United States Patent

[11] 3,564,169

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[54] STATIC PUNCH CARD READER

13 Claims, 24 Drawing Figs.

[52] **U.S. Cl.** **200/46;** 235/61.11
[51] **Int. Cl.** **G06k 7/04**
[50] **Field of Search** ..... 200/46, 164; 235/61.111—113

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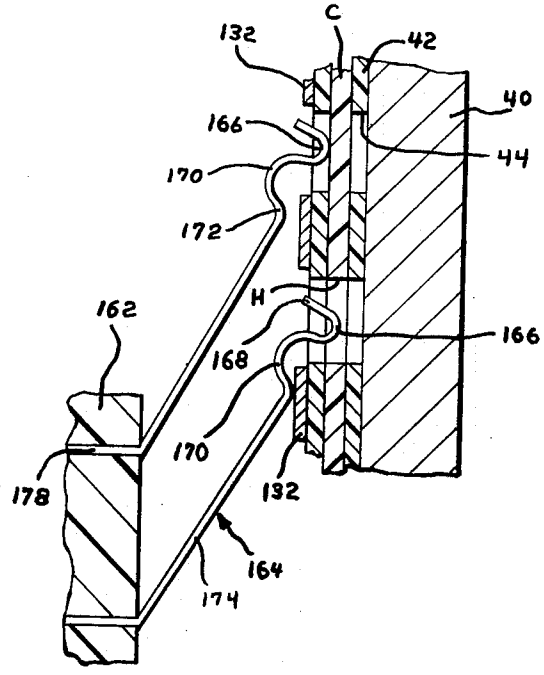
ABSTRACT: A static punchcard reader assembly is disclosed having an array of contact spring members, one for each possible bit position and hole in a data card. An interposed plate is provided to receive the ends of the spring members and to prevent fouling thereof on a card. The assembly includes a mechanism for effecting relative movement between contact spring members and conductive pads disposed in planar array on the interposed plate or, alternatively, on a sheet engaged by portions of the contact members made to project through card holes. Embodiments are disclosed featuring an assembly effecting contact closure with constant spring deflection in a manner insensitive to card dimensions and particularly card thickness, and an adjustment is provided in one embodiment for causing the contact members to engage fresh surfaces on conductive pads to extend the life of the assembly relative to contact wear. An embodiment is disclosed which features a wiping action under low force loads also to increase wipe.



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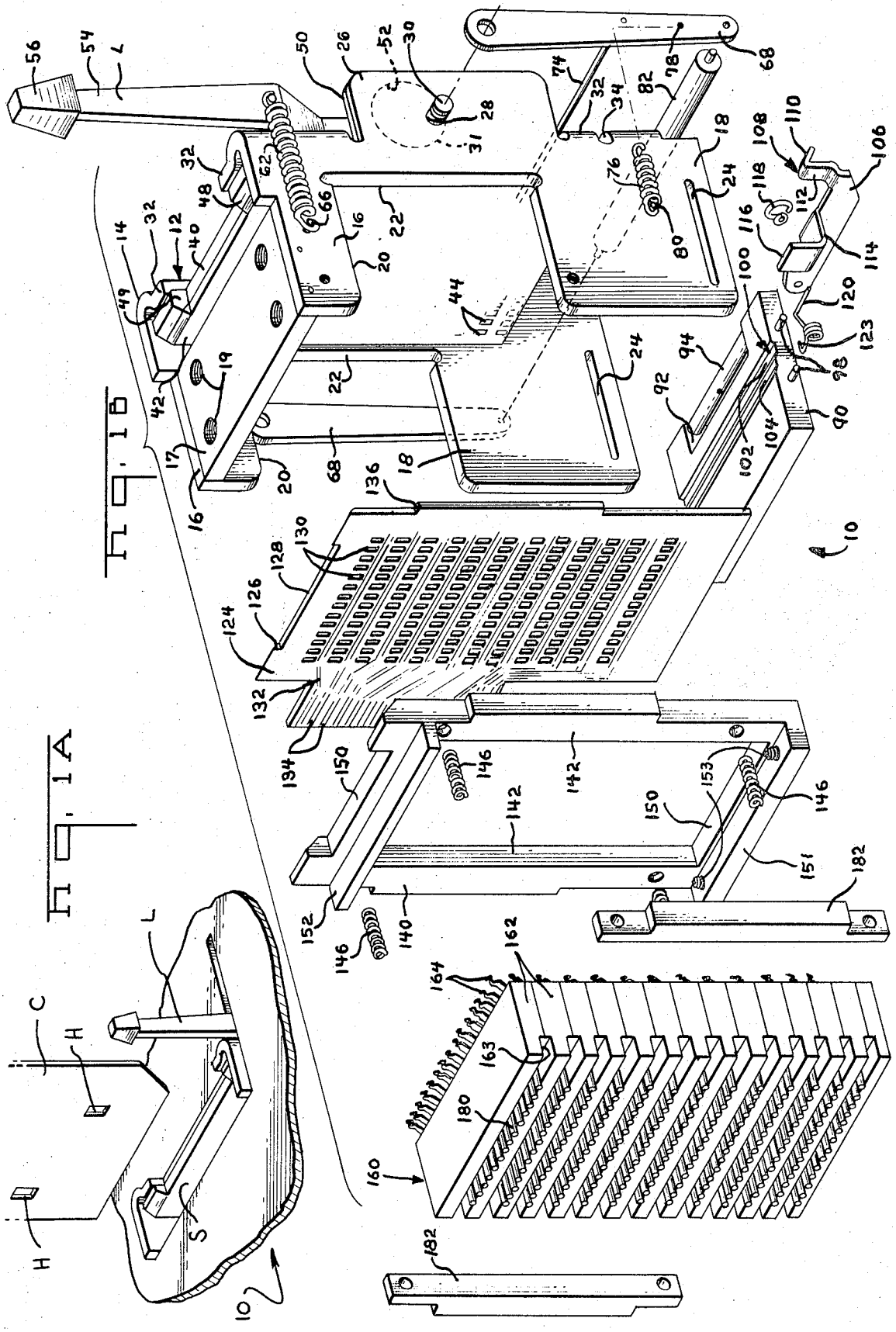

