A lever for aiding in inserting printed circuit cards into and extracting them from mating connectors mounted in a multiple card guiding arrangement. The cards ride in individual slots in a multiple card cage, and during insertion they can be guided freely until the card's output conductors initially confront the receiving connector block at the rear of the cage. At this point, cylindrical bosses on corresponding upper and lower levers are positioned to contact a reinforced edge of the card, with pivoting action by the lever driving the card into the cage and urging the card's conductors into their mating connectors. Rotation of the levers in the opposite direction brings another cylindrical boss on each lever into contact with an inner surface of the card's reinforced edge, extracting the card conductors from the connector block and permitting free-sliding removal of the card from the cage.

13 Claims, 11 Drawing Figures
This invention relates to equipment-handling apparatus, and in particular, to a device for controlling the loading and unloading of circuit cards into the out of card-connecting housings.

The development of high speed electronics in recent years has been continuing at ever-increasing rates. Together with that development, the applications of integrated circuitry for use in such electronic circuits have also advanced rapidly. Integrated circuits, such as miniaturized semiconductor "chips" and wafers, are generally mounted together on some common board or card for connection to other electronic apparatus. Thus, typical circuitry element in systems utilizing integrated circuits would be a module having numerous semiconductor components (e.g., flip-flops) therein. Output leads are connected to these components and act as external connectors from each module. The modules are generally mounted on rigid printed circuit cards or boards which themselves have wired interconnections — each card may carry many modules and the output conductors or tabs at the edges of the cards are arranged to be coupled to connector blocks fixed to machine frames (e.g., of a memory unit). In this manner, each card may carry hundreds of thousands or even millions of bits of information.

It is also known to mount several cards together in a common housing to provide even greater memory or programming capacity. One arrangement along these lines is to mount cards side by side in a cage-type unit, with each card having its own mounting position and female connecting blocks. Because of the critical importance of proper mounting, it is essential that the cards be aligned precisely during mounting — this also serves to minimize the risk of card mutilation and ensures that neither the card conductors nor the connector blocks are damaged in loading or unloading the cards. These several problems, while having been generally recognized heretofore, have not been adequately solved by the prior art.

Thus, prior art systems have often ignored the problem of facilitating multiple mounting of cards. In prior art arrangements, circuit cards are often manually forced into their respective connector blocks. This technique is unsatisfactory for several reasons, including the lack of control over both the insertion and extraction steps, and the real possibility of damage being caused to either the cards or the connector blocks because of the use of excessive force. This manual approach, which is also time consuming, too frequently results in binding or even breaking of the cards.

One prior art attempt at alleviating these problems has been to employ small pivotable tabs on each card. These tabs are designed to engage a flange on the card cage and to pull the card into the cage and to eject it therefrom when desired. However, these tabs were wholly inadequate because they still failed to give the operator much control over the insertion or extraction steps. For instances, with more concentrated cards, there may be many output conductor tabs and a corresponding increase in the number of connectors. This may lead to the need for greater force to be applied for insertion and extraction, and the small pivotable tabs on each card could not furnish sufficient leverage or force to properly perform both the insertion and extraction steps. Moreover, by mounting the tabs on the cards, additional bulk was created for the cards which made ordinary handling thereof more difficult.

It is therefore an object of this invention to obviate one or more of the aforesaid difficulties.

It is a further object of this invention to provide a more convenient technique for controlling the positioning of electronic circuit cards in a card mounting system.

It is also an object of this invention to facilitate the insertion of circuit cards into and their extraction from a multiple card guiding system.

It is still another object of this invention to arrange for the accurate connection of elecronic circuit cards to connectors in electronic apparatus.

Additional objects and advantages of this invention will become apparent when considered in conjunction with one particular illustrative embodiment of the invention, wherein one or more circuit cards are introduced into a multiple card guiding arrangement so that contact can be made between the conductive tabs on the card and the stationary connector blocks on the frame of a memory unit or other similar piece of apparatus. In one embodiment, the card guiding system takes the form of a cage having a plurality of parallel slots for receiving the circuit cards. The initial insertion of cards into the cage is done manually, with the card itself being inserted in aligned upper and lower slots or channels. As the card is inserted further into the cage, it reaches the point where contact is made between a reinforced edge or stiffener on the outer vertical edge of the card and a boss on the control lever. This stiffener is provided to receive pressure from the lever of the invention and to transmit that pressure to the card to complete the insertion process.

