Feb. 1, 1966 H. C. McMILLAN 3,233,051

SWITCH ASSEMBLY FOR PUNCH CARD READOUT DEVICES

Filed April 6, 1964 2 Sheets-Sheet 1

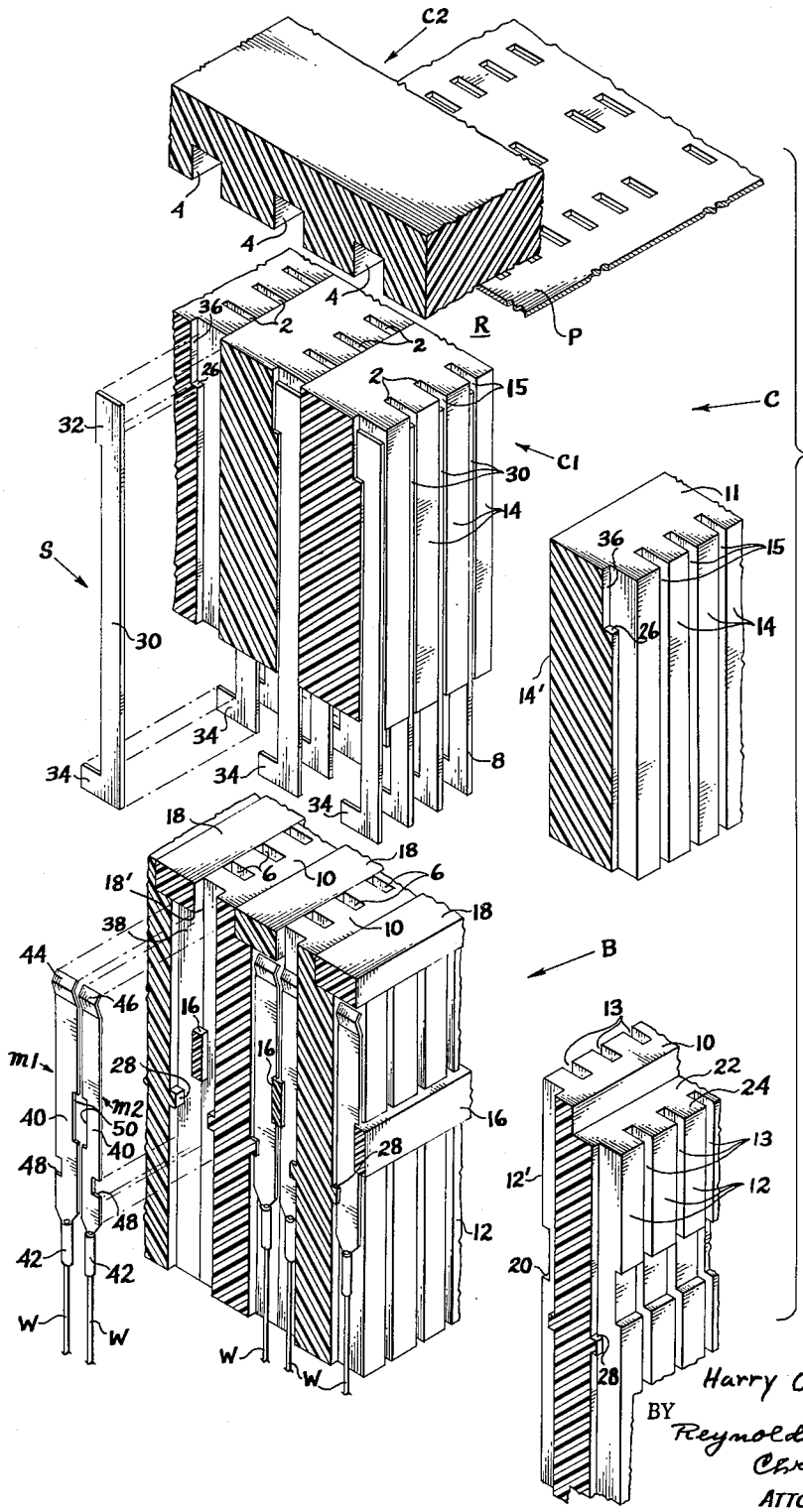

Fig. 1.