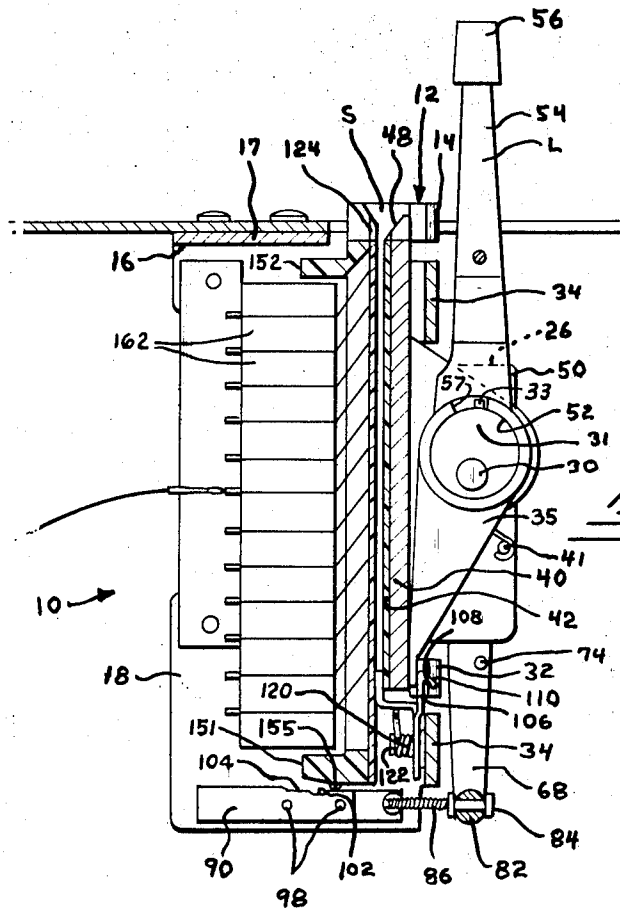

Fig. 2

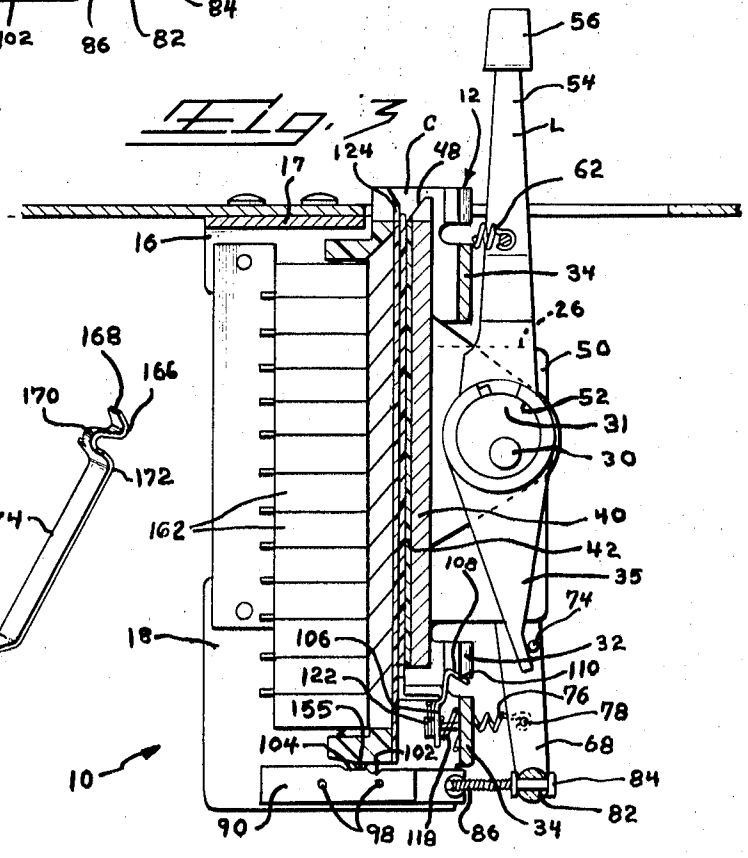

Fig. 3

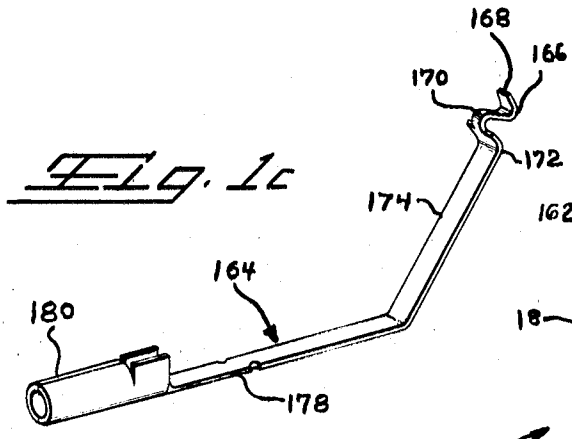

Fig. 1c

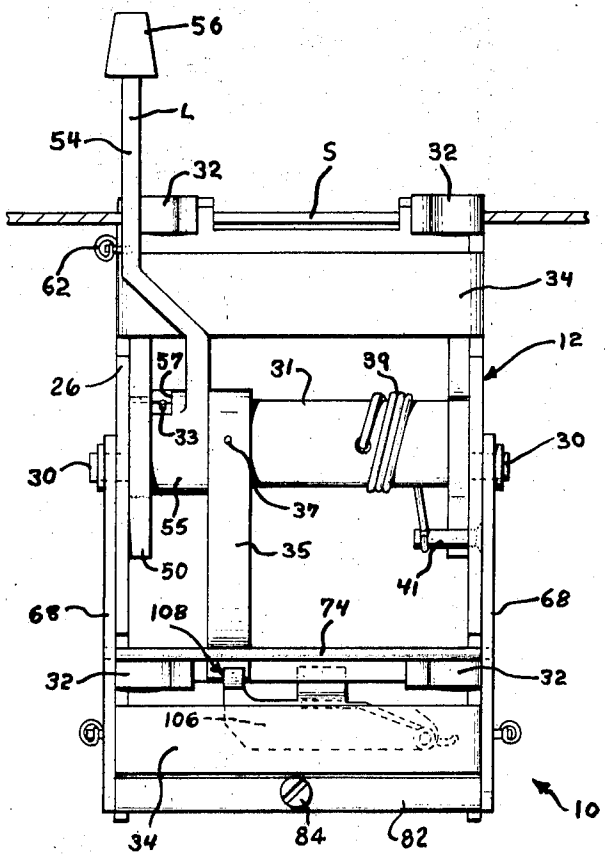

Fig. 4

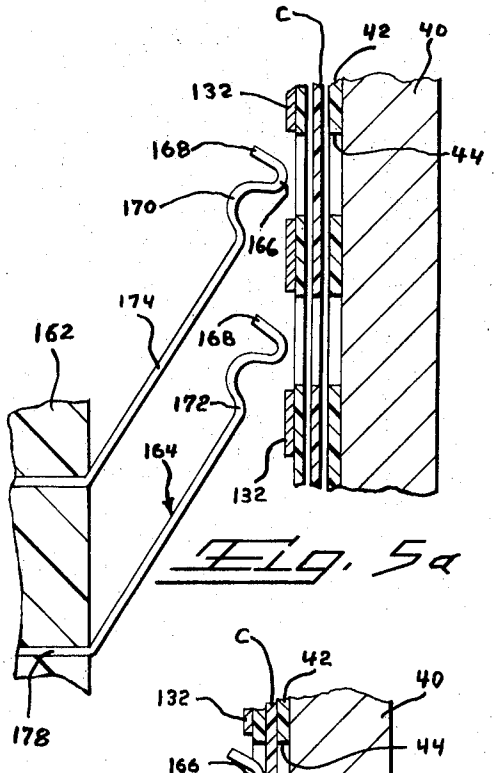

Fig. 5a

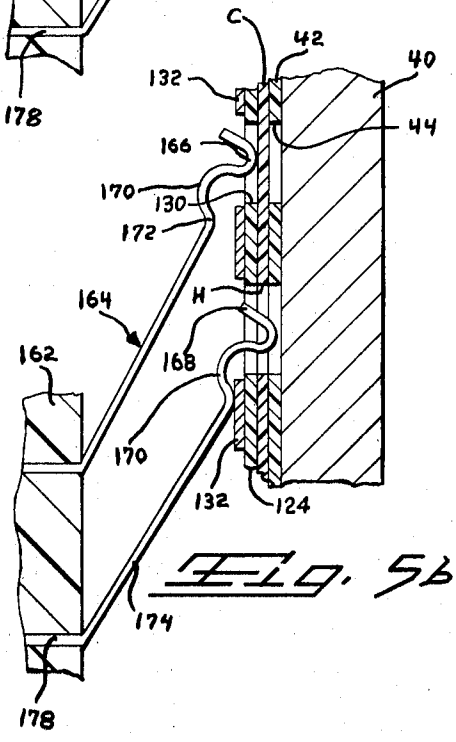

Fig. 5b

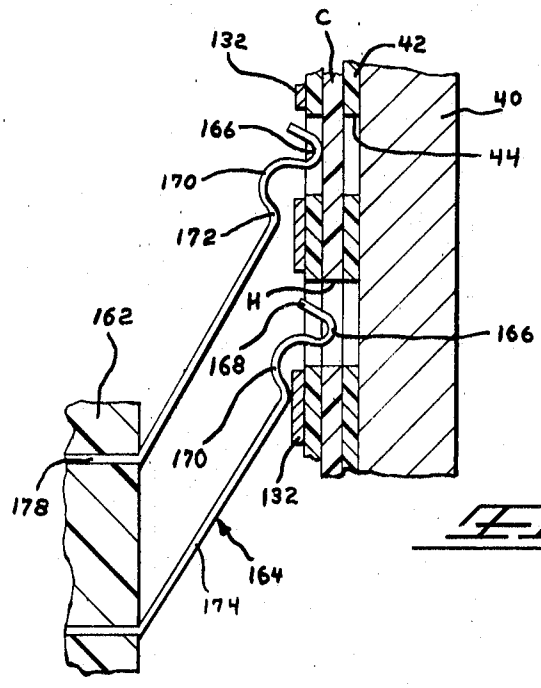

Fig. 6

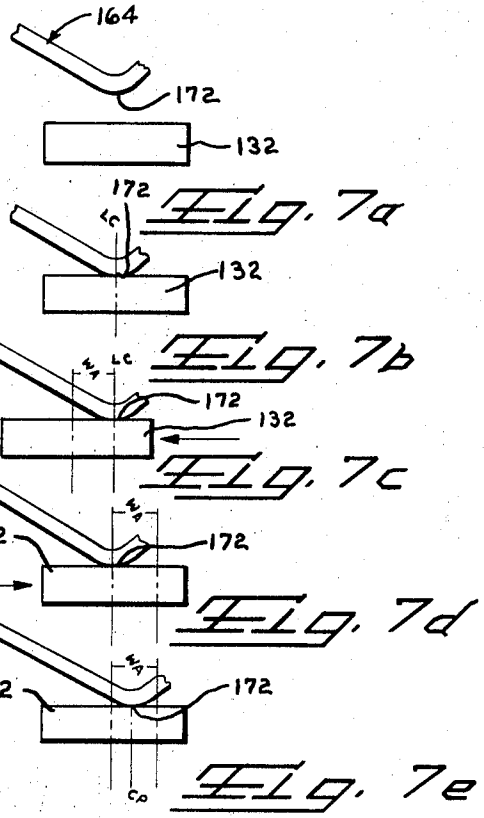

Fig. 7a

Fig. 7b

Fig. 7c

Fig. 7d

Fig. 7e

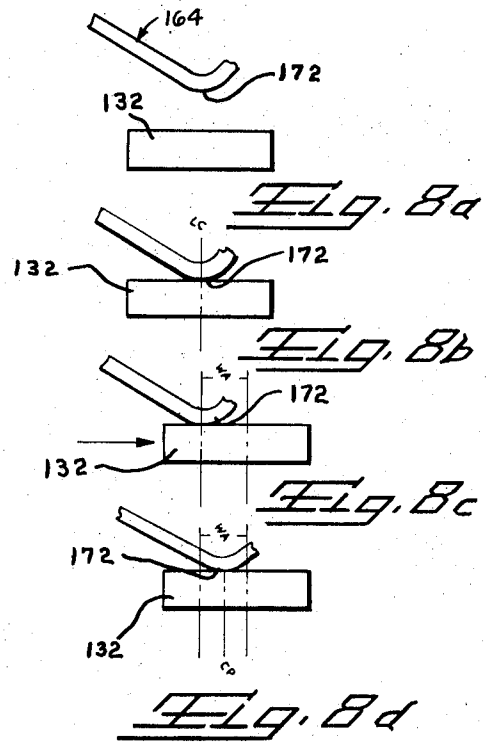

Fig. 8a

Fig. 8b

Fig. 8c

Fig. 8d

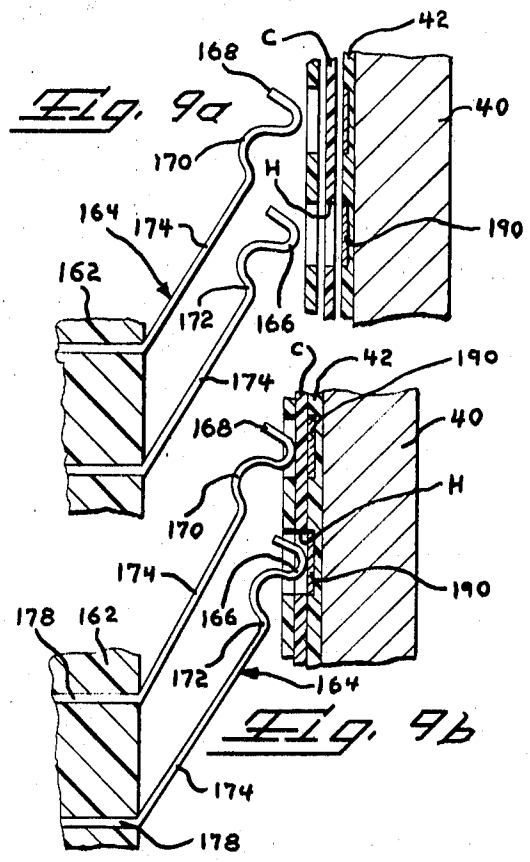

Fig. 9a

Fig. 9b

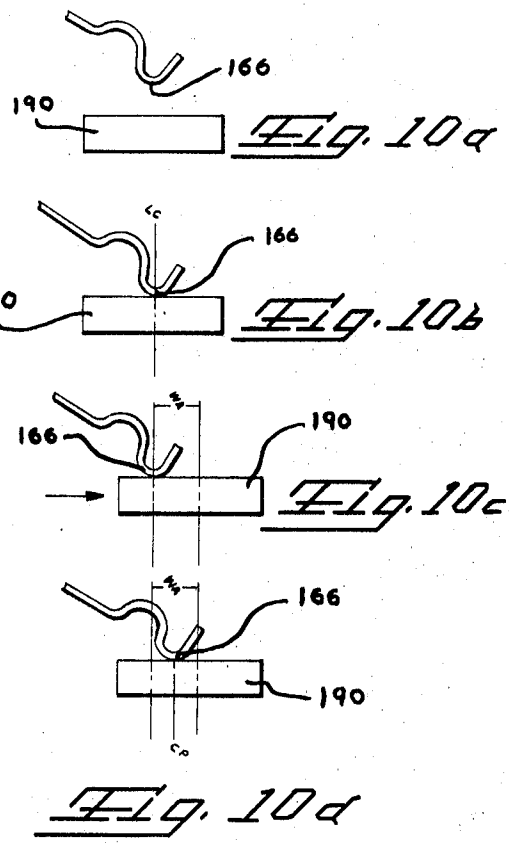

Fig. 10a

Fig. 10b

Fig. 10c

Fig. 10d

STATIC PUNCH CARD READER

BACKGROUND OF THE INVENTION

Static punched card readers differ from dynamic readers by providing one contact spring member for each possible bit position in a data card rather than a single row of contact members made to scan rows of bit positions by relative movement of a card with respect to such members. The problems of obtaining a low resistance, stable contact interface through many cycles of use are much greater with readers which must read a card in a fixed position that with dynamic readers, The wipe between contact surfaces which is necessary to clear such surfaces of foreign objects such as card fibers or bits of card material which tend to accumulate in a reader after use with many hundreds of thousands of cards is inherent in a scanning or dynamic-type reader, but is not inherent in a static-type reader. Thus, in many of the prior art static reader devices, a considerable design effort has been made to achieve wiping action. Many of the devices resulting from this effort have resulted in a wiping action under increasing pressure. Unfortunately, contact wear is directly proportional to contact pressure and reduced contact life is a direct incident thereof.

As another problem, particularly affecting static card readers, the use of a number of contact spring members equal to the number of possible bit positions means that the reader assembly must contain a relatively large number of individually mounted and supported members having spring characteristics and thus including at least a portion free for spring movement. For example, the data card having the greatest usage includes 960 bit positions requiring that the reader therefore have at least 960 individual spring contact members. The failure of any one of these contact members to make adequate contact results in failure of the assembly. Also worth pointing out is the fact that all punched data cards, even those of less bit capacity, have bit positions on relatively close center-to-center spacing requiring a complementary spacing of contact spring members in a reader assembly and ultimately requiring that the individual contact members include at least portions which are quite small. Those skilled in a related art will immediately appreciate the problems inherent in production of devices of this type and, further, of the problems of maintenance during use. As a specific problem with devices of these characteristics, based upon experience, the requirement that the contact spring members engage the card or, alternatively, extend through a hole therein makes it possible for an individual spring to be fouled on a card by being caught up a card hole on the edge thereof. If this happens the contact spring member may become broken or damaged. As previously mentioned, disablement of a single contact spring effectively disables the whole reader unit and necessitates a replacement of the major physical part thereof.