Specifically, when the card reaches its initial contact position during insertion, the card stiffener comes into contact with a first substantially cylindrical boss on corresponding upper and lower control levers or control lever means. These levers are mounted on tapered fingers which project outward from the cage, and which are provided with recessed holes to receive pivoting ears on the lever. When the levers are mounted with their pivoting ears in the recesses of the tapered cage fingers, there is sufficient drag in the pivotal movement of the levers to overcome any gravity forces (e.g., to permit the lever to remain stationary once it occupies either an upper, intermediate, or lower position).

When contact has been established between the card stiffener (at upper and lower points) and the first boss on corresponding upper and lower levers, the rear metallized conductors on the card are in confronting relationship with the corresponding connector blocks at the rear of the cage. Thus, the invention insures that the initial contact between the card and the control lever will occur just prior to actual contact between the metallized conductors on the card and the connector block. This prevents any improper insertion of the card into the connectors and also permits the levers of the invention to maintain complete control over the insertion and extraction steps.

Thereafter, each of the upper and lower levers are rotated about their respective pivoting ears and toward the cage unit. After a brief rotation, a second boss on each of the levers comes into contact with the card stiffener. As rotational force continues to be applied to the levers by an operator, the second cylindrical boss
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3 bears against the card stiffener and drives it firmly towards the rear of the cage. The metallized conductors on the card are thereby inserted into the female connector blocks at the rear of the cage, with insertion being complete when the levers have moved from their horizontal position (the initial contact point) to a substantially vertical position. In this latter position, the second cylindrical boss continues to be in engagement with the card stiffener, and helps to maintain the card in the inserted position.

The card stiffener is also provided with upper and lower stops, formed at the junction at the card itself with the stiffener. The stop is a blunt edge of the stiffener element which projects inwardly towards the card cage and which rides above the card on its upper edge and below the card on its lower edge. As the insertion process takes place, the stop comes into contact with the base of the respective upper and lower guiding channels to limit the insertion depth of the card into the cage. The actual depth of insertion of the card conductors into the mating connectors is thereby limited by the dimensional relationship of the card stiffener stop and the depth of the card guidance channel, thereby preventing the improper application of excessive forces on the connector block.

After the final insertion position is obtained, with the control lever substantially vertical and the card stiffener stop in contact with the guide channels, the lever is then moved slightly further in the same rotational direction as it has been during insertion. This brings a slot in the lever handle over corresponding upper and lower retention snaps projecting outwardly (i.e., away from the cage) from the card stiffener. These snaps have a base portion and a slightly enlarged outer portion, for example in the form of sideways projecting wings or tabs. The slots in the levers are provided with corresponding shoulders on either side such that the further depression of the lever over the snap causes the snap wings to be forced past the side ledges of the slot. This retains the lever in pressure engagement with the card stiffener, and acts as a clamp for the entire system to avoid any problems associated with possible card movement or vibrational forces.

The extraction process commences with the removal of the lever from the retention snap. After the slot has been disengaged from the snap, pivotal lever motion is continued until an extraction boss at one end of each lever comes in contact with an inner edge of the card stiffener. This applies outwardly directed forces against the card as the levers are rotated. As lever motion continues, the card is withdrawn from the connector blocks and is partially extracted from the card cage itself. Thereafter, the card, which is now riding freely in the guiding channels, can be easily withdrawn by the attendant.

It is therefore a feature of an embodiment of this invention that a lever is mounted on a card cage and is pivotable with respect to a circuit card to urge the card into proper contact with a stationary connector block and to extract it therefrom.

It is also a feature of an embodiment of this invention that an insertion and extraction lever is provided with a pair of bosses, one of which transfers lever force to the circuit card during insertion into a housing and the other of which transfers such force to the card during extraction from the housing.

It is a further feature of an embodiment of this invention that a combined insertion and extraction lever for use in a circuit card mounting system includes a slot for receiving therein a projecting tab on the card to positively retain the card in position after insertion.