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SWITCH ASSEMBLY FOR PUNCH CARD READOUT DEVICES

Filed April 6, 1964 2 Sheets-Sheet 2

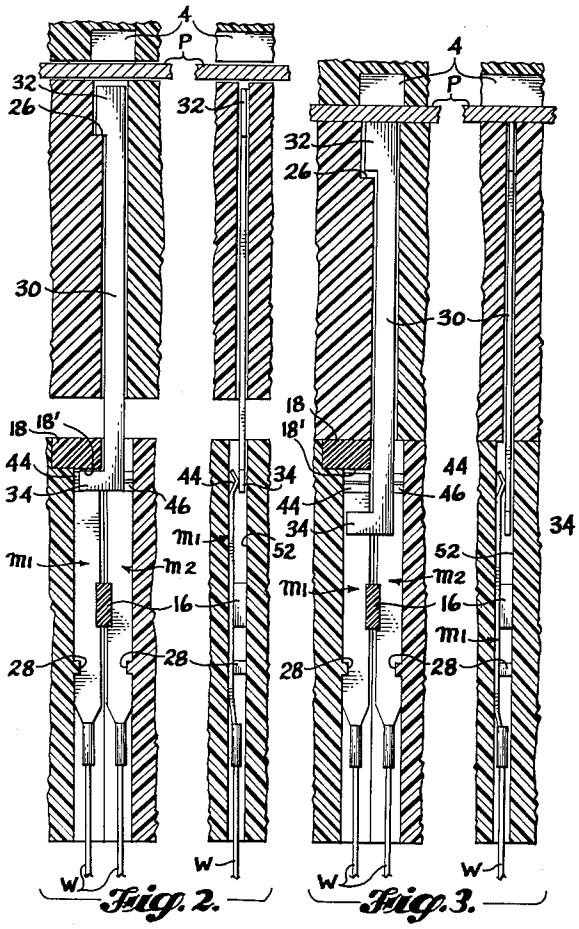

Fig. 2.

Fig. 3.

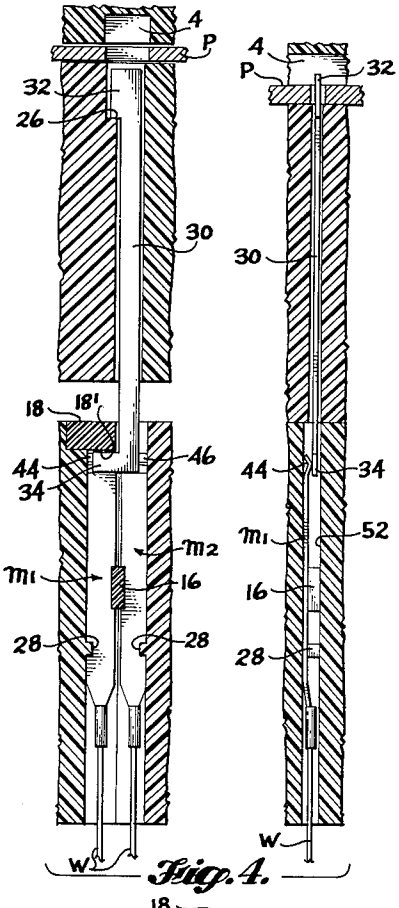

Fig. 4.

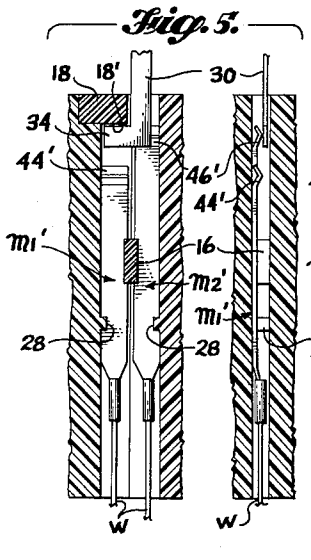

Fig. 5.