U.S. Pat. No. 2,830,759 to E. Hudes et al., grated April 15, 1958, and U.S. Pat. No. 3,042,299 to A. Sherman, granted Jul. 3, 1962, represent static card readers having a multiplicity of individual contact spring members made to extend for a considerable length for spring deflection and engagement with or insertion through data cards. U.S. Application S.N. 296,812 by Glen R. Ekers, filed Jul. 22, 1963, now U.S. Pat. No. 3,352,981 issued on Nov. 14, 1967, evidences a static card reader construction utilizing a substantial contact pressure to reduce open circuits caused by foreign objects including card fibers lodged in the assembly or extending from a data card.

Some of the prior art static card reader assemblies attempt to solve the problem of spring damage by the use of a surrounding insulating shroud or projections of an insulating block housing the contact members. One such prior art assembly is shown in U.S. Pat. No. 2,941,054 to G. N. Willis, granted Jun. 14, 1960. Readers having the type of construction shown in the new Willis patent usually are limited to use with cards of certain and carefully controlled dimensions and a particular card thickness.

SUMMARY OF THE INVENTION

The present invention relates to a card reader assembly utilized to read a card having punched holes therein defining data and, particularly, to a reader device having improved features of ease of initial assembly and maintenance free operation during use. It is an object to prevent damage of reader contact members by cards and a further object to provide a reader of extended life by providing constant deflection of contact spring members and a reduction in contact pressure through a novel wiping action. It is another object to extend reader life by providing an adjustment to provide fresh contact areas for contact engagement without replacement of device components.

The problems previously outlined are eliminated and the foregoing objectives are achieved through a card reader device which may be manually operated or motorized to respond to the insertion of a data card to drive such card in a planar engagement with a planar array of contact spring members; the members in alignment with card holes being caused in different embodiments to either make or break contact with a conductive path, such as a printed circuit pad secured on a flat sheet member. Each of the contact members is made to extend from a contact block in a manner causing a controlled deflection of the contact members with an end of each contact member projecting to engage the card surface or extend through a card hole to sense the presence or absence of such hole. A plate member having a hole for each contact member in alignment with the possible bit positions and holes in the data card is provided with the projecting portion of contact member being made to extend therethrough so that the entire array of contact spring members is maintained to avoid fouling of any of the members on the card or holes therein in a manner to cause contact member damage or damage to such card. In one embodiment the contacting surface of each contact member is located away from the card surface so as to engage a conductive pad on a side of an insulating member opposite to that engaged by the card and provision is made in the card-driving mechanism to facilitate use with cards of different dimensions and, in particular, cards of different thickness. In one embodiment the plate contains the conductive paths positioned to mate with the contact members and effect the contact-switching action of the device. In an alternative embodiment the conductive paths are disposed on a further member and contact switching occurs in a read-through arrangement with signal current caused to flow through a hole in the card. The driving mechanism of the device for one embodiment includes structure to effect an initial wiping of contact member and conductive pads while engagement pressure is relatively low. The wiping action provided is of a substantial path length to ease assembly and maintenance tolerances of the various elements of the device. Low wiping pressure achieved through the greatest part of the wipe operates to extend contact life while still providing the contact surface cleaning action required in use with punched data cards, particularly, cards of a paper base stock. As a separate embodiment of the invention, an adjustment is provided which operates to move the member carrying the conductive pads a slight amount. This feature, in conjunction with the shape of the contact members, permits all contact and wiping engagement to thereafter occur on a fresh contact surface of the conductive pads on such sheet.

In the drawings:

FIG. 1*a* is a perspective showing a card position for insertion in a slot which represents the entry of the reader assembly of the invention;

FIG. 1*b* is an exploded and perspective view of the reader assembly of the invention;

FIG. 1*c* is a perspective of the contact spring of the assembly of the invention;

FIG. 2 is a side elevational view in section of the assembly of the invention in an open position prior to receiving a card;

FIG. 3 is a view of the assembly of FIG. 2, but in a closed and reading position;

FIG. 4 is an elevational and sectional view from the rear of the assembly as shown in FIG. 2;

FIG. 5*a* is an enlarged, partially sectional view showing contact member disposition relative to a card and conductive path, in an open position;

FIG. 5*b* is a view of the elements of FIG. 5*a*, but in a closed and reading position;

FIG. 6 is a view of the structure of FIG. 5, but in use with a card of different thickness;

FIGS. 7*a*—7*e* depict contact engagement and wiping action effected by the assembly of the invention in one embodiment;

FIGS. 8*a*—8*d* depict contact engagement and wiping action following a different setting of the driving linkage of the assembly of the invention to provide fresh contact surfaces;

FIGS. 9*a* and 9*b* are enlarged, partially sectional views showing an alternative embodiment for read-through operation, depicting respectively opened and closed contact positions; and

FIGS. 10*a*—10*d* depict contact engagement and wiping action effected by the assembly of the invention in the alternative embodiment.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to FIGS. 1*a* and 1*b*, a general description of the invention will first be given. The invention device **10** is shown in FIG. 1*a* mounted vertically in the top or surface of equipment served thereby, such as in the desk portion of a computer console. The device **10** includes an operating lever L projecting above the mounting surface for manual operation by one using the reader. A card C having data thereon or therein defined by the position of holes H punched therein is positioned above **10** preparatory to insertion in a slot S which extends within **10**. FIG. 1*b* shows certain of these elements in detail. The card C is of a design to accommodate 168 possible bit positions arranged in 12 rows formed into 14 columns. In general, cards of this type have an identifying number encoded thereon by the pattern of holes placed in certain of the bit positions. The exemplary showing should not be taken to mean that the invention is limited in its application to cards having a particular number of bit positions. It is contemplated that data cards of various types, including plastic cards for credit or security usage having relatively few holes therein may be accommodated by the invention, as well as standard tabulating cards having 960 bit positions and formed of paper base material which may be accommodated by merely using more of the elements shown in the same general relationship. It is also to be understood that a horizontal mounting of the assembly **10** is contemplated and that the manually operated lever to be described in the exemplary embodiment could readily be replaced by a motorized drive means, such as a solenoid connected in a simple push-pull manner.

Card reading is effected by the insertion of the card C into the slot S which, in accordance with the invention concept, is made to engage a trigger **106**, shown in FIG. 1*b*, disposed in the path of insertion of the card. In accordance with the arrangement of the invention the actuation of the trigger effects an automatic closure of a driving mechanism displacing the card in a sense transverse to its major surface, driven by a backup pressure plate **40** into engagement with an array of individual cantilever supported contact spring members **164**. Switching action results by reason of portions of the contact members extending through holes in the card to sense the presence of such holes and thus to close an electrical circuit between portions of the contact members **164** and portions of conductive pads **132** which are, in such embodiment, separated from any engagement with the card or surfaces thereof. In an alternative embodiment the conductive pads are disposed in a sheet driven by the backup plate. In both embodiments, a member **124** of insulating sheet material having holes therein of the configuration of the holes **130** in the card positioned in the array of bit positions for the card is utilized to receive the ends of the contact members during reader operation. The sheet member or plate **124** is also used during initial assembly of the device in a manner to be described and is of a construction made by a technique providing an inherent control of tolerances both of the hole itself and of hole-to-hole spacing. This feature is particularly advantageous when used in applications for tabulating cards or cards having a relatively large number of data bit positions.

The reader device **10** includes a main frame **12** with the pressure plate **40** driven by a driving linkage to effect card displacement and contact closure for switch action. The device includes a fixed block **160** containing the contact members **164** extending therefrom and positioned free for deflection and spring action. The sheet member **124** which serves to receive the card is, in one embodiment, carried by a slide frame **140** loaded under spring pressure relative to the fixed contact member block **160**. In the one embodiment the conductive pads **132** engaged by the contact spring members are disposed on member **124**. In an alternative embodiment the conductive pads are disposed on a sheet **42** of insulating material affixed to the main driving plate **40** of the device. In the one embodiment a camming mechanism including a slide cam **90** is arranged to jog the member carrying the conductive pads to effect a wiping action prior to any substantial deflection of the contact members **164** but after initial engagement of such contact members with the conductive pads so as to effect a wiping under reduced force loads to increase contact life. In this same embodiment an adjustment for the cam slide is provided in the driving linkage for displacing the member-carrying conductive pads **132** a slight amount to establish contact between all contact spring members and the conductive pads in a different zone to provide fresh contact areas for all operations of the device thereafter.