Additional objects, features and advantages of the invention will become apparent when considered in conjunction with a presently preferred but nonetheless illustrative embodiment of the invention explained in the following detailed description and as shown in the accompanying drawing, wherein:

FIG. 1 is a perspective view of a multiple card mounting system comprising a card cage, and illustrating a specimen circuit card partially inserted into the cage, and other cards in the fully inserted condition;

FIG. 2 is a side view of the control lever of the invention;

FIG. 3 is a front edge view of the lever;

FIG. 4 is a cross-sectional view through the retention slot of the lever, taken along the lines 4—4 of FIG. 3, in the direction of the arrows;

FIG. 5 is a fragmentary sectional view of the upper portion of the lever, taken along the lines 5—5 of FIG. 3 in the direction of the arrows;

FIG. 6 is a side view of the cage, illustrating a circuit card having been inserted up to the point of initial contact between the card stiffener and the upper and lower levers;

FIG. 7 is a fragmentary showing of the cage and card during the insertion process showing only the upper lever and its direction of rotation during insertion;

FIG. 8 is a fragmentary showing of the cage with the card having been fully inserted, the lever being in the substantially vertical position;

FIG. 9 is a fragmentary showing of the cage and card stiffener, partially broken away to reveal the contact between the card stop on the stiffener and the cage guiding channel, and also showing the lever slot having been engaged by the retention slot;

FIG. 10 is a fragmentary view of the retention snap and lever slot in engaging relationship, taken from the perspective of line 10—10 of FIG. 9 in the direction of the arrows; and

FIG. 11 is a fragmentary showing of the cage and card, with the control lever being pivoted in the direction of the arrow for extraction of the card from the cage.

The multiple card guiding system 20 of the invention as illustrated in perspective in FIG. 1 includes a cage having side panels 22 which are rigidly fixed to a rear frame or connector board 24. A plurality of connector blocks 26 is mounted on board 24, with an additional plurality of blocks 26 being located between side plates 22 and in line to receive the printed circuit cards upon their insertion. A series of parallel upper and lower guide channels 28 project outward from the rear of board 24 to define the insertion and extraction paths of the printed circuit cards.

A typical printed circuit card 34 is illustrated as being partially inserted into (or extracted from) the cage system 20, with insertion and extraction being controlled by levers 46 which are fixed to the cage by being mounted over fingers 32 which themselves project outward from transverse cage bar 30. The printed circuit card 34 illustrated in FIG. 1 includes active electronic portion 36 which has on one side a plurality of semiconductor modules 38 and on the other a plurality of
soldered connections 40 which project through the card from module 38, making contact with various internally wired connectors. The outer edge of card 34 is defined by reinforced stiffener member 42 (which is generally of one-piece molded construction) which is permanently attached to active card portion 36. Stiffener 42 functions to receive the bearing forces from lever 46 during the insertion and extraction steps and transfers the forces to card portion 36 without damaging that portion. The card is provided with upper and lower projecting tabs 42a which actually receive the principal thrust of the control levers during insertion and extraction. Also formed as part of stiffener 42 are corresponding upper and lower retention snaps 44 which are adapted to fit within slot 52 on levers 46 to firmly position cards 34 within the cage system 20 after insertion has been completed.

Considering FIG. 1 along with FIGS. 2-5, it will be appreciated that lever 46 includes a first outer insertion boss 48 and a second inner extraction boss 50, as well as through slot 52 for the retention of cards 34 in cage 20 after insertion has been completed. Each of levers 46 is provided with a pair of inwardly facing ears 54 at the upper end of the lever as shown in FIGS. 2 and 3. These ears are adapted to occupy through holes 32a in tapered fingers 32. The fingers 32 are provided with a lead-in angle or taper, such that the upper side branches 53 of levers 46 are spread apart (during mounting of the levers) until ears 54 enter the finger holes 32a. Thereafter, levers 46 pivot relatively freely about their mounting position within finger holes 32a, although the system is designed to have some “drag” upon the levers to permit any particular rotational position of levers 46 to be maintained against gravity. Considering FIGS. 3 and 4, the configuration of slot 52 includes an outer portion and an inner portion of reduced width adapted to fit over retention snap 44. In particular, slot 52 is provided with oppositely confronting shoulders 52a which can be forced over outwardly projecting wings 44a on retention snaps 44 to affirmatively hold cards 44 in position after the insertion process has been completed. This retention arrangement is illustrated in FIGS. 9 and 10 and will be described in greater detail below.