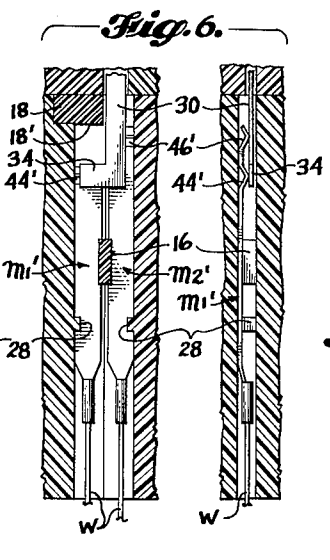

Fig. 6.

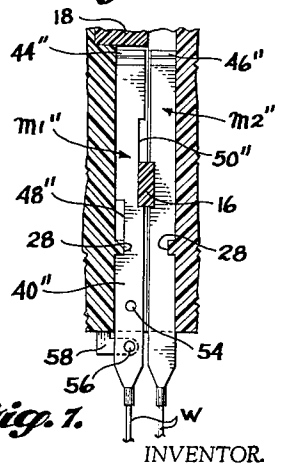

Fig. 7.

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3,233,051

SWITCH ASSEMBLY FOR PUNCH CARD READOUT DEVICES

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This invention concerns an improved form of electrical switch assembly which is adapted for use in devices having the function of sensing the presence or absence of pressure or of solid media on or within an article which may be probed by the device. The switch assembly is particularly adapted for collective use in so-called punch card readout devices which, it will be recalled, are a form of sensing apparatus in that they are equipped with a bank of electrical switches that operate through probing elements to examine a perforated card and to translate the pattern of perforated and unperforated areas on the card into a corresponding pattern of electrical response in circuitry associated with the switches.

If devices of this nature are to function reliably, there must be assurance that the switches are accurately repositioned after each readout operation. To provide this assurance various schemes have been adopted whereby the switches are, in many instances, released from their actuation courses and promptly urged by springs or the like to return to their initial stationary positions against an abutment; or in others are more positively arrested from their courses and forcibly returned to their stationary positions by some form of moving recovery mechanism. Still other schemes employ combinations of these. Detent means are often also employed, particularly in combination with the moving recovery mechanisms, to mechanically interlock with the elements as they reoccupy their stationary positions.

While all of these schemes are effective to reposition the switches, they often do so only at the expense of decreasing their sensitivity inasmuch as the bias or detent forces which play a part in these schemes increase the level of pressure at which the switch can become operative. It is a principal object of the present invention to provide a switch assembly which employs neither bias nor detent forces in its repositioning. It is also an object to provide a switch of this character which, though free from bias and detent forces, is, nevertheless, accurately and consistently repositioned following each switch operation.

Many of the earlier schemes for controlling the movement and positioning of the switch, also accomplished their purposes only at the sacrifice of enlarging upon the size and complexity of the switch assembly. Another important object of the invention is to provide a switch assembly whose movement and position are accurately and consistently controlled though the switch remains extremely simple in its design and assembly.

A further object is to provide a switch assembly in which the various functional requirements of the switch are concentrated into as few elements as possible. Still further objects call for producing the foregoing switch assemblies from quick-stamped light sheet metal and molded-plastic strip materials, and for using a mode of assembly of the same which is readily and simply effected and which lends itself to mass production assembly techniques. They also call for using components which require no special tools in their assembly and which, in fact, can be assembled by hand, if need be, with no more than a simple pinch tool for attaching wires to pinch terminals.

Still another important object of the invention is to provide a switch assembly having all or certain of the foregoing features and also offering a choice of form between a normally closed condition and a normally open condition, and the added feature, if desired, of rapid convertibility from one form to the other with no substantial physical modification of its parts. A related object is to provide such a switch assembly which can employ programmed or mixed contact forms. Still other objects include providing a switch assembly of these characteristics which not only affords the reliability of having a pure wiping action of metal on metal in the operation of its contacts, but which may also provide for having at least one contact element covered at all times.