The device **10** operates to effect a mechanical reading of a punched data card by causing individual spring members **164** carrying contact portions to be deflected or not deflected to sense the presence or absence of a card hole with such sensing resulting in a switch action defined by a related closure of certain contacts. This mechanical reading of the card is then converted into an electrical reading of the card by an appropriate application of signals to one or the other of the mating contact elements, contact spring members or conductive pads, the other member being either interconnected or connected to a lead in a manner to develop an associated flow of current as an output signal. With the reader device of the invention, output signals may be developed simultaneously from all of the switch closures caused by the mechanical reading or may be developed on a row-by-row or column-by-column basis through the use of external scanning equipment such as a stepping switch or solid state equivalent thereof.

DETAILED COMPONENT DESCRIPTION

Turning now to a detailed description of assembly **10**, FIG. 1*b* shows to the right a main frame assembly **12** which carries the driving mechanism and linkage of the device along with structure to position and drive the remaining elements and to mount the device in a panel for use. The assembly **12** includes a main frame **14**, which in a preferred embodiment is stamped out of metal stock and formed into a generally boxlike configuration; housing, to the right the card-driving mechanism, and at the bottom, a linkage and structure to effect contact wipe at reduced loads, as well as the trigger **106**. Extending to the left of **14** are pairs of projecting flanges identified as **16** at the top between which is fitted a mounting plate **17**, apertured as at **19**, and anchored to **16** by a series of pin members as shown. The assembly **10** is mounted on the panel of use by bolts or suitable other fastenings passed through holes **19** of plate **17**. Frame **14** further includes a pair of flanges **18** extending from the lower portion thereof to the left which are spaced from flanges **16** to define a recessed area generally

shown as 20, terminated in a vertical and flat surface 22 which operates as a stop or bearing surface limiting displacement to the right of the other movable portions of the assembly.

At the bottom of flanges 18, disposed in a horizontal sense, are slots 24 which serve to support, for limited horizontal movement, the cam slide 90 disposed between the lower flanges. Frame 14 includes a pair of further projecting flanges 26 extending oppositely from the flanges 16 and 18 in a position to contain portions of the main pressure plate 40, which portions extend on either side of such plate as at 50, adjacent to the flanges 26. Movement of the pressure plate to the right is restricted by projections 32 located at the top and near the bottom of the main frame. These projections can be better seen in FIG. 4. The sides of the main frame, including the various flanges 16, 18 and 26, are held together by integral straps which extend across the back of the frame in the manner depicted in FIGS. 3 and 4, by the numeral 34. The main pressure plate is comprised of a base plate 40 having permanently affixed to the surface thereof an insulating sheet 42 which, in one embodiment, contain a series of rectangular holes 44 disposed in an array and positioned to accommodate portions of the contact spring members 164 of the assembly which each project therewithin through a card hole during reading. In another embodiment, sheet 42 is made to contain conductive pads in lieu of the holes 44, the pads being in turn connected to conductive paths which extend outwardly of the assembly to be terminated to input and output leads in a manner to be described hereinafter. The upper end of plate 40 and sheet 42 is beveled as at 48 to serve as a guide for card insertion. The center of such end is relieved as at 49 to facilitate grasping the end edge of a card during card withdrawal. As a preferred construction, base plate 40 is stamped and formed of sheet metal stock and the sheet 42 is formed of a plastic board punched out to define the holes 44 and then bonded to the base plate 40 by a suitable adhesive.

Plate 40 includes a pair of flanges 50 which have the configuration and position indicated in FIGS. 1*b*—4. Each flange 50 includes an eccentric surface 52. Extending through the surface 52 of each flange 50 is a cam including an enlarged portion 31 of a dimension to bear against the surfaces of the two eccentrics 52. The cam is anchored for rotary movement by an off-centered portion extending from 31 and shown as a pin 30, which is made to project through a bearing support 28 in each of the flanges 26 and 50 in the manner depicted in FIG. 1*b*. As the cam is rotated in limited movement about 30, the main pressure plate is driven along a horizontal axis extending from left to right of the assembly.

As can be discerned from FIG. 4, a spring 39 extends around 31 with one end thereof anchored in 31 and the other end thereof tied to the main frame through a pin 41. The spring 39 operates to drive 31 in a counterclockwise direction to effect closure of the device and card reading. The spring is loaded when the pressure plate is positioned fully to the right in the main frame, as indicated in FIG. 2 so as to effect the displacement indicated in FIG. 3.

Referring to FIGS. 2—4, the operating lever L is made to extend from a lever portion 54 upwardly to an operating knob 56 and downwardly to a sleeve portion 55 which surrounds 31. The sleeve portion 55 includes in the upper surface a slot 57 extending partially around the periphery thereof. A pin member 33 affixed to 31 is fitted within slot 57 to be engaged by the end thereof and driven by 55 during operating of the lever L. The lever L may be seen to pivot about 31 as biased by a tension spring 62 tied by a pin to the portion 54 of the lever and by a further pin 66 to the near projecting flange 16 of the main frame 14, as shown in FIG. 1*b*. The spring 62 tends to pull L in a counterclockwise sense relative to FIGS. 2 and 3. As previously mentioned, the lever L could be replaced by a motorized drive attached below the surface of the mounting panel, the upper part of 54 being eliminated.

The pins 30 of the cam are made to extend outboard of flanges 26, as shown in FIG. 4, and a pair of links 68 are provided positioned on pins 30 for relative rotary movement. Links 68 depend from the pins 30 and are tied together by an actuating rod 74 extending between the links on each side of the assembly. An actuating arm 35, secured against movement relative to 31 by a pin 37, extends downwardly from 31 to engage the actuating rod 74 and drive such rod and thereby drive links 68 from the position shown in FIG. 2 to the position shown in FIG. 3. Links 68 are biased in a clockwise sense relative to FIGS. 1*b*—3 by tension springs 76, anchored by a pin 78 in each link and by a pin 80 in the flange portion 18 of the main frame 14. The bottom ends of links 68 carry a rod 82 extending between the two links. In the center of the rod, as shown in FIGS. 2—4, is an adjustment mechanism comprised of a bolt member headed as at 84 in a position of access for adjustment and threaded as at 86 to mate in complementary threading in the cam slide 90. Movement of the links 68 results in a movement of the cam slide.

Cam slide 90 is comprised of a block of hard material recessed at the right-hand end, as shown in FIG. 1*b*, by the numeral 92 to contain a rod 94, which is made to receive the threaded bolt member 86. At each side of 90 a pair of projecting pins 98 are positioned to engage the guide slots 24 of the projecting flanges 18 to align, limit and guide the cam slide for horizontal movement under drive of links 68. Toward the center of the top of 90 is a groove 100 which extends thereacross to define camming surfaces including a first surface 102 of a depth greater than a second surface 104 adjacent thereto. FIGS. 1*b*, 2 and 3 reflect the operation of these surfaces relative to driving a slide frame to effect a particular contact wiping engagement associated with one embodiment of the invention, and heretofore mentioned.