THE INSERTION STEP

The insertion of a circuit card 34 is commenced by placing the upper and lower edges of active card portion 36 in corresponding upper and lower guide slots 28a within card mounting system or cage 20 (see FIG. 1). The slot 28a is sufficiently wide to permit free riding of card portion 36 therein, and the card is moved towards the rear of cage 20 by an attendant until the position illustrated in FIG. 6 is attained. At this point, levers 46 are in substantially horizontal orientation, such that inner bosses 50 (to be used primarily for extraction as described below) of both upper and lower levers are contacted by the inner edges of upper and lower projecting tabs 42a of card stiffener 42. At this point, it will also be appreciated that the rear edge 35 of card 34 (which carries the conductive tabs coupled to all the soldered connections on the card) is confronting but is not actually contacting the connector block 26 mounted on supporting board or frame 24. Thus, the maximum insertion depth of card 34 with levers 46 in the horizontal or open position is with rear card edge 35 not quite making contact with connector blocks 26.

This ensures that no improper manual and uncontrolled insertion of the card will take place.

Once card stiffener tabs 42a make contact with bosses 50 as illustrated in FIG. 6, levers 46 are pivoted about their respective ears 54 as shown (for the upper lever only) in FIG. 7 (see direction of arrow). This rotation brings insertion boss 48 into contact with stiffener 42 and applies a force vector substantially perpendicular to the stiffener edge from both the upper and lower contact points between lever 46 and stiffener 42. Continued application of rotational pressure (e.g., by an operator’s downwardly and inwardly pressing upper lever handle 47) urges card 34 further within cage 20. In particular, rear conductive edge 35 of card 34 enters mating connector block 26 and makes electrical contact with the connectors therein, with the card and lever assuming the positions illustrated in FIG. 8. At this point, lever 46 is substantially vertical, and boss 48 is in bearing contact with card stiffener 42, although it is not forcing card 34 any further into the cage.

THE RETENTION ARRANGEMENT

As also shown in FIG. 8, retention snap 44 has entered within slot 52 of lever 46. At this point, however, sidewise projecting tabs or wings 44a of retention snaps 44 have not passed flanges 52a within slots 52. Accordingly, lever 46 is still capable of being withdrawn upward by an operator, and correspondingly, card 34 is not positively fixed in place within cage 20. Thus, it is conceivable that extraneous forces (e.g., vibration or improper jostling of the card) could result in the cards being withdrawn slightly from the cage, thereby breaking some contacts between rear conductive edge 35 and connector blocks 26.

In order to avoid this problem, levers 46 are forced past the position illustrated in FIG. 8 to that shown in FIG. 9. Continued inward rotational force is applied to actuating handle 47, and insertion boss 48 transfers this force to the card via stiffener 42. Card 34 cannot, however, be inserted any further within cage 20 because of a stop arrangement between stiffener 42 and cage guiding channel 28. In particular, stiffener 42 is provided with an inwardly projecting arm 42b which, at its inner edge 42c, is elevated above active card portion 36. Edge 42c of stiffener thereby acts as a stop limiting the further insertion of card 34 when edge 42c comes into contact with guiding channel 28 as shown in FIG. 9. The dimensions of guiding channel 28 are such that at the point of limiting, rear conductive edge 35 of card 34 is appropriately inserted within connector blocks 26 without being forced to the furthest rear edge of those blocks.

Accordingly, when further rotational forces are applied to levers 46 as previously mentioned, the bearing of boss 48 against stiffener 42 does not insert card 34 within cage system 20 any further. However, by applying such additional force at handle 47, wings 44a of retention snaps 44 overcome the resistance offered by flanges 52a within lever slot 52 and snap past these flanges to occupy the position shown in FIG. 10. At this point, therefore, lever 46 is retained at an angle slightly inward from the vertical (see FIG. 9) and forcibly retains card 34 in its fixed inserted position to minimize any possible effects of vibration or other extraneous forces. This retention position will be maintained for so long as lever slot 52 has its inwardly facing flanges 52a past wings 44a of retention snaps 44.
THE EXTRACTION STEP

The extraction process is commenced by disengaging the retention slot from the wings of the retention snaps. This is done by an operator applying outward pivotal force to levers 46 at handles 47. Flanges 52a within slot 52 move outward and engage retention snaps 44. These forces are sufficient to overcome the gripping relationship between rear conductive edge 35 of card 34 and the connectors within mating connector blocks 26 at the rear of the cage. Rotational movement is then continued until levers 46 are essentially in the position illustrated in Fig. 6, namely with extraction bosses 50 in contact with the inner edges of tabs 42a of stiffener 42. However, at this point, levers 46 have reached the maximum rotational position because of contact between bosses 50 and fingers 32. Cards 34 are now capable of freely riding within guide slots 28a and an operator can simply withdraw the card; levers 46 having overcome the principal resisting force which had been the mating relationship between rear conductive edge 35 and connector block 26.