These and still other objects, advantages and features are realized by a switch assembly of my conception making use of a unique form of shuttle pin having a lateral ear which performs both the switch function and the function of arresting the pin at the close of the switch operation. The assembly comprises a pair of members constituting a switchbank and a carriage spaced above the switchbank and reciprocative with respect thereto. The shuttle pin, which is slidably guided and electrically conductive, is connected to one side of an electrical circuit and interposed between the members so that the end portions of its shank are received in mutually aligned slots in the opposing faces of the members. There are means on the carriage for holding a punch card in a position aligned with and relatively crosswise of the slot therein so that the card is operable, where no aperture occurs in the area of the slot, to displace the pin in conjunction with the carriage upon the latter's operating movement in the direction relatively toward the switchbank. In addition, there are also means on the carriage for displacing the pin in conjunction therewith upon the carriage's return movement in the direction relatively away from the switchbank. The ear projects laterally from the lower end portion of the pin's shank, within the switchbank slot, and there are means adjacent the switchbank slot defining a limit stop for the ear when the pin completes its displacement in the latter recited direction. The switch function is performed by the ear as a consequence of there also being an electrical contact member disposed in the switchbank slot at a position laterally offset from the path of the shank and abreast the path of the ear. The contact member is connected to the other side of the circuit and biased in a direction crosswise of the ear's path so as to alternately engage and disengage the ear as the pin is reciprocated with the carriage.

Because of these structural and positional relationships, the contact member can be shifted to alternative positions abreast the path of the ear spaced lengthwise of the switchbank slot. In this way the assembly can employ programmed or mixed contact forms. In my more preferred constructions, the switchbank slot has a longitudinal recess in the side wall thereof and the ear is received in the recess to abut with the limit stop provided by the upper end wall of the same, in the stationary condition of the carriage, the contact member being disposed in the recess and shiftable to alternative positions spaced lengthwise of the same. In addition, the lower end of the recess may open onto the under side of the switchbank and the contact member may include means by which it is shiftable from a point outside of the switchbank.

Certain of these more preferred constructions are described in greater detail hereafter with reference to the accompanying drawings wherein:

FIGURE 1 is an exploded view in perspective of one embodiment made up in multiple units for use as a switch block in a punch card readout device;

FIGURE 2 is a pair of sectional views taken at right angles to one another through an individual unit for pur-

poses of illustrating the switch assembly in its normally closed condition;

FIGURE 3 is also a pair of sectional views taken at right angles to one another for purposes of illustrating the actuated condition of the switch assembly in FIGURE 2 where the probed region or area of the punch area has no aperture;

FIGURE 4 is a similar pair of views illustrating the switch actuated condition where the probed region or area of the card presents an aperture;

FIGURE 5 is a further set of views illustrating an individual switch assembly disposed in the normally open condition;

FIGURE 6 illustrates the switch actuated condition of the assembly in FIGURE 5 where no aperture appears in the card; and

FIGURE 7 illustrates a modified form of the embodiments of FIGURES 1–6 whereby the switch assemblies can be readily converted from a normally open to a normally closed condition or vice versa from below the switch block.

Referring first to FIGURE 1, it will be seen that the switch block comprises a pair of relatively superposed and relatively reciprocative members B and C. The lower B of the members serves as a stationary switch bank and the upper C serves as a reciprocative carriage for the shuttle pins S which, in this instance, have a thin, flat, elongated form. The members B and C can be mounted, guided and relatively reciprocated in any conventional fashion, there being a large selection of means and techniques for this purpose in the prior art.

