

Aug. 16, 1966

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3,267,260

PUNCH CARD READ-OUT DEVICE

Filed Feb. 21, 1962

2 Sheets-Sheet 1

*Fig. 1.*

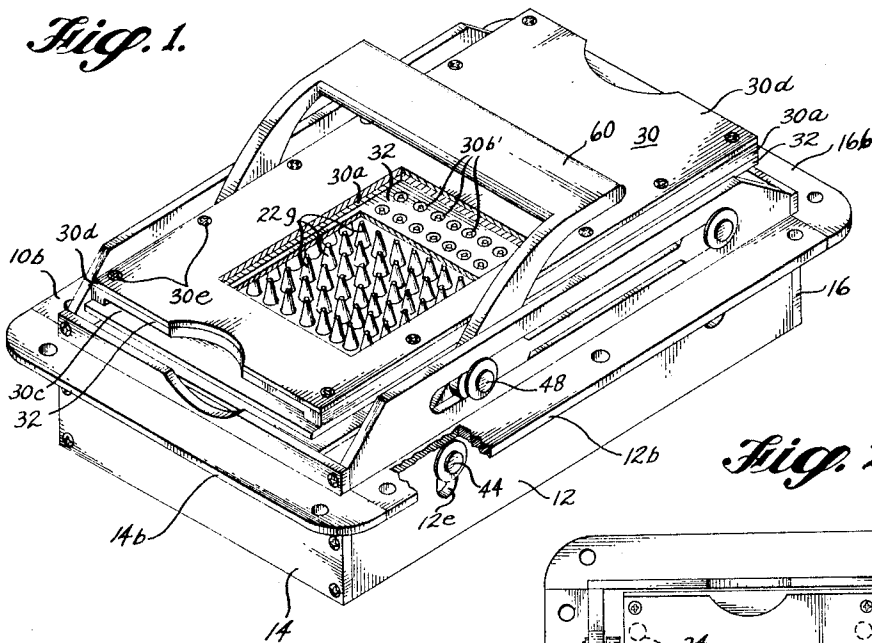


*Fig. 2.*

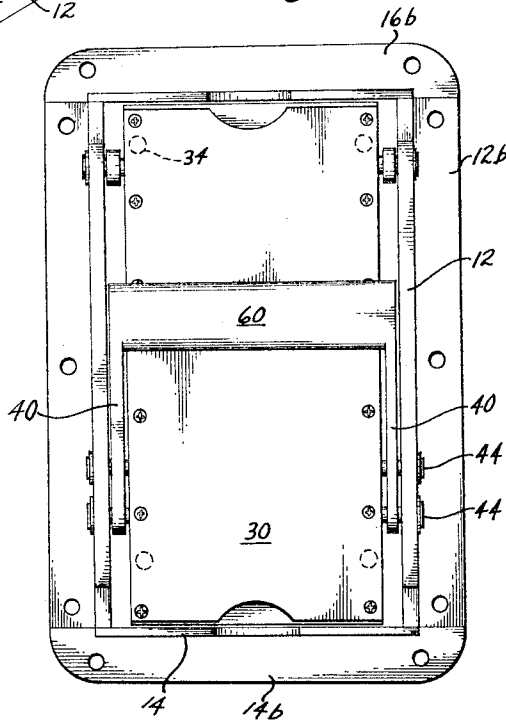


*Fig. 3.*

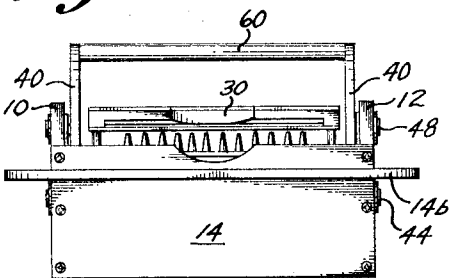
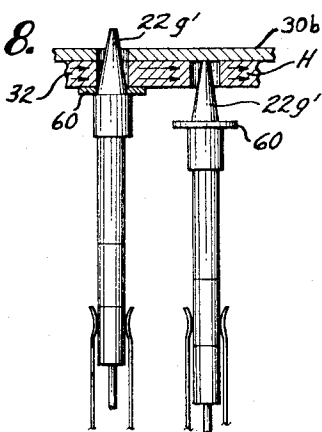


*Fig. 8.*



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2 Sheets-Sheet 2

Fig. 4.