It is to be understood that the above-described embodiments are merely illustrative of the application of the principles of this invention. Numerous variations may be devised by those skilled in the art without departing from the spirit or scope of the invention.

In order to permit variations in tolerance which naturally occur in the fabrication of the parts, the lever is preferably made out of thermal plastic, such as manufactured by General Electric under the tradename LEXAN, which plastic material permits the lever to act in the manner of a spring thereby significantly improving the retention characteristics of the lever.

We claim:

1. Apparatus for controlling the positioning of a plurality of circuit cards with respect to a card guiding system comprising a plurality of cards, a housing for receiving said cards which are removably mounted in said housing, a pair of control lever means for each of said cards mounted in said housing for inserting each of said cards into and extracting it from said housing, each of said cards including a control edge for transmitting to each of said cards insertion and extraction forces applied by said pair of control lever means.

2. Apparatus in accordance with claim 1 wherein said housing includes a plurality of guide slots for receiving said cards, and wherein said slots define a limit stop for said insertion of said cards.

3. Apparatus in accordance with claim 1 wherein said control edge of each of said cards includes at least one arm gripping each of said cards, said arm having means cooperating with said limit stop to define the final insertion depth of each of said cards within said housing.

4. Apparatus in accordance with claim 3 wherein said cooperating means includes a ridge extending beyond the dimensions of each of said cards, said ridge coming into contact with said limit stop at said final insertion depth for each of said cards.

5. Apparatus in accordance with claim 4 wherein said housing includes a plurality of connector blocks mounted on a rear wall thereof, each of said cards includes a plurality of conductive members received within said connector blocks, and wherein said conductive members are received with said connector blocks at said final insertion position of each of said cards.

6. Apparatus in accordance with claim 1 wherein said pair of control lever means includes a first boss for applying said insertion force to each of said cards and a second boss for applying said extraction force to each of said cards.

7. Apparatus in accordance with claim 6 wherein said housing includes an outwardly projecting mounting finger carrying said pair of control lever means for rotational movement, said finger having a transverse bore, and said pair of control lever means including a bifurcated mounting portion having at least one pivoting ear received within said bore of said finger.

8. Apparatus in accordance with claim 7 wherein said finger includes a forward tapered region accommodated within and to spread said bifurcated mounting portion of said pair of control lever means, said spreading terminating when said pivoting ear mates with said bore of said finger, thereby defining the pivoting arc of said pair of control lever means.

9. Apparatus in accordance with claim 6 wherein said housing includes means mounting said pair of control lever means for rotation toward and away from said housing, and wherein said first boss contacts said control edge of each of said cards during insertion of said card into said housing and said second boss contacts said control edge of each of said cards during extraction of each of said cards from said housing.

10. Apparatus in accordance with claim 9 wherein said first and second bosses are substantially cylindrical in shape.

11. Apparatus in accordance with claim 9 wherein each of said cards includes a plurality of conductive elements along a rear edge thereof and said housing includes a plurality of connector blocks for receiving said conductive elements of each of said cards and at least one channel for guiding each of said cards toward said connector blocks, and wherein each of said cards is inserted into said channel and rides freely therein until said rear edge is in confronting relationship with said connector blocks, the rotation of said pair of control lever means toward said housing causing said first boss to force said conductive elements into said connector blocks.

12. Apparatus in accordance with claim 11 wherein the rotation of said control lever means away from said housing causes said second boss to contact said control edge to withdraw said conductive elements from said connector blocks, to thereby reposition each of said cards for free riding within said channel.

13. Apparatus in accordance with claim 11 wherein each of said cards further includes retaining means for cooperatively engaging said pair of control lever means for positively urging each of said cards into said insertion position, said retaining means including an outwardly projecting tab having a pair of gripping wings, and said pair of control lever means includes a retention slot in the body thereof having a pair of side flanges, said control lever means adapted to be rotated further toward said housing after said conductive elements have been received within said connector blocks to cause said side flanges of said slot to pass over said gripping wings to establish a retention position for each of said cards.

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