Secured to the lower strap 34 of the main frame is trigger 106 formed in a preferred embodiment of flat metal stock into the configuration best shown in FIG. 1*b*. The trigger includes a latching arm 108 which has a depending and angularly disposed camming surface 110, supported by a portion 112 in a position to be engaged by the end of 35 during operation of the driving mechanism. FIG. 2 shows the trigger in a set position holding 35 to the left against rotation in a counterclockwise sense. FIG. 3 shows the trigger-following release of 35, which release permits an automatic closure of the assembly under drive of the elements heretofore mentioned. As the assembly is reset by operation of lever L, the end of 35 engages the camming surface 110 to depress 106 and slide up and over 110 to be latched by 112. The portion 114 formed out from the center of 106, as shown in FIG. 1*b*, carries a tab 116 positioned to extend up into the card-receiving slot S to be operated by a card insertion. The trigger is pivotally mounted and biased in a clockwise sense with respect to a showing in FIG. 4 by a spring member 120 secured about an anchoring pin 122, seated within the strap 34, as shown in FIGS. 2 and 3. One end of the spring 120 bears against the trigger and the other end is bent to fit within an anchoring hole in the strap 34. This end is identified as 123 in FIG. 1*b*. A spring 118 is disposed between the strap 34 and the trigger to accommodate trigger movement transverse to the strap as the main pressure plate is operated. FIGS. 2 and 3 reflect this movement.

Referring again to FIG. 1*b*, a sheet or plate 124 is provided which serves the function heretofore mentioned of receiving the contact spring members 164 during operation of the assembly. The plate 124 includes at the top edge a slight bevel 126 which cooperates with the bevel on slide frame 140 to accommodate card insertion within the assembly. The center of the top edge of plate 124 is relieved as at 128 to facilitate card removal. The plate is preferably formed out of plastic board material such as phenolic sheet, punched out to define an array of holes 130. In the embodiment herein disclosed the holes are rectangular and in a pattern corresponding to the pattern of possible bit positions in a card to be read and also corresponding to the positions of contact members 164.

As an important aspect of the invention, to be described in more detail hereinafter, the plate 124 serves in both preferred embodiments of the invention as a means to receive the ends

of the contact members during operation of the reader device. The plate **124** also serves as a sort of jig fixture during initial assembly of the device, the holes therein permitting a final check of the position of the contact springs **164** for a proper alignment with any slight individual adjustment of a contact spring being made relative to a given hole in the sheet **124**. With the contact block **160** containing the contact springs positioned on a flat surface the plate **124** may be positioned thereon with the slide frame **140** which carries the plate disposed between the contact block and the plate and having a preapplied adhesive so that the plate may be aligned with each contact spring member made to extend through a related hole therein and with the slide frame thereby properly positioned relative to this alignment and permanently secured to the plate **124**. Operation of the plate during use to prevent fouling of the card by the contact members will be described hereinafter.

In one embodiment of the invention the plate **124** is provided with a conductive pad disposed along at least one side of each hole to be contacted by a contact member. FIG. **1***b* shows that this structure may be provided by portions of conductive strips **132** extending along each row of holes to electrically common the paths for each hole of a given row. In this embodiment the strips **132** are extended out to the edge of the plate **124**, as indicated by the numeral **134** for termination to input and output leads through some suitable connector means, such as a standard printed circuit edge connector. The opposite side of the portion of the plate carrying the extensions **134** and the projecting portion shown as **136** of the plate engage the surfaces **22** on either side of the main frame to limit rightforward displacement of the plate **124**.

Plate **124** is, as previously mentioned, secured to a slide frame **140**, which includes side members **142** and top and bottom members **150** rigidly fastened together or, if desired, made integral as by casting. Within each side member **142**, at the top and bottom thereof are apertures in which are seated springs **146** which are made to engage the contact block shown as **160**. In the embodiment shown in FIG. **1***b* these springs are in loose engagement with the contact block and the slide frame and are compression springs which tend to push the slide frame **140** and plate **124** away from block **160**. As an alternative, it is also contemplated that in a standard fashion the ends of the slide springs may be fastened to the block **160** and to the slide frame and made to operate in tension to tend to pull the frame and plate **124** toward the block **160**. This latter feature will, as to be described hereinafter, permit a normally closed switch operation of the device. In the embodiment actually depicted in FIG. **1***b*, normally open switch operation is contemplated. The bottom crossmember **150** of the frame includes a projecting flange **151** which is made to extend beneath the contact block **160** in all positions of the device operation. A pair of compression springs **153** are seated in recesses in the flange **151** to bear against the bottom of contact block **160** and spring load the slide frame **140** downwardly relative thereto. FIGS. **2** and **3** show this arrangement. On the bottom of flange **151** is a projection which forms a camming surface **155** also as shown in FIGS. **2** and **3**. This camming surface engages the surfaces **102** and **104** and also the top surface of the cam slide **90** to control movement of the slide frame during device closure. A projection **152** from the top crossmember **150** limits downward movement of the slide frame **140**. As can be discerned, movement of the slide frame effects a corresponding movement of the plate **124**, which is rigidly secured thereto. The thickness of the slide frame permits the plate **124** to be held in a position limiting deflection of the contact spring members during operation.

The contact block **160** is comprised of a series of blocks of insulating material, shown as **162**, which are fitted together to entrap a series of contact members in an array corresponding to the array of holes in plate **124** and in sheet **42** of the main pressure plate. Each of the blocks **162** is relieved at the rear, as at **163**, as shown in FIG. **1***b* to provide a slot extending across the block to accommodate termination to or between the individual contact members. Each of the contact members **164** include a terminating portion at the rear end, such as the barrel **180** into which may be inserted a contact pin member terminated to an electrical lead. The contact members may be interconnected in a variety of ways, including individual connections to each contact member or busing together of all of the contact members of a column or a given row, depending upon the application of use and the type of electrical readout preferred. It may be necessary to alter the disposition of conductive strips **132** to a column disposition, rather than the row disposition indicated. This could be accomplished by having the conductive strips **132** extend downwardly between the column of holes with a portion thereof extending outwardly beneath each hole to form a conductive pad for such hole. The immediately foregoing description applies equally well to the alternative embodiment wherein the conductive pads are placed on the sheet **42** of the main pressure plate.

A pair of stiffeners shown as **182** are provided on each side of the contact block **160** and the contact block is secured to the main frame **14** by a suitable attachment to the projecting flanges **16** and **18**, as fitted within the recess portion **20** therebetween. The projecting portions of the stiffeners shown in FIG. **1***b* are of a size to facilitate this.

FIG. **1***c* shows the contact members **164** in greater detail relative to other components of the assembly. Each contact member includes a rounded end portion **166** of reduced width, which is made to engage a card C or extend through a hole in such card in a manner depicted in FIG. **5***b*. The reduced width of the end of the contact member permits a reading with wide variations in card hole tolerance or positioned in the reader device. The end of the contact member may be turned up as at **168** to operate in conjunction with the plate **124** to prevent the contact member from accidentally catching on any portion of the card. In one embodiment the contact member end **166** serves as merely a sensing means and in an alternative embodiment the portion **166** is made to have a contact-bearing surface to effect a read-through contact engagement in the manner to be hereinafter described. The contact member is rounded upwardly, as at **170** as shown in FIG. **1***c* and downwardly as at **172** to define a line contact surface which in one embodiment may be positively controlled to be either in engagement or out of engagement with a mating conductive pad on strip **132**. The rounded portion **170** serves in both embodiments to orient the sensing or contact portion **166** in a sense which is substantially transverse to the holes of a card and to the disposition of conductive pads. Each contact member includes a cantilever arm shown as **174** in FIG. **1***c* extended from a support portion **178** which is trapped within the block **162** and which extends to the rear of the block assembly for suitable termination to leads or busing members, as previously mentioned. The contact members are thus made and mounted to permit a substantial but controlled spring action on deflection to either make or not make contact, depending upon the presence or absence of a hole in a card C. Overstress is precluded by the position of plate **124** as held by slide frame **140**. The spring action provided by contact members of the configuration shown permits repeated deflection in use without taking a set which could result in either a failure of contact closure or at least cause a high resistance circuit path resulting in poor electrical performance.

In an actual assembly the contact members **164** were made of phosphor bronze material approximately 0.012 inch thick with the portion **172** approximately 0.380 inch in length and approximately 0.050 inch in width. The end portion defining **166**, **168** and **170** was about 0.018 inch in width. In a test involving appreciable deflection of an array of some 960 contact springs of a configuration shown the greatest permanent deflection in any of the contact spring members after 50,000 cycles was only about 0.001 inch, an amount not incompatible with excellent operating characteristics.