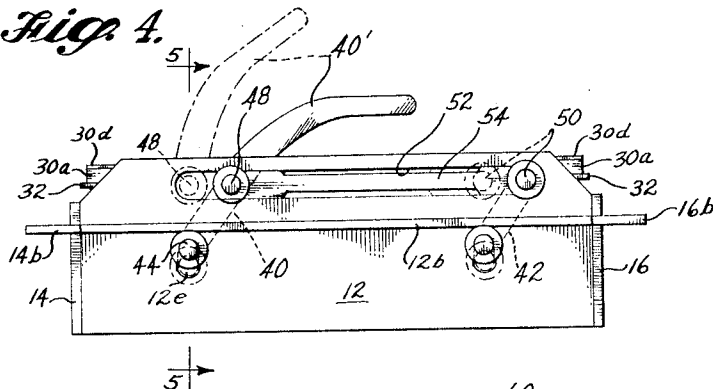


Fig. 5.

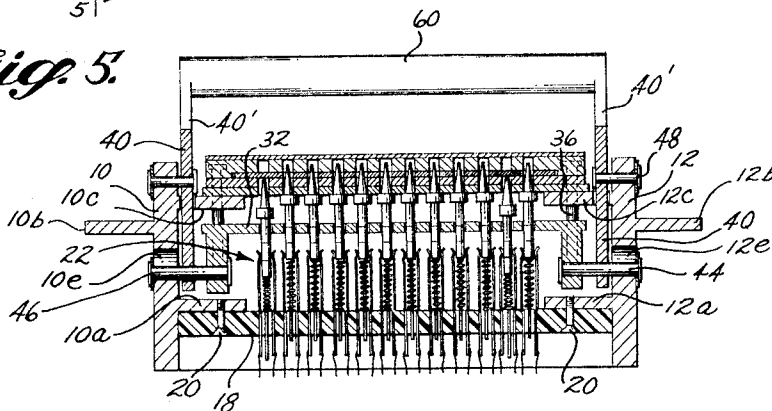


Fig. 7.

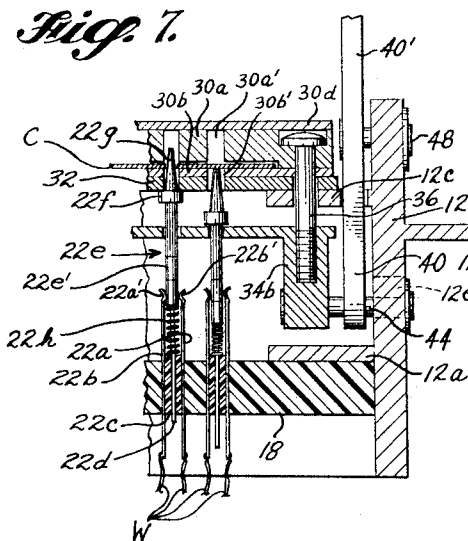
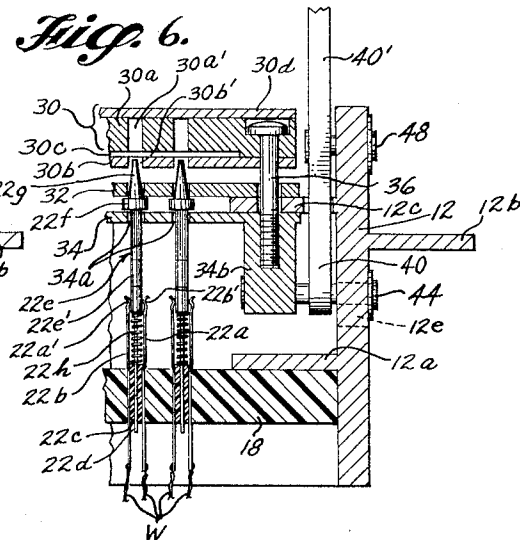


Fig. 6.