The carriage C has two parts or components C1 and C2 which are connected for conjoint reciprocation by means not shown. As seen the lower C1 of the two parts is in the form of a block having a number of rectangularly cross-sectioned slots or channels **2** which are vertically oriented in spaced, parallel ranks in the block and extend through its entire depth. In use the slots serve as guideways for the pins S and as such will be referred to as the pin guide slots. The lower part C1 also serves a switch return function which will be discussed hereinafter. The upper part C2 is in the form of a platen which is transversely grooved along its underside, the grooves **4** being disposed in parallel relationship to and vertically above the ranks of the pin guide slots **2** in the lower part. In their mounting the two parts C1 and C2 are spaced from one another so as to define a reception slot R for a punch card P. The card is inserted into the slot R in a known manner so that its pattern of apertured and nonapertured areas is interposed between the ranks of the pin guide slots **2** and the grooves **4** thereover. See FIGURES 2–6 in this connection.

The switch bank B is likewise characterized with a coplanar array of vertical, rectangularly cross-sectioned slots or channels **6** which are equal in number to the overhead pin guide slots **2** and aligned with the latter in their distribution. As will be seen, these lower slots **6** in the switch bank operate to receive the inferior or descending ends **8** of the shuttle pins S and also serve to house a pair of contact members M1 and M2 which are received in the slots **6** from below the switch bank. The contact members are capable of assuming either a normally closed or a normally open condition. In the contact form illustrated in FIGURE 1 the two contact members present a normally closed condition as will be explained, and in addition contribute to a nip which is developed in the slots **6** for the pins, as will also be explained.

It should be mentioned beforehand, however, that each of the switch bank B and the lower carriage component C1 is constructed from a plurality of molded insulative plastic strips **10** and **11**, respectively, which are supplied with transverse grooving **13** and **15** so that when placed upright and clamped abreast of one another in a horizontal and lengthwise sense, as illustrated, their abutting faces **12** and **12'**, and **14** and **14'**, respectively, act to define the slots **6** and **2** found in the respective components. In the case of the lower carriage component C1, only one **14** of the abutting faces of the strips **11** is grooved. In the case of the switch bank, both abutting faces **12** and **12'** are grooved and two sets of molded plastic, insulative keys **16** and **18** are interengaged with the strips in additional grooves **20** and rabbets **22** formed in their abutting faces. The additional grooves **20** run lengthwise and horizontally of the strips **10** in the assembly so as to traverse the vertically oriented grooves **13** therein. One set of the keys **16** is received in these additional grooves and as will be later explained serve a separator and locator function for the contact members M1 and M2 inserted into the slots **6**. The rabbets **22** are formed in only one of the upper edges of the abutting faces of the strips **10** and in effect leave benches **24** on which the second set of keys **18** are allowed to rest, the rabbets **22** and keys **18** being mutually sized to leave the latter flush with the upper face of the switch bank B. Functionally, this second set of keys **18** serves as a set of limit stops or bumpers to be more fully described hereinafter.

The pin guide slots **2** and the switch bank slots **6** have still further configurational features. In the case of the former it will be noted that the upper end portions of the slots are recessed to one side so as to form steps **26** for a function to be described. As for the switch bank slots, projections **28** are permitted to remain on their side walls at opposing locations in the assembly for a locator function to be mentioned.

Reference should now be made to the pins S and the contact members M1 and M2. Each of the pins has an elongated center shank portion **30** which in the assembly is slidably received and guided in the lower end portion of one of the pin guide slots **2**. At each end of the shank portion the pin has a lateral extension furnishing it with upper and lower ears **32** and **34**, respectively, between which the pin in effect has a relieved longitudinal profile.

In the assembly the upper ear **32** is normally received in the pocket or recess **36** formed above the step **26**, so that the step and the ear form a pair of cooperable abutment shoulders. At the other end of the pin, its lower ear **34** is received in the well or recess **38** formed below the underside **18'** of the key **18**. Thus the lower ear **34** is in a position to perform in cooperation with the underside **18'** of the key **18** as an additional set of abutment shoulders which, as will be seen, operate in a reverse directional sense from the pair of abutment shoulders comprising the step **26** and the upper ear **32**.