DETAILED ASSEMBLY OPERATION

Referring now to FIG. 2 and to the operation of one embodiment of the device of the invention, the assembly 10 is shown in an open position preparatory to receiving a card C inserted therein. As can be discerned, portion 116 of trigger 106 is disposed within the card slot projecting upwardly from the end thereof and biased by a spring 120 into this position. The driving mechanism is disposed to the right with the pressure plate 40 fully to the right. In the embodiment shown in detail in FIG. 1*b* the plate 124, as carried by slide frame 140, is positioned to the right, as driven by the compression springs 146. At this time the individual contact members are in the relative position shown in FIG. 5*a*. The arm 35 and cam 31 are biased for counterclockwise rotation by a spring 39. At this time pin 33 is disposed toward the center of the slot 57 with the operating lever L biased in the position shown in FIG. 2 by a spring 62. Also, at this time, links 68 are disposed generally vertically, biased in a clockwise sense by a spring 76 to in turn hold the cam slide 90 to the left with the right-handed pin 98 in engagement at the end of the guide slot 24. The cam surface 155 is thus made to rest on top of the cam slide out of the cam groove containing camming surfaces 102 and 104. The slide frame 140 is thus disposed upwardly to compress springs 153, which in turn tend to drive the slide frame downwardly.

FIG. 3 shows the assembly of the invention following insertion of a card C which engages portion 116 of the trigger, driving the trigger 106 downwardly to release 35 and thereby release 31. As 31 is released it is driven in a counterclockwise sense relative to FIG. 3 by a spring 39 to rotate to a position with pin 33 in engagement with the left-hand end of slot 57. As 31 rotates within eccentric 52 it drives the main pressure plate to the left which carries the card C the plate 124, and the slide frame 140 to the left. Also, as 35 moves counterclockwise after release from the trigger, it engages rod 74, driving such rod to the right which in turn drives links 68 in a counterclockwise rotary movement against the spring force provided by 76. This movement of links 68 draws the cam slide 90 to the right, causing the surface 155 on the bottom of slide Frame 140 to enter groove 102. dropping the slide frame downwardly. FIG. 7*a* shows the relative position of a contact member 164 to a conductive pad just prior to operation with the contacts in an open circuit condition. FIG. 7*b* shows first engagement between a contact member and a conductive pad. The driving linkage of the device is adjusted so that an engagement as depicted in FIG. 7*b* is made prior to any vertical movement of the slide frame caused by 155 entering into the camming groove. FIG. 7*c* shows the resulting wiping action caused by the slide frame being dropped vertically as 155 moves into engagement with camming surface 102. FIG. 5*b* shows the contact member 164 in closure and it should be apparent that the ends of the contacts are held from being caught on the card. In accordance with the setting shown in FIGS. 2 and 3, the cam slide continues to move to the right until 155 rides up onto surface 104. This results in the wiping action shown in FIG. 7*d*, which is approximately equal to but in a reverse sense, from the wipe occurring in FIG. 7*c*. Further movement of the slide frame under drive of the pressure plate to the left causes a deflection of the contact members as indicated in FIG. 7*e* to place the contact members in contact with a prewiped contact zone on the conductive pads.

In accordance with a further aspect of the invention the adjustment mechanism can be operated by a few turns of the threaded portion 86 to displace the cam slide to the right from the position shown in FIG. 2, so that 155 rests in a normal position in the center surface 104. Operation of the unit will then cause the slide frame carrying the conductive pads to move to the left effecting a displacement of contact surfaces between the open circuit position shown in FIG. 8*a* and the point of initial contact shown in FIG. 8*b*. As the cam slide 90 is then drawn to the right, surface 155 will engage the left-hand end of surface 104 to be driven upwardly onto the top of the cam slide effecting the wiping action shown in FIG. 8*c*. This wiping action may be compared to that depicted in FIGS. 7*b*—7*d*, to indicate that wiping is occurring on a fresh zone of contact on the conductive pad. Final closure of the contacts operates to deflect the contact members effecting a further wipe, as indicated in FIG. 8*d*, which leaves the interface between contact members and conductive pads in a prewiped zone. The configuration of the contact members permits this adjustment to provide fresh contact surfaces. This feature is of considerable practical advantage in that the life of the contact members can be more easily increased than can the life of the conductive pads considering the various factors of tolerance and the amount of contact material required.

In use with a card having holes with a maximum dimension of approximately 0.125 inch, the spacing between contact surfaces 172 and conductive strips 132 when the assembly is in an open position may be approximately 0.032 inch. The first wiping movement resulting from drive of the slide frame downwardly can be made approximately 0.010 to 0.020 inch with the second or final movement being approximately half that.

FIG. 6 depicts the switching elements of the assembly in use with a card of substantially greater thickness than that evidenced in FIGS. 5*a* and 5*b*. As can be seen, the closure motion of the device of the invention, in conjunction with the configuration of the contact members facilitates a use with cards of varying thickness. It is also to be noted that variations in other card dimensions, including the length or width of card holes or the position of card holes relative to the invention assembly can be accommodated by the invention.

Following the operation just described to effect card reading, the card may not be withdrawn from the assembly until operation of the lever L, which must be displaced to the right relative to the showing in FIGS. 2 and 3. This displacement results in an engagement of the left-hand end of slot 57 with pin 33 to rotate cam 31 in a clockwise sense. This in turn results in a driving engagement of 31 with eccentric 52 in flange 50 to draw the pressure plate to the right permitting the slide frame to move to the right under drive of the compression springs 146, breaking all contact and freeing the card from engagement with contact members. Simultaneously, arm 35 is rotated clockwise until the end thereof engages portion 110 of the trigger to depress the trigger 106 until the end of 35 slides over 108 to engage and be latched by 112 in the position shown in FIG. 2. The trigger is in an upward position loaded by spring 120 and ready for operation with the next card to be inserted. Movement of the operating lever L again loads spring 39 and the lever is maintained in the position shown in FIG. 2 by spring 62. Also, simultaneously, links 68 are pulled to the left by the spring 76, following the movement of 35 and its engagement with rod 74. As this occurs the cam slide is drawn back to the position of FIG. 2, driving the slide frame upwardly a slight amount. The assembly is now ready for use with another card.

In the foregoing description contact closure has been described for normally open operation; i.e., where all of the contacts are normally or initially out of contacting engagement and contact closure and switching action results from device operation. It should be apparent that normally closed operation can be obtained by an arrangement of the springs 146 to operate in tension to maintain the slide frame 140 and plate 124 to the left, with the driving plate then operating to force a card to drive the contact members out of engagement with conductive pads on plate 124.

It is also contemplated that the feature of the invention relating to the use of a plate such as Plate 124 described above for receiving the contact members may be used to advantage in an assembly wherein contact is made through a card hole. In this embodiment conductive pads are placed in the sheet 42 mounted on the pressure plate 40. These conductive pads are formed in the positions of holes 44. FIGS. 9*a* and 9*b* depict this arrangement. As can be discerned, contact is made through the portion 166 of each contact member and the conductive pads shown as 190 in the sheet 42. The conductive

pads **190** may be interconnected by strips extended in a suitable fashion outwardly of the zone of contact engagements for termination by a suitable technique. It is contemplated that the sheet **42** may be extended at the bottom thereof to accommodate a printed circuit edge connector or the like device for such termination. FIGS. **10***a*—**10***d* depict contact engagement between the portion **166** of each contact member and the conductive pad **190**. The wipe shown is similar to that evidenced in FIGS. **8***a* —**8***d* and results in a final contact engagement in a prewipe zone, in the manner previously described. In this latter embodiment the plate and the slide frame structure can be fixed to the pressure plate, if desired, to fix the card-receiving slot dimension.

It is also contemplated that alternative switching paths can be provided utilizing conductive pads on plate **124** and on sheet **42**. Auxiliary circuits for control or other purposes can be handled in this manner with the contact member configuration shown. If the alternative structure is used, however, the feature of accommodating cards of different thicknesses by permitting a portion of the contact member to extend through the card and into the hole of **42** cannot be carried out. In certain applications control of card thickness can be expected because of a single source of cards and the read-through arrangement may be preferred.