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## PUNCH CARD READ-OUT DEVICE

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Filed Feb. 21, 1962, Ser. No. 174,882

21 Claims. (Cl. 235—61.11)

This invention relates to improvements in devices for sensing mechanical pressure or its absence, or for sensing the presence or absence of solid media in selected regions probed by the device. More particularly it concerns an improved punch card read-out device by which selected switches in a bank or array of switches are actuated in accordance with the number and relative locations of unpunched areas on a card probed by elements of the switch array. The invention is herein illustratively described by reference to the presently preferred embodiment thereof; however, it will be recognized that certain modifications and changes therein with respect to details may be made without departing from the essential features involved.

Various multiswitch devices for registering or functionally responding to the coded information borne by a punch card or the like have been devised heretofore. An object of the present invention is to achieve greater reliability and functional accuracy in a device of this nature particularly by overcoming the problem of the switch elements sticking in one position or another and thus failing to respond or to be in position to respond during probing operation of the device. Adverse environmental conditions, slight imperfections in the form or finishing of the switch elements or guides therefor, wear, and similar causes may create or aggravate this problem in previous read-out devices. The spring loading or other bias acting on the individual switch elements is not always effective to return those elements to the normal or starting position, noting that the bias force should be made sufficiently small that the switch actuating probe will not tend to damage the card and so that the summation of individual bias forces on all the switch elements—and there may be hundreds of these elements in a given device—does not become unduly large and make the device difficult to operate.

An object of this invention, therefore, is to provide a positive and reliable means acting upon the switches of a sensing or read-out device in order to assure proper positioning and functioning of those switches at all times and under all operating conditions. A related object is to achieve this result without necessity for increasing the detention or bias force of the individual switch elements and, indeed, with the purpose of permitting these forces to be reduced if anything so that the device will be more easily operated than heretofore. It is a further object to achieve these results by a positioning mechanism which functions automatically in the normal operating cycle of the read-out device.

A related object is to achieve these results in a simple, conveniently organized, compact, easily shielded, and inexpensive read-out device. Increased durability, reduced maintenance problems and greater versatility in terms of the practical number of switches that may be incorporated in a single device are further objectives.

The disclosed mechanism lends itself to operation manually or by any of various more highly mechanized arrangements. It includes a locking feature operable to hold the mechanism in actuated position so as to sustain the read-out signals generated.

In one illustrative embodiment improved sensing apparatus according to this invention comprises a plurality of individually yieldably biased reciprocative switch-actuating elements or probes mounted in a coplanar array, with stop means common to these elements normally

limiting displacement thereof, and reciprocative-switch operating means including a punch card holder mounted for movement against the switch elements in a direction opposing their bias in order to displace selectively and positively those elements which contact solid (unpunched) areas of the punch card, and further including drive means to return the switch elements positively in the direction of their bias toward the stop means. The switch return drive means, being coordinated with the punch card holder, retracts as the holder moves through its actuation stroke so as to permit the biased switch elements to be displaced positively by contact with the punch card, whereas the punch card holder itself retracts on the return stroke of the machine and therefore inherently permits the switch return drive means to move the switch elements positively toward their normal or preparatory position. Thus the elements are reliably and positively controlled as to position, yet are delicately and sensitively yieldable as probes to perform the read-out function.

In a broader light the invention comprises sensing apparatus featuring yieldably held switch-actuating probes combined with means to advance a punch card or the like against the probes with a force sufficient to overcome the detent forces acting thereon and thereupon to displace the probes positively so as to perform a switching or equivalent read-out function thereby, and with further means to drive the element positively in the return direction, back toward its initial position in which it is once again held by the force of the detent. While the detent force may comprise a continuing bias force such as that furnished by a return spring, it may also represent the tentative holding force of another type, such as that of a mechanical or magnetic latch or the like which applies substantially no force to the probe when displaced appreciably from its initial position.

Additional features reside in the illustrative embodiment wherein the punch card holder, stop means and return means respectively comprise parallel platens having aligned sets of holes therein, with the card holder platen and the switch-return platen being spaced apart and with the stop platen being interposed between and spaced from them. Additional aspects reside in the rod-like switch elements having enlargements trapped between the stop platen and the switch return platen, and in the novel linkage-and-slot actuating mechanism for the movable platens.

These and other features, objects and advantages of the