Each of the contact members M1 and M2 takes the form of a flat elongated tongue **40** the lower ends of which in the assembly are shaped to act as pinch terminals **42** for a pair of wires W leading to the members and the upper ends of which are laterally deflected to leave transverse ribs **44** and **46** outstanding on the tips of the tongues. Also, the relatively adjacent and remote longitudinal edges of the tongues are notched at corresponding locations so that the contact members can be located in their slot **6** through engagement of the projections **28** in their notches **48** and engagement of the keys **16** in their notches **50**. To also separate the contact members M1 and M2 by an insulative air gap, the latter notches **50** have a depth of less than a half thickness of the key **16** thus preventing the members from engaging one another.

Each of the pins S and the contact members M1 and M2 is made from an electrically conductive light sheet metal material and can be conveniently stamped from such material for its use in the illustrated assembly.

Referring at once now to FIGURES 1–4, it will be noted that the tongues **40** of the contact members are of such length above of the location of the projections **28** as to position their ribs at a level or station just below the lip or inverted shoulder formed by the underside **18'** of the key **18**. Note also from the cross sectional views of FIGURE 2 that the lower ear **34** of the pin bridges the air gap between the ribs **44** and **46** of the contact mem-

bers. Note still further that the ribs close upon this lower extremity of the pin when it is drawn up into their station and by their bending action in cooperation with the opposite wall 52 of the slot form a nip exerting a slight gripping or pinching action on the pin. This constitutes the normal or stationary position of the pin. In the operation of the assembly, when the carriage C is displaced relatively toward the switch bank B, the card P abuts the pin and depresses it further into the slot 6 so as to displace the ear 34 thereon relatively out of the nip formed by surfaces 44, 46, 52. See FIGURE 3. The step 26 is also depressed but due to a slight initial gap between the pin and the card, finds itself slightly below the ear 32 at the close of the carriage's downstroke. On the carriage's upstroke, however, the step reengages the ear and serves to lift the pin back into the nip between surfaces 44, 46, 52. Progress of the pin beyond the position in which its ear 34 is disposed in the nip, is prevented by the key 18 whose underside 18' forms an abutment for the ear 34.

In the at rest condition of FIGURE 2 the upper ear 32 of the pin rests on the step 26 and a slight gap is seen between the key 18 and the lower ear 34 of the pin. In operation the ear 34 may in fact never reach the key 18 as it enters the nip but the likelihood is greater that the uplifting action of the carriage and its abrupt halt will bring the key 18 into operation as a means of stopping the pin through its lower ear 34. The pin will eventually thereupon settle back into its at rest condition as illustrated. In no case will it exert undue pressure on the card P. Note that the gap between the upper edge of the pin and the underside of the card is considerably larger to assure that the card is at no time given a blow by the pin.

Now consider FIGURE 4. Where an aperture appears in the card the pin remains in its stationary position frictionally engaged at the hands of the rib and wall surfaces and the carriage merely reciprocates over the length of the pin, the upper extremity of the pin being taken up by the overhead groove 4 in the platen C2. Thus whereas in the former instance the circuit otherwise closed between the ribs by the pin, was opened when the carriage was depressed, in the latter instance the circuit remains closed as relative reciprocation occurs between the pin and the carriage.

Obviously, only the left hand rib 44 is necessary to the nip acting on the pin; consequently, where current is passed in or out of the ear 34 by other means (as by a flexible lead to the same) the right hand contact member M2 can be removed. However, the illustrated arrangement is much preferred not only because the contact provided through the right hand rib 46 is at all times shrouded by the pin, but also because the additional frictional engagement made with the pin through this rib is at all times present to steady the pin and to maintain better control over its shuttle action in the assembly. The right hand rib 46 in fact acts to keep the pin and the card continuously engaged until the latter is withdrawn in the return stroke of the carriage.

The versatility of the assembly is illustrated by FIGURES 5 and 6. Where the left hand contact member M1' is of shorter length than the right hand member M2' a normally open condition is obtained due to the lower disposition of the rib 44' on the left hand member. The assembly operates the same otherwise, the depressed condition of the pin serving now, however, to close the circuit, as seen in FIGURE 6. Obviously, the non-aligned or offset relationship of the ribs can also be gained through an adjustment made in the relative positioning of the locator projections in the slots 6 and the notches in the contact members.