In summary, the invention has been described in several embodiments, one effecting a contact closure and engagement which develops reading signals which do not pass through a card hole and the other effecting a reading with signals passing through a card hole. Both embodiments utilize a plate member which has holes therein to surround spring contact members when such are in a reading position to preclude fouling thereof on any portion of a card to be read. Additional features are included to provide a wiping engagement under reduced contact pressure and an adjustment which introduces fresh areas of contact for increasing contact life. It is contemplated that these features may be selectively used as application requirements dictate. In a general sense the device of the invention is a multiple switch structure capable of achieving a plurality of switching engagements and having a particular use as a card reader for reading functions wherein contact engagements are in a pattern related to holes in a card-defining data.

Having now disclosed the invention in terms intended to enable a preferred mode of practice thereof, claims are appended which define the subject matter asserted as inventive.

We claim:

1. In a device for switching a plurality of electrical circuits, an array of contact members each comprising a cantilevered leaf spring having a mounting portion, an end-projecting portion carrying a contact surface thereon, and a thin flat spring portion supporting said end portion to provide substantial deflection and spring action therefore; an insulating block fixedly mounting said contact members with their spring portions extending at an appreciable angle outwardly from said block to permit movement of the end portions of said contact members toward and away from said block under a spring force developed by said spring portions; first means comprised of a thin plate of insulating material having a plurality of holes therein, including an individual hole for each contact member aligned therewith to receive the corresponding contact member; an array of conductive members disposed upon and carried by said thin plate, said array of conductive members having portions complementary to the array of contact members; drive means for moving the array of contact members and the array of conductive members disposed on said plate relatively together to effect a switching action therebetween; guide means to guide and position a data card having holes therein into a predetermined reading location in which the holes in said card permit an engagement between certain of said contact members and certain of said conductive members and portions of said card apart from said holes preclude switching action between the remainder of said contact members and said conductive members; and second means for mounting said plate for movement by said drive means to a position in which each hole in said plate surrounds the said end portion of the corresponding one of said contact members to receive said end portion and to preclude damage to said contact members by said card.

2. The device of claim 1 including means to limit the position of said first means relative to said block to limit deflection of said contact member spring portions and prevent overstress of said contact members in use.

3. The device of claim 1 wherein there is included a further means operable to effect a wiping action between said certain of said contact members and certain of said conductive members during a first portion of relative movement therebetween to provide a wiping under reduced contact pressure.

4. The device of claim 3 wherein there is included means to position said block and said array of contact members in a position relatively fixed to cause a deflection of said contact members resulting in a second wiping action causing the contact surfaces carried on the end portions of said contact members to reside in a prewipe zone of contact with said conductive members responsive to a final portion of relative movement.

5. The device of claim 1 wherein there is included a further plate positioned between said drive means and said card, said further plate including an array of recesses complementary to the end portions of said contact members and positioned to receive said end portions to facilitate the use of said device with cards of different thicknesses.

6. The device of claim 1 wherein there is included a trigger means operated by engagement with said card to actuate said drive means and effect an automatic operation of said device responsive to the full insertion of a card therewithin.

7. The device of claim 1 wherein said conductive members are disposed on said plate adjacent the holes therein and the end portions of said contact members have the said contact surfaces positioned to engage said conductive members with a further portion positioned to extend through the said plate.

8. In a switch assembly having an array of individual contact members each including a contact surface and an array of conductive members each including a second and larger contact surface, means to effect an engagement between contact members and conductive members in a first zone of contact engagement therebetween to effect a switching action and adjustment means coupled to one of said arrays for positioning said array of conductive members relative to said array of contact members wherein said engagement occurs in a fresh zone of contact between said members to increase the life of said device.

9. In a device for switching a plurality of electrical circuits, an array of contact members each including a mounting portion, a spring portion and an end portion carrying a contact surface thereon, an insulating block fixedly mounting said contact members with the spring portions extending at an appreciable angle outwardly from said block to permit movement of the end portions of said contact members toward and away from said block under a spring force developed by said spring portions, an array of conductive members having portions complementary to the array of contact members, drive means operable to move the array of contact members and the array of conductive members relatively together to effect a switching action therebetween, means to guide and position a data card having holes therein between said array of contact members and said array of conductive members, the holes therein permitting an engagement between certain of said contact members and certain of said conductive members and portions of said card apart from said holes precluding switching action between the remainder of said contact members and said conductive members, further means comprised of a thin plate of insulating material having holes therein in an array complementary to the arrays of contact members and conductive members, said plate being driven by said drive means so that the holes thereof surround the said end portions of said contact members to receive said end portions and to preclude damage to said contact members by said card, and

including an adjustment means coupled to said array of conductive members for positioning said conductive members relative to said contact members so that the engagement between each contact member and a conductive member occurs in a different zone on said conductive member to provide a fresh area of contact therebetween and extend the life of the device.

10. In an assembly for reading data cards having data defined therein by the position of holes therein or the lack thereof, an array of contact spring members, one for each possible bit position in said card, and each including a contact surface and a projecting portion, a plate member carrying a series of conductive pads, one for each contact member in alignment therewith, a driving plate and means to drive said driving plate, means positioning said driving plate relative to said plate member carrying said conductive pads so as to receive and position a data card therebetween with the bit positions thereof aligned with said contact members, the contact pad carrying plate member further having a series of holes therein in alignment with said bit positions on a card inserted in said assembly with portions of said contact members extending outwardly to pass through said holes upon operation of said driving plate to drive said card against the rear of said contact pad carrying plate member and drive said contact pad carrying plate member toward said contact members whereby the projecting portions of the contact members extend through holes in said card causing the contact surfaces of said contact members associated therewith to engage the conductive pads to effect switch action, said projecting portions of said contact members being of a configuration relative to the holes in said card and to the holes in said conductive pad carrying plate member to facilitate a slight transverse movement of said plate member to provide a wiping action between said contact members and said contact surfaces, means to effect said slight movement during operation of said driving means, and including an adjustment means coupled to said conductive pad carrying plate member to adjust the position thereof so as to cause an engagement between said contact surfaces and said conductive pads in a fresh zone of contact to increase the life of said assembly.

11. In an assembly for reading data cards having data defined therein by the position of holes therein or the lack thereof, an array of cantilevered leaf spring contact members, one for each possible bit position in said card, and each including a mounting portion, an end projecting portion having a contact surface thereon, and a thin flat spring portion supporting said end portion to provide spring action therefor; a movable plate member carrying a series of conductive pads, one for each contact member in alignment therewith; means comprising a driving plate for imparting a transverse motion to said movable plate member with respect to said contact members; means positioning said driving plate relative to said movable plate member so as to receive and position a data card therebetween with the bit positions thereof aligned with said contact members; the movable plate member further having a series of holes therein in alignment with said bit positions on a card inserted in said assembly; and means to drive said driving plate to in turn drive said card against said movable plate member and displace said movable plate member transversely toward said contact members into a predetermined reading position in which the end-projecting portions of the contact members extend through holes in said card, causing the contact surfaces of said contact members associated therewith to engage the conductive pads to effect switch action.

12. The assembly of claim **11** wherein the shape of said end projecting portions of said contact members relative to the holes in said card and to the holes in said movable plate member permits a slight transverse movement of said plate member to provide a wiping action between said contact members and said contact surfaces; and means are provided to effect said slight movement during operation of said drive means.

13. In a switch assembly an array of individual contact spring members each including a contact surface, a complementary array of conductive members each including a second and larger contact surface, means to effect an engagement between contact members and conductive members in a first zone of contact engagement therebetween to effect a switching action which establishes a selected pattern of interconnections between members, means to cause a wiping engagement between the selected pattern of interconnections which occurs during engagement under light wiping pressure followed by a second wiping action due to deflection of said contact spring members, and adjustment means coupled to one of said arrays for positioning said array of conductive members relative to said array of contact spring members wherein said engagement occurs in a fresh zone of contact between said members to increase the life of said assembly.