with the invention;

FIG. 3 is a schematically illustrated top view of the card handling apparatus of the invention;

FIG. 4 is a cross-sectional view of the card transfer chamber taken along line 4—4 in FIG. 3;

FIG. 5 is an enlarged partial top view of part of the card handling apparatus of the invention, partially broken away;

FIG. 6 is a perspective schematic illustration of the main drive train of the card handling apparatus;

FIG. 7 is a vertically sectioned view of the main drive train taken along line 7—7 in FIG. 5;

FIG. 8 is a schematic illustration depicting the operation of a portion of the main drive train shown in FIGS. 6 and 7;

FIG. 9 is a vertical section taken along line 9—9 in FIG. 7 showing the construction of the hopper pressure plate assembly;

FIG. 10 is a perspective schematic illustration of the indexing drive system of the invention;

FIG. 11 is a perspective schematic illustration of the optics positioning system of the invention;

FIG. 12 is simplified schematic illustration showing a portion of the electrical control circuitry incorporated in the invention; and

FIG. 13 is also a simplified schematic illustration showing another portion of the electrical control circuitry incorporated in the card handling apparatus in accordance with the teachings of invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The particular embodiment of the invention which is described hereinafter and illustrated in the drawings can be incorporated in a projection viewing apparatus such as the microfilm reader 20 illustrated in FIG. 1 and shown supported by a workstation 22. Located beside microfilm reader 20 are several convenient storage bins 24 for storing aperture cards before and after they are projected by reader 20. In front of storage bins 24 is located a pair of card stations or hoppers for holding decks of aperture cards which are to be fed into microfilm reader 20. There is a front hopper 26, and a rear hopper 28 which is located between front hopper 26 and storage bins 24. The front hopper 26 is the hopper nearest the operator when he is in position for viewing an image projected on viewing screen 30. Since the primary card handling device is bidirectional, as will be subsequently explained, either hopper 26 or hopper 28 can be used as the card feeder station or supply hopper for feeding cards into reader 20. In either case, the opposite hopper becomes the card receiver station. Workstation 22 includes a work shelf 32 on which is mounted a control panel 34. Microfilm reader 20 is one of a type adapted to accept and project images from apertured data cards similar to card 36 illustrated in FIG. 2. Aperture card 36 carries a microfilm chip 38 containing eight specific image portions which are numbered 1-8 and are in a two row format of four images in each row.

In operation, a stack or deck of aperture cards is loaded into rear hopper 28 or front hopper 26, depending on whether it is desired to feed cards from the top or bottom, respectively, of the deck. The desired mode of operation, as later explained, is selected and the card feed cycle initiated by actuating the proper controls on control panel 34.

PRIMARY CARD HANDLING ASSEMBLY

Referring now to FIG. 3, the primary card feeding and transporting assembly of the invention disclosed herein is depicted by a schematic diagram. This primary card handling device is capable of operating in two specific modes: first a "pass" mode in which cards are transferred directly from a feeder station to a receiver station and second, a "feed" mode in which the cards are transferred from a feeder station to a projecting station of a microfilm reader and then to a receiver station. Both modes of operation utilize an intermediate station or card transfer chamber 40 which is defined by a pair of card guides 42. As illustrated in the cross-sectional view in

FIG. 4, guides 42 are symmetrical in shape and are formed with a recessed center portion 43. Such a shape provides clearance for film chip 38 thereby eliminating scratching of the film surfaces during transportation of the card 36 from one hopper to the other hopper or from hopper to projecting station to hopper.

The card handling assembly is shown in FIG. 3 in position for feeding cards in the "pass" mode from front hopper 26 to transfer chamber 40, and from chamber 40 to rear hopper 28. In FIG. 5, the assembly is shown positioned for feeding cards in the reverse direction, i.e., from rear hopper 28 to front hopper 26. In either case the cards are loaded into the hopper with the aperture to the right as viewed in FIGS. 3 and 5. In the "feed" mode of operation a card 36 is fed from either of hoppers 26 or 28 into transfer chamber 40 and from transfer chamber 40 to the projecting station of a microfilm reader such as reader 20. When the viewing function has been completed card 36 is transported back to transfer chamber 40 and from there into either front hopper 26 or rear hopper 28. Generally the card is returned to the hopper opposite the one from which it was fed unless direction of operation is reversed while the card is in the projecting station of the reader in which case it is returned to the same hopper from which it was fed.

A more detailed view of the primary card handling assembly is illustrated in FIG. 5. There is shown a deck of cards 37 which has been loaded into rear feeder hopper 28. A gentle pressure is being applied to deck 37 by a spring-loaded rear pressure plate 44. Separating the front and rear hoppers 26 and 28 is a center dam 48 which houses a pair of card deflecting arms 52, card return wheel 56 and card deflector 54 when they are in a centered or neutral position, and card feed wheel 50. Located at the feeding end 49 of center dam 48 are five sets of rollers including primary feed rollers 58, stripper/feeder rollers 60 and 62 and idler feed rollers 64 and 66. These rollers are driven by main drive motor 68 as are card feed wheel 50 and card return wheel 56. Likewise, deflecting arms 52, card deflector 54 and card return wheel 56 are extended to their operating positions 52', 54', and 56', respectively, by main drive motor 68 in a manner to be next described.

For a better understanding of the entire drive train of main drive motor 68, reference is made to FIGS. 5, 6, and 7. Main drive motor 68 is a bidirectional motor which can be operated in either direction. For illustration purposes, shaft F of main drive motor 68 is shown rotating in a clockwise direction as illustrated by the arrows in FIG. 6. Primary feed rollers 58 and drive shaft F of main drive motor 68 are interconnected so that they will always rotate in the same direction. Rotational motion is imparted to shaft A from shaft F of drive motor 68 by toothed pulley 70 which is fastened to shaft F, by toothed belt 72, and by toothed pulley 74 which is affixed to shaft A. Primary feed rollers 58 are also affixed to shaft A. Idler rollers 64 and 66 are mounted for rotation about shafts D and E, respectively, and always rotate in contact with primary feed rollers 58.