In fact, as seen by FIGURE 7, steps can be taken to make the mechanism convertible from one form to the other even while in a fully assembled state. In this instance each of the notches 48'', 50'' made in the left hand contact member M1'' has been enlarged lengthwise of the member and a pair of holes 54 has been provided in the lower end portion of the tongue 40''. The latter has also been lengthened so that the position of the rib 44'' on the member M1 can be adjusted from below the switch bank by first disengaging the member from a pin 56 passed through one of the holes 54 and thereafter shifting the member up or down in the slot. The pin 56 is supported on a bracket 58 and may be nothing more than a shallow "button" over which the member is sprung and engaged; or it may be of considerably greater length and may, in fact, pass through a row of similar contact members, it thus being necessary first to disengage the pin from other assemblies before shifting the member M1. The choice will depend on the circumstances under which the switch block is to be employed.

Obviously, the contact members can be otherwise located in the switch bank slots, as, for example, by additional grooving made in what are the walls of the slots as seen. The invention is likewise susceptible to many other modifications and additions, all of which can be made without departing from the spirit of the invention as defined in the claims following.

I claim as my invention:

1. In combination, a pair of members constituting a switchbank and a carirage spaced above the switchbank and reciprocative with respect thereto, the opposing faces of the members having mutually aligned slots therein, a slidably guided electrically conductive shuttle pin connected to one side of an electrical circuit and interposed between the members so that the end portions of its shank are received in the slots, means on the carriage for holding a punch card in a position aligned with and relatively crosswise of the slot therein so that the card is operable, where no aperture occurs in the area of the slot, to displace the pin in conjunction with the carriage upon the latter's operating movement in the direction relatively toward the switchbank, and means on the carriage for displacing the pin in conjunction therewith upon the carriage's return movement in the direction relatively away from the switchbank, there being an ear projecting laterally from the lower end portion of the pin's shank, within the switchbank slot, means adjacent the switchbank slot defining a limit stop for the ear when the pin completes its displacement in the latter recited direction, and an electrical contact member disposed in the switchbank slot at a position laterally offset from the path of the shank and abreast the path of the ear, which contact member is connected to the other side of said circuit and biased in a direction crosswise of the ear's path so as to alternately engage and disengage the ear as the pin is reciprocated with the carriage.

2. The combination according to claim 1 wherein the contact member is shiftable to alternative positions abreast the path of the ear spaced lengthwise of the switchbank slot.

3. The combination according to claim 2 wherein the switchbank slot has a longitudinal recess in the side wall thereof and the ear is received in the recess to abut with the limit stop provided by the upper end wall of the same, in the stationary condition of the carriage, the contact member being disposed in the recess and shiftable to alternative positions spaced lengthwise of the same.

4. The combination according to claim 3 wherein the lower end of the recess opens onto the under side of the switchbank and the contact member includes means by which it is shiftable from a point outside of the switchbank.

5. The combination according to claim 1 wherein the switchbank is constructed from a plurality of vertically oriented strips having abutting faces of which at least one is grooved to define the slot for the pin, there being a key disposed across the upper end of the slot, to one side of the pin's shank, to define the limit stop for the ear.

6. The combination according to claim 1 wherein the

contact member takes the form of a thin flat elongated tongue disposed lengthwise in the switchbank slot at a position abreast the path of the ear, and one end of the tongue is biased in the direction crosswise of the ear's path.

7. The combination according to claim 6 wherein the pin is thin and flat in the lengthwise direction and there is a second thin flat elongated electrically conductive tongue disposed lengthwise in the switchbank slot at a position abreast the path of the pin's shank, said second tongue being connected to the one side of the circuit and biased at one end in a direction crosswise of the shank's path so as to continuously engage the pin as it is reciprocated with the carriage.

8. The combination according to claim 7 wherein there is a transverse rib on each of the tongues having a bending moment in the direction crosswise of the respective path of the ear or shank.

9. The combination according to claim 1 wherein the pin's shank is slidably guided in the carriage slot.

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