Because of the function of stripper/feeder rollers 60 and 62, it is necessary that they always rotate in the same direction regardless of the direction of operation of motor 68 and primary feed rollers 58. Therefore, as shown by the arrows in FIGS. 5 and 6, rollers 60 must always rotate in a clockwise direction and rollers 62 must always rotate in a counterclockwise direction. When a card 36 is being fed from rear hopper 28 by card feed wheel 50 as depicted in FIG. 5, it is picked up by primary feed rollers 58 and conveyed to transfer chamber 40 by rollers 58 and 64. The function of rollers 60, which are not in the same horizontal plane as rollers 58 (see FIGS. 6 and 7), is to prevent a second card 35 from being fed with card 36. Friction between cards 35 and 36 is overcome by rollers 60 rotating in the same clockwise direction as rollers 58 such that adjacent portions of rollers 58 and 60 are moving in opposite directions thereby "stripping" card 35 from card 36 and preventing it from leaving hopper 28. Stripper/feed rollers 62,

which, like rollers 60, are not in the same horizontal plane as rollers 58, perform a feeder function in conjunction with primary feed rollers 58 in conveying a card from transfer chamber 40 to front hopper 26. When the direction of operation is reversed, as illustrated in FIG. 3, the functions of rollers 60 and 62 are reversed; rollers 62 perform the card stripping function as cards are fed from front hopper 26, and rollers 60 perform the feeder function as cards are transported from transfer chamber 40 to rear hopper 28. So that the stripping function will be reliably accomplished, rollers 60 and 62 should overlap rollers 58 by approximately 0.003 of an inch. Any greater overlap will result in significant card edge damage.

So that rollers 60 and 62 can be rotated in a single direction even though the main drive motor 68 is reversed, another toothed pulley 76 is affixed to the end of shaft F. Pulley 76 drives toothed belt 78 which in turn drives toothed pulleys 82 and 84 on shafts B and C, respectively, in directions as indicated by the arrows in FIG. 6. Idler pulley 80 is rotatably mounted on shaft A such that it is free to rotate in either direction without affecting the direction of rotation of shaft A. Pulleys 82 and 84 are mounted on shafts B and C by one-way clutches 86 and 88, respectively. A gear 90 is attached to the lower end of shaft A thereby rotating in the same direction. Gears 92 and 94 are engaged with and driven by gear 90. Gear 92 is mounted on the bottom of shaft B by a one-way clutch 96, and gear 94 is mounted on the bottom of shaft C by a one-way clutch 98.

In operation, when shaft F of motor 68 is rotated in a clockwise direction as indicated in FIG. 6, primary feed rollers 58, shaft A, pulley 74, and gear 90 are likewise rotated in a clockwise direction. Gear 94 is rotated in a counterclockwise direction by gear 90, thereby driving shaft C in the same direction due to the engagement of clutch 98 with shaft C. Although pulley 84 is being rotated in a clockwise direction by belt 78, it has no effect on the rotation of shaft C because one-way clutch 88 is disengaged thereby allowing pulley 84 to rotate freely about shaft C. Since rollers 62 are affixed to shaft C, they are likewise being driven in a counterclockwise direction, which is the necessary direction.

Gear 92 is being driven in a counterclockwise direction by gear 90; however, it has no effect on the rotation of shaft B because one-way clutch 96 is disengaged thereby allowing gear 92 to rotate freely about shaft B. Pulley 82 is being driven in a clockwise direction by belt 78, thereby driving shaft B in the same direction due to the engagement of one-way clutch 86 with shaft B. Since rollers 60 are affixed to shaft B, they are correspondingly rotated in the necessary clockwise direction.

When shaft F of motor 68 is reversed, i.e., driven in a counterclockwise direction, the directions of gears 92 and 94 and pulleys 82 and 84 are reversed, thereby effecting the disengagements of clutch 86 from shaft B and clutch 98 from shaft C, and the engagements of clutch 96 with shaft B and clutch 88 with shaft C, thereby allowing gear 92 to drive shaft B and rollers 60 in the same clockwise direction, and allowing pulley 84 to drive shaft C and rollers 62 in the same counterclockwise direction.

Card feed wheel 50 and card return wheel 56 are also driven by main drive motor 68 by way of gear 100 which is engaged with gear 90. Gear 100 drives gear 102 which in turn drives shaft G1. When electromagnetic clutch C1 is energized, shaft G1 rotates shaft G2, thereby driving card feed wheel 50 which is fixedly attached to shaft G2. Shaft G1 also drives toothed pulley 106 and toothed belt 108 which in turn drives toothed pulley 110. Pulley 110 drives shaft H1 which in turn drives gear 112. Gear 112 is in constant engagement with gear 114 which is mounted for free rotation on shaft J. Gear 114 is also in continual engagement with and therefore drives gear 116 which is fixedly attached to shaft K. Since card return wheel 56 is also affixed to shaft K, it is driven by the rotation of gear 116. Shaft K is journaled at its uppermost end (as seen in FIG. 6) in connecting arm 118 which in turn is secured to shaft J. The lowermost end of shaft K is journaled in pivot member

128 which is also secured to shaft J. It can be seen from the foregoing gear train description that any time motor 68 is driving, card return wheel 56 is being driven in the same direction, and card feed wheel 50 is being driven in the same direction as long as clutch C1 is energized.

The positioning of card return wheel 56, card deflector 54 and deflector arms 52 is controlled by electromagnetic clutch C2. Anytime clutch C2 is energized, shaft H2 will rotate with shaft H1 thereby rotating cam 122. Therefore, if shaft H1 is rotating in a clockwise direction, shaft H2 and cam 122 will also rotate in a clockwise direction as indicated by the arrows in FIG. 6. Because of the shape of cam 122 and the reaction of cam follower 124 thereto, cam follower arm 126 which is secured to shaft J is caused to pivot in a counterclockwise direction about shaft J, thereby rotating shaft J in the same direction. Since connecting arm 118 and pivot member 128 are secured to shaft J, when shaft J rotates in a counterclockwise direction, both connecting arm 118 and pivot member 128 are pivoted in the same direction about the same axis thereby swinging shaft K, gear 116, and card return wheel 56 in a counterclockwise direction about shaft J.

As illustrated in FIG. 8, if cam follower 124 were allowed to ride up on the outer periphery of cam 122, the counterclockwise rotation of arm 126, shaft J, pivot member 128, and connecting arm 118 would be stopped. Therefore, when the desired positioning of card return wheel 56 is achieved, and before cam follower 124 is allowed to ride up on the outer periphery of cam 122, a tab 130 actuates switch S8 which deenergizes clutch C2 thereby stopping the rotation of shaft H2 and cam 122. Card return wheel 56 and shaft K will remain in the position shown in FIG. 8 as long as cam 122 is maintained in this position by friction brake 123. When cam 122 is returned to its centered position as shown in FIG. 6 (dotted lines in FIG. 8), card return wheel 56 will center itself in the position as shown in FIG. 6 (dotted lines in FIG. 8) because of the opposing rotational force exerted on shaft J by return spring 132 through return spring arm 134. When motor 68 is reversed so as to rotate shaft F in a counterclockwise direction, cam 122 will be caused to rotate in a counterclockwise direction, and, in a manner similar to that described above, the same events will take place, but in reverse. The pivoting of arm 118 and member 128 about shaft J does not interfere with the rotation of shaft K and card return wheel 56 by gear 116. As long as shaft F of motor 68 is rotating, wheel 56 is likewise rotating, and in the same direction.

Card deflector 54 is rigidly attached to shaft J in the same angular orientation as connecting arm 118 and pivot member 128; it will therefore pivot about shaft J while maintaining a constant position relative to connecting arm 118. Also affixed to shaft J is a toothed pulley 136 which drives toothed belt 138 which in turn rotates deflecting arm body 140 which is rotatably mounted on shaft G2 (see FIG. 9). Card deflecting arms 52 are pivoted about the axis of shaft G2 to either of their extended positions, one of which is shown in dotted lines in FIG. 9, by the rotation of body 140 in response to the rotation of shaft J. The motion of arms 52 therefore corresponds to the motion of card deflector 54 and connecting arm 118. As can be seen in FIG. 5, when card deflecting arms 52, card deflector 54 and card return wheel 56 along with connecting arm 118 are returned to center position, they are located within center dam 48. When card deflector 54 is pivoted to its extended position in either of hoppers 26 or 28, it extends through openings 142 in either side of center dam 48. Likewise when connecting arm 118 and card return wheel 56 are moved to their extended position in either of hoppers 26 or 28, they extend through openings 144 in either side of center dam 48 while shaft K moves in an arcuate slot 145 in hopper bottom plate 29. Similarly, when card deflecting arms 52 are moved to their extended position, they move through openings 146 in either side of center dam 48. Openings 142, 144, and 146 are clearly shown in FIG. 7. Slot 145 is shown in FIG. 7 and by dotted lines in FIG. 5.

CARD TRANSFER CYCLE IN "PASS" MODE

Referring now to FIGS. 3, 5, 8 and 12, a card feed or transfer cycle in the "pass" mode will now be explained. Referring specifically to the electrical schematic diagram in FIG. 12, when power is turned on it can be seen that clutch C2 (FIGS. 6 and 7) will be energized immediately if switch S8 (FIG. 8) is in its normally closed position. To initiate a transfer cycle, "pass" switch S3 on control panel 34 (FIG. 1) is closed, providing power to the main motor drive circuitry or motor drive control 67 which can be any electric motor control known to those skilled in the art such as, for example, a relay or a bidirectional thyristor. Control 67 causes main drive motor 68 to operate in either direction as selected by the operator. If a card is already present in the projecting station of microfilm reader 20, actuating arm 155 will have been depressed by the card thereby actuating switch assembly S6 (FIG. 3) in which case switches S6-a and S6-b of switch assembly S6 are positioned opposite their positions shown in FIG. 12, i.e., switch S6-a is opened and switch S6-b is closed. Opening switch S4-a (to be later discussed) is in its normally closed position as illustrated in FIG. 12, relay K2 will be energized and relay contacts K2-2 will close energizing the index "out" drive circuitry or motor drive control 157 which can be any electric motor control known to those skilled in the art such as, for example, a relay or a bidirectional thyristor. The energizing of control 157 activates motor 158 thereby enabling rollers 150 and 152 in a manner subsequently to be described to transport the card to transfer chamber 40. The card is then transported to the receiving hopper in the same manner as already described. Assuming no cards are present in the feed paths of rollers 58, 60, 62, 64 and 66, or in transfer chamber 40 or the projecting station of reader 20, it can be seen in FIG. 12 that relay K2 will remain deenergized as long as switches S1-b, S2-b and S6-b are in their normally open position. Correspondingly, as long as switches S1-a, S2-a and S6-a are in their normally closed position, relay K7 can be energized thereby closing relay contacts K7-1 which are in the circuit for the card feed wheel clutch C1.

Since clutch C2 is already energized as described above, when main drive motor 68 begins to run, cam 122 will begin to rotate thereby extending card deflecting arms 52, card deflector 54 and card return wheel 56 to their operating positions in either front hopper 26 or rear hopper 28, depending on the direction of rotation of motor 68 and in a manner previously described. Clutch C2 remains energized and cam 122 continues to rotate until tab 130 contacts normally closed switch S8 (see FIG. 8) thereby opening its contacts and closing switch S8-a (FIG. 12) with which it is connected. Since relay contacts K7-1 have already been closed by the energization of relay K7, the closing of switch S8-a energizes card feed roller clutch C1 while the opening of switch S8 deenergizes clutch C2 allowing brake 123 to stop the rotation of cam 122. Upon energizing clutch C1, shaft G2 is driven with shaft G1 thereby driving card feed roller 50.

Assuming that cards are to be fed from rear hopper 28 to front hopper 26 as illustrated in FIG. 5, when card deflecting arms 52, card deflector 54 and card return wheel 56 have been completely extended into front hopper 26 as indicated by the dotted lines and reference numerals 52', 54' and 56', and when card feed roller 50 has begun rotating in a clockwise direction as indicated by the arrow in FIG. 5, it can be seen that card 36, the card of deck 37 which is nearest roller 50, is fed by roller 50 into the nip of primary feed rollers 58 and stripper rollers 60. A second card 35 of deck 37 is prevented from being fed into the nip of rollers 58 and 60 because of the rotation of stripper rollers 60 relative to the direction of rotation of primary feed rollers 58 as previously described and indicated by the arrows in FIG. 5. As card 36 passes between rollers 58 and 60, it actuates switch assembly S1 when it comes in contact with switch actuator arm 148 (FIGS. 3 and 5). When switch assembly S1 is actuated, switch S1-a is

opened and switch S1-b is closed. As shown in the circuit diagram in FIG. 12, relay K2 therefore is energized closing relay contacts K2-2, which contacts complete the circuit to the index "out" drive control 157, thereby initiating the operation of indexing drive rollers 150 and indexing idler rollers 152 in a direction as indicated by the solid arrows in FIG. 3. With rollers 150 rotating in a counterclockwise direction and rollers 152 rotating in a clockwise direction, they define one end of transfer chamber 40 because a card cannot pass from transfer chamber 40 through rollers 150 and 152. The opening of switch S1-a (FIG. 12) deenergizes relay K7 thereby opening relay contacts K7-1 and deenergizing clutch C1, bringing card feed roller 50 to rest. This insures that another card 35 will not be fed into transfer chamber 40 while card 36 is present therein. Card 36 is driven the rest of the way into transfer chamber 40 by primary feed rollers 58 and idler feed rollers 64.

As card 36 enters transfer chamber 40, it actuates switch assembly S6 by contacting switch actuator arm 155. This event takes place before card 36 releases actuator 148 of switch assembly S1. Switches S6-a and S6-b perform the same function as corresponding switches S1-a and S1-b in that relay K2 continues to be energized and relay K7 continues to be deenergized. Since card 36 cannot pass through rollers 150 and 152 because of their direction or rotation, the card stops at that point. The lengthwise dimension of transfer chamber 40 from the entrance of rollers 150 and 152 to the surface of roller 58 is slightly less than the length of card 36. As card 36 continues to be fed by rollers 58 and 64, the leading edge of the card stops at the entrance of rollers 150 and 152, and because of the shorter dimension of transfer chamber 40, the trailing edge of card 36 is transferred to the entrance of rollers 58 and 62 in the following manner: Transfer chamber 40, as defined by card guides 42, is wide enough to allow card 36 to bow slightly and take a reverted S-shape as partially shown by dotted lines and indicated by reference numeral 36' in FIG. 5. In the situation where cards are being transferred from front hopper 26 to rear hopper 28, card 36 will take a regular S-shape as illustrated in FIG. 3. Because of this bowing of card 36, its trailing edge is carried around the face of roller 58. As the trailing edge of card 36 passes over center of roller 58 the card is directed to the entrance of rollers 58 and 66 which then carry the card 36 to the entrance between rollers 58 and 62. As card 36 passes between rollers 58 and rollers 66 and 62, switch assembly S2 is actuated when the card deflects switch actuator arm 154. This takes place just prior to the release of actuator arm 155 of switch assembly S6. Switches S2-a and S2-b of switch assembly S2 perform the same functions as those of switches S6-a and S6-b described above.

As card 36 enters front hopper 26 it is deflected by card deflecting arms 52' away from center dam 48 towards pressure plate 46. Deflecting arms 52 are located so that the leading edge of card 36 is deflected towards pressure plate 46 after it has passed the film chip and bonding area of the card already stacked in hopper 26. If the card edge were not properly deflected in this manner there is a chance it would catch on the film chip or bonding tape of the card already in the hopper and would fold over on itself and cause a card jam. Card 36 continues to be driven by rollers 58 and 62 after it is deflected and until it is picked up by card return wheel 56. Wheel 56 pulls card 36 completely free from rollers 58 and 62 and continues to transport it until the card edge strikes the side wall 27 of hopper 26. Since there is a possibility that a bent card may continue to be fed around the end of connecting arm 118 by wheel 56, there is an extension 119 attached to the end of arm 118. Extension 119 extends through opening 120 in side wall 27 of hoppers 26 and 28. Since card return wheel 56 continues to rotate even though card 36 has stopped, it should have a low coefficient of friction so that it can slip against the card.

As soon as card 36 is pulled free from rollers 58 and 62 by card return wheel 56, switch assembly S2 is deactivated. Switch S2-b is therefore opened deenergizing relay K2, and switch S2-a is closed energizing relay K7 and closing relay

contacts K7-1 (FIG. 12). Since switch S8-a is still closed due to the actuation of switch S8 by tab 130 as previously explained, clutch C1 is energized thereby rotating card feed wheel 50 and starting a new transfer cycle for the next card. The apparatus can be stopped at any stage of the transfer cycle by opening switch S3 on control panel 34.

If switch S3 (FIG. 12) is opened inadvertently by the operator or another before a card cycle has been completed, relay contacts K2-1, which are closed as long as relay K2 is energized, will prevent relay K2 from "dropping out" or becoming deenergized until all three switch assemblies S1, S2 and S6 have been cleared by the card; relay K2 is deemed to have been "locked in" by its contacts K2-1. Relay contacts K2-1 also keep main drive motor 68 running until the cycle has been completed. If desired, a counter (not shown) with a display on control panel 34 can be operated by switch assemblies S1 and S2 for counting the number of cards transported from either hopper.

The above described transfer cycle in the "pass" mode is completely bidirectional and operates in a similar manner when main drive motor 68 is operated in a reverse direction. Card deflecting arms 52, card deflector 54, and card return wheel 56 pivot to the opposite hopper 28 thereby pushing pressure plate 44 to an open position in preparation to receive cards from hopper 26 as illustrated in FIG. 3. Likewise, primary feed roller 58 and idler rollers 64 and 66 will reverse direction from that as shown in FIG. 5 to that as shown by the arrows in FIG. 3. As previously explained, stripper/feeder rollers 60 and 62 will continue rotating in the same direction. Generally, cards will be transported from rear hopper 28 to front hopper 26 as shown in FIG. 5 because it is usually preferable to sort cards from the top of the deck to the bottom of the deck rather than vice versa.

Both hopper pressure plates 44 and 46 are independent of each other and can individually travel the limit of the hopper. The construction of each of pressure plates 44 and 46 is identical, therefore only the construction of plate 44 will be explained in conjunction with FIGS. 7 and 9. Corresponding parts of plate 46 are identified by like reference numerals followed by the suffix *a*. One portion of plate 44 extends through slot 212 (FIG. 5) in hopper bottom plate 29 and is attached to square bearing plate 216. A second portion of plate 44 extends through slot 218 (FIG. 5) in hopper bottom plate 29 and is attached to rectangular bearing plate 220. Extending between and journaled in bearing plates 216 and 220 is a shaft 222. Affixed to each end of shaft 222 is a gear 224, each of which engages and rotates along separate racks 226 attached to the underside of hopper bottom plate 29. Secured to bearing plate 220 is a guide member 228 which slides along the underside of bottom plate 29 as pressure plate 44 is moved back and forth. The only interconnection between pressure plates 44 and 46 is a pair of springs 230 which extend between shafts 222 and 222a of plates 44 and 46, respectively. The function of springs 230 is to cause plate 44 to exert a slight pressure on card deck 37 when plate 46 is in its open position in hopper 26 so that hopper 26 can function as the receiving hopper (FIG. 9). The function of springs 230 is reversed when the transfer cycle is reversed.

CARD TRANSFER CYCLE IN "FEED" MODE

Referring now to FIGS. 3 and 13, when it is desired to feed a card into the projection station or film gate 156 of microfilm reader 20, "feed" switch S4 on control panel 34 (FIG. 1) is closed momentarily by the operator to initiate the "feed" mode cycle. When switch S4 is open (position 1, FIG. 13), capacitor CP-1 will become charged; when switch S4 is closed (position 2) it will discharge through switch S4 and the connected circuit and energize or "pick up" relays K5, K6 and K15 provided other conditions, to be discussed below, have been met.

If a card is already present in film gate 156, actuating arm 155 of switch assembly S6 is already depressed and switch as-

sembly S6 actuated in which case switch S6-c (FIG. 13) of switch assembly S6 will be closed. In that situation, relay K5 will become energized as soon as switch S4 is closed by the operator, thereby closing relay contacts K5-2 and energizing index "out" drive control 157, thereby activating motor 158. Indexing motor 158 will drive rollers 150 and 152 in directions indicated by the solid line arrows in FIG. 3 so that the card is extracted from film gate 156 and fed into transfer chamber 40. From there the card will be conveyed into either of hoppers 26 or 28 in a manner already described. As illustrated in FIG. 3, the card will be fed into rear hopper 28.

It should be noted that when the operator momentarily closes switch S4, switch S3 in the circuit shown in FIG. 12 is also closed thereby initiating the cycle which was previously described in conjunction with FIG. 12 including energizing the main motor drive control 67. Although switch S4 is linked in any known manner so as to close switch S3, as indicated by the dotted lines in FIGS. 12 and 13, switch S3 should remain closed when switch S4 returns to its position 1. Furthermore, the independent closing of switch S3 by the operator so as to effect operation in the "pass" mode as described previously will have no effect on the position of switch S4. The momentary closing of switch S4 also opens normally closed switch S4-a (FIG. 12) thereby disabling relay K2 since relay K5 will perform the K2 function in this mode. Switch S4-a will remain open until switch S4 is again momentarily depressed. This type of sequence can be accomplished by interconnecting switches S4 and S4-a with a linkage arrangement known to those skilled in the art and represented by the dotted lines in FIGS. 12 and 13.

When all cards have been cleared from the machine thereby deactuating switch assembly S6, relay K5 (FIG. 13) is deenergized allowing relay contacts K5-2 to go to their normally open position thereby deenergizing the index "out" drive control 157. Similarly, relay contacts K5-3 are allowed to go to their normally closed position. Assuming switch M8-a is in a closed position as illustrated in FIG. 13, relay K6 will become energized when switch S4 is closed (position 2) by the operator thereby closing relay contacts K6-2 which in turn prevent relay K6 from becoming deenergized when switch S4 is returned to its position 1. In this manner relay K6 has become "locked in." Switches M4-a and M8-a will be described in detail below in conjunction with the indexing drive system. Since relay K6 is energized, relay contacts K6-1 are closed, and since relay contacts K5-3 are in a normally closed position (relay K5 deenergized), the index "in" drive circuitry or motor drive control 159 which like control 157 can be any electric motor control known to those skilled in the art, is energized thereby reversing indexing motor 158. Indexing rollers 150 and 152 now begin to rotate in a clockwise and counterclockwise direction, respectively, as indicated by the dotted line arrows in FIG. 3. Therefore a card which has been fed into transfer chamber 40 in a manner as described in conjunction with the circuitry of FIG. 12 will be conveyed by rollers 150 and 152 into film gate 156. Although switch assembly S6 is actuated when a new card enters transfer chamber 40 and will remain actuated as long as a card is in chamber 40 or film gate 156, relay K5 cannot be energized as long as contacts K5-1 and switch S4 are open. Therefore the card will remain in film gate 156 as long as is desired.

When it is desired to retrieve the card from film gate 156, switch S4 is again closed momentarily by the operator, thereby energizing relay K5 which becomes "locked in" in a manner similar to that described in conjunction with relay K6 by closing relay contacts K5-1. Relay contacts K5-3 are opened and relay contacts K5-2 are closed thereby energizing the index "out" drive control 157. Rollers 150 and 152 will then extract the card from film gate 156 and the card will be returned to the receiving hopper via transfer chamber 40. When switch S4 is momentarily closed by the operator this second time, switch S4-a will be closed by the linkage arrangement connecting the two switches and it will remain closed until the next time switch S4 is operated. Also, each

time S4 is allowed to return to this position 1, capacitor CP-1 is recharged so as to be ready for the next cycle.

CARD INDEXING SYSTEM

The indexing drive systems will now be explained with reference to FIGS. 10 and 11. The indexing drive system for horizontally positioning an aperture card in film gate 156 is shown in FIG. 10. Power is provided by indexing motor 158 which drives shaft P and toothed pulley 160 which is affixed to the lower end of shaft P. Indexing motor 158 is a bidirectional motor and can be operated in either direction. Pulley 160 is connected to toothed pulley 164 by toothed belt 162 and is therefore effective to drive pulley 164 in either direction as governed by the operation of motor 158. Pulley 164 is mounted for free rotation about shaft L; however, when electromagnetic clutch C3 is energized, pulley 164 will be coupled with shaft L. Generally, clutch C3 is energized at the same time motor 158 is running and deenergized when motor 158 is stopped as shown in FIG. 13. The function of clutch C3 is to disconnect shaft L from motor 158 instantaneously when the desired index is reached, thereby eliminating inertia effects of motor 158 which could otherwise result in overtravel.

Indexing drive rollers 150 are affixed to and therefore driven by shaft L. The functions of rollers 150 and idler rollers 152 have been previously discussed. Shaft L passes through a hollow shaft T which is mounted to rotate freely about shaft L. Fixedly attached to shaft T is an indexing cam 168 which has four detents, marked 1 through 4, in its outer periphery. Also affixed to shaft T are index switching cams 172 and 174. An electromagnetic index clutch C4 is mounted above cam 172. The function of clutch C4 is to couple shaft T with shaft L so that cams 172, 174 and 168 will rotate with shaft L. When clutch C4 is energized, indexing arm solenoid SOL-1, shown in FIG. 10, is deenergized allowing spring 178 to pull indexing arm 180 and index centering roller 182 from the detents of cam 168 to the dotted line positions indicated by reference numerals 180' and 182', respectively.

Indexing switches M1 through M8 are shown clustered about index switching cams 172 and 174 with switching cam followers 184 tracking the cam surfaces of cams 172 and 174. Switches M1 through M4 are operated by cam 172 and control clutch C3 and the index "in" drive control 159; switches M5 through M8 are operated by cam 174 and control clutch C3 and the index "out" drive control 157.

As was previously mentioned, the aperture card 36 contemplated for use with the subject invention and illustrated in FIG. 2 carries a microfilm chip 38 containing two rows of images with four images per row. It is therefore necessary to provide means for positioning the optics of reader 20 so that images in either the first or the second row can be projected. Such an optics positioning means is illustrated in FIG. 11 where there is shown an optics vertical drive motor 190 which drives shaft R and cam 194. The primary optics of microfilm reader 20 are schematically represented in FIG. 11 by projection lens 196 on one side of film gate 156 and a condenser lens 198 and a lamp 200 on the other side of film gate 156. These elements are supported by an optics platform 202 which is lowered and raised by the action of cam follower 204 riding on the cam surface of cam 194. Film gate 156 remains stationary since it extends upward through opening 206 in platform 202. Therefore, when optics platform 202 is in its uppermost position as shown in FIG. 11, the optics of microfilm reader 20 are in position for projecting any one of the four images in the top row of microfilm chip 38 carried by aperture card 36 when positioned in film gate 156, and when optics platform 202 is in its lowermost position (not illustrated) the optics are positioned to project any one of the four images in the bottom row of microfilm chip 38. Switches S11 and S12 shown in FIG. 11 are limit switches which are actuated by cam 194 as platform 202 reaches its uppermost and lowermost positions, respectively, thereby deenergizing the optics "up" drive circuitry or motor drive control 189, and the optics "down" drive cir-

cuitry or motor drive control 191, respectively, both controls 189 and 191 being any electric motor control known to those skilled in the art such as, for example, a relay or a bidirectional thyristor; further rotation of cam 194 is thereby discontinued.

Referring now to FIGS. 3, 10, 11, and 13 the operation of sequence of the above described indexing drive systems of the present invention will now be discussed. As was previously mentioned, when switch S4 (FIG. 13) is closed momentarily by the operator, switch S3 also closes energizing main motor drive control 67. Also, relays K6 and K15 are both energized by current flowing from capacitor CP-1 through switch S4. Relay K5 will also be energized if there is a card present in the transfer chamber 40 which would be indicated by switch assembly S6 being actuated thereby closing switch S6-c. Assuming no card to be present in transfer chamber 40, relay K5 will not be energized. In this situation, normally closed relay contacts K5-3 will be closed and, since relay K6 is also energized by the operation of switch S4, relay contacts K6-2 will also be closed thereby completing a circuit through relay contacts K6-1 and K5-3 to clutch C3 and the index "in" drive control 159 which in turn will operate the indexing motor 158 and pulley 160, and therefore rollers 150, in a clockwise direction as indicated by the solid arrows in FIG. 10. A card 36 present in transfer chamber 40 will be conveyed by rollers 150 and 152 in the direction of film gate 156 (FIG. 3).

Card edge sense switch S7 shown in FIG. 3 is a normally closed switch, as depicted in FIG. 13, which is opened by the leading edge of card 36 as it is fed towards film gate 156. When the contacts of switch S7 are separated, relay K20 is deenergized thereby opening relay contacts K20-2 and closing relay contacts K20-1. The opening of relay contacts K20-2 as shown in FIG. 13 deenergizes indexing arm solenoid SOL-1 unless normally closed relay contacts K5-5, K6-5, K15-5, K32-1 and K33-1 are all closed; at this step in the sequence relays K6 and K15 are energized, having been "picked up" by the momentary closing of switch S4 by the operator as explained above, and therefore relay contacts K6-5 and K15-5 are open. With solenoid SOL-1 deenergized, spring 178 is then allowed to withdraw indexing arm 180 and index centering roller 182 from detent 1 of indexing cam 168. The closing of relay contacts K20-1 energizes index clutch C4 coupling shafts L and T. Cams 168, 172 and 174 then begin to rotate with index rollers 150. The four detents on index cam 168 correspond to the four image positions on microfilm chip 38 in aperture card 36.

As can be seen in FIG. 13, as long as relay K6 is energized, indexing motor 158 will continue to drive rollers 150. When the number 4 and 8 image areas on microfilm chip 38 are centered in film gate 156, switches M4 and M8 will be opened by cams 172 and 174, respectively. Corresponding switches M4-a and M8-a, which switches are linked mechanically to switches M4 and M8, respectively, will be also opened thereby deenergizing relay K6, opening relay contacts K6-1 and K6-2 and closing relay contacts K6-5. Indexing motor 158 will continue to run, however, because relay K15 will still be "locked in" by relay contacts K15-1 and switch M1-a. Switch M1-a is linked with and therefore closed by switch M1 when cams 168, 172 and 174 begin to rotate with rollers 150. Current is now being supplied to clutch C3 and the index "in" drive control 159 through switch M1-a and relay contacts K15-1, K15-2 and K5-3. When the number 1 and 5 image areas on microfilm chip 38 are centered in film gate 156, switches M1 and M5 will be opened by cams 172 and 174, respectively. Switch M1-a will also be opened thereby deenergizing relay K15 and opening relay contacts K15-1 and K15-2. Since current is no longer being supplied to clutch C3 and the index "in" drive control 159, motor 158 is stopped and disengaged from shaft L. Relay contacts K15-5 will be closed and solenoid SOL-1 energized thereby pulling index centering roller 182 into detent 1 in cam 168. If V-shaped detent 1 is not precisely aligned with centering roller 182, then as roller 182 is thrust into detent 1 by the action of solenoid SOL-1, cam 168 will rotate slightly in either direction until roller 182 is

firmly seated in detent 1. Since clutch C4 is still energized (relay K20 deenergized) and clutch C3 is deenergized, this slight rotation of cam 168 is transmitted through clutch C4 to shaft L and rollers 150 thereby finally aligning aperture card 36 in film gate 156. Clutch C4 will remain energized as long as there is a card in film gate 156 keeping switch S7 open and thereby preventing relay K20 from being energized.

At this step in the operation sequence of the indexing system, aperture card 36 is positioned in film gate 156 so that any one of the eight images contained on microfilm chip 38 can be viewed by closing the appropriate switch assembly P1 through P8 located on control panel 34 (FIG. 1). As shown in the wiring schematic in FIG. 13, the *a* switches of switch assemblies P1 and P5 are wired in parallel and the closing of either switch assembly has the same effect. The same situation exists with switch assemblies P2 and P6, P3 and P7, and P4 and P8. Before the *a* switches of switch assemblies P1 through P8 can be effective, they must be enabled by relay contacts K5-4, K6-4 and K15-4, which are normally closed contacts. Once a card 36 is positioned in film gate 156 and relays K5, K6 and K15 are deenergized, relay contacts K5-4, K6-4 and K15-4 are closed thereby enabling the *a* switches. The *b* switches of switch assemblies P1 through P8 serve to control the optics vertical drive motor 190 for raising or lowering optics platform 202 in the manner previously discussed. The *b* switches for switch assemblies P1 through P4 are wired in parallel and serve to energize the optics "up" drive control 189; the *b* switches of switch assemblies P5 through P8 are also wired in parallel and serve to energize the optics "down" drive control 191.

Indexing switches M1 through M4 serve to control indexing motor 158 by controlling current to clutch C3 and the index "in" drive control 159. Indexing switches M5 through M8 serve to control indexing motor 158 by controlling current to clutch C3 and the index "out" drive control 157. For example, if the operator desires to view the image at image position 8 on the microfilm chip 38 he closes switch assembly P8, thereby closing switch P8-*b* and sending current to the optics "down" drive control 191 which results in the lowering of the optics platform 202 to its lowermost position. When cam 194 actuates limit switch S12 opening its contacts, the optics "down" drive control 191 is deenergized and motor 190 stopped.

The closing of switch P8-*a* sends current to the terminals of both switches M4 and M8. Since switch M4 is open because of the position of cam 172, the index "in" drive control 159 cannot be energized. However, switch M8 is closed due to the position of cam 174 and the circuit is completed thereby energizing clutch C3 and the index "out" drive control 157 and operating indexing motor 158 and indexing rollers 150 in a counterclockwise direction (solid line arrows in FIG. 3). Aperture card 36 is extracted from film gate 156 a distance such that the number 4 and 8 image areas on microfilm chip 38 are centered in film gate 156. When this position is reached, cams 172 and 174 will have assumed the positions indicated schematically by the dotted lines in FIG. 13. Switch M4 will remain open while the movement of cam 174 will open switch M8 thereby deenergizing clutch C3 and the index "out" drive control 157 and stopping the movement of card 36 at that point.

At the same time the index "out" drive control 157 is energized through switches M8 and P8-*a*, relay K32 is also energized opening relay contacts K32-1 and deenergizing indexing arm solenoid SOL-1. As was explained above, this allows index centering roller 182 to be withdrawn from detent 1 of indexing cam 168 leaving cam 168 free to rotate with indexing rollers 150. When switch M8 is opened by cam 174, relay K32 is deenergized allowing relay contacts K32-1 to close so that solenoid SOL-1 is reenergized. Final alignment is thereby effected by the engagement of centering roller 182 with detent 4 of indexing cam 168 in a manner similar to that described above.

As another example, if the operator now wishes to view the image at image position number 2 on microfilm chip 38 he

closes switch assembly P2 thereby closing switches P2-*a* and P2-*b*. The closing of switch P2-*b* sends current to the optics "up" drive control 189 thereby raising the optics platform 202 to its uppermost position as shown in FIG. 11. When cam 194 actuates limit switch S11 opening its contacts, the optics "up" drive control 189 is deenergized and motor 190 stopped.

The closing of switch P2-*a* allows current to flow through switch M2 which is now closed because of the position of cam 172 as depicted by the dotted lines in FIG. 13. Clutch C3 and the index "in" drive control 159 is thereby energized operating indexing motor 158 and rollers 150 in a clockwise direction (dotted line arrows in FIG. 3). Aperture card 36 is inserted further into film gate 156 a distance such that the number 2 and 6 image areas on microfilm chip 38 are centered in film gate 156. When this position is reached, switch M2 is opened by the action of cam 172 thereby stopping indexing motor 158 and rollers 150; switch M6 remains open. The function of relay K33 in this sequence is identical to that of relay K32 explained above and controls indexing arm solenoid SOL-1. Therefore, when switch M2 is opened deenergizing relay K33, index centering roller 182 is pulled into detent 2 of indexing cam 168 by solenoid SOL-1 thereby effecting final alignment of image area number 2 in film gate 156.

When the operator has finished viewing the images of card 36 and wishes to retrieve the card from film gate 156, he momentarily closes switch S4. Since switch assembly S6 is actuated by the presence of card 36, switch S6-*c* is closed. Therefore, when switch S4 is momentarily closed, relay K5 is energized closing relay contacts K5-1 and K5-2 thereby energizing clutch C3 and the index "out" drive control 157. Relay contacts K5-5 are opened deenergizing solenoid SOL-1 and allowing index centering roller 182 to be withdrawn from the detents of cam 168. As card 36 is extracted from film gate 156 by rollers 150 and 152, and as soon as the card clears switch S7 allowing it to go closed, relay K20 is energized opening relay contacts K20-1 and closing relay contacts K20-2; clutch C4 is deenergized uncoupling cams 168, 172 and 174 from rollers 150, and solenoid SOL-1 is energized pulling cam centering roller 182 into detent 1 of cam 168. Card 36 is carried to transfer chamber 40 from which it is returned to the receiving hopper 26 or 28. Main drive motor 68 may then be stopped by the operator by closing switch S3 which was opened by switch S4 in a manner previously described.

The simplified control circuits schematically illustrated in FIGS. 12 and 13 are representative of but one way to control the operation of the card handling apparatus. Other, more complex control circuits known to those skilled in the art may be incorporated into the card handling apparatus without departing from the teachings of the invention.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. A reversible, bypassable aperture card reader comprising:

a pair of card hoppers;

a projector film gate spaced from said hoppers;

means, including a first reversible drive roller and two idler pinch rollers, defining two reversible, oppositely transporting nips, positioned near said hoppers for transporting a card from either hopper and later delivering it to the other hopper; and

means, including a second reversible drive roller and idler pinch roller, defining a third, reversible-go, or no-go nip, positioned near said film gate for transporting said card from one of said two nips into said film gate, and then retrieving it from said film gate and delivering it to the other of said two nips, or for preventing said card from entering said film gate, causing the trailing edge of said card to follow said first reversible drive roller from said one nip to said other nip.

2. A reader as set forth in claim 1, wherein said hoppers are parallel and confronting; and

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means positioned between said hoppers for feeding a card to either of said two nips from the hopper nearer said nip, and for delivering said card from said other of said two nips to the other of said hoppers.

3. A reader as set forth in claim 2, and further including: 5
means, including two stripper rollers flanking said first
reversible drive roller between said hoppers and said two
idler pinch rollers, for preventing more than one card
from entering either of said two nips at any time.
4. A reader as set forth in claim 2, and further including; 10

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means, including switches disposed to be actuated by a card fed from either of said hoppers by said feeding means, for disabling said feeding means until said card has been delivered to said other of said hoppers.

5. A reader as set forth in claim 1, and further including:
means, including symmetrically bowed-apart card guides, for
guiding said card from either of said two nips to said third
nip, and vice versa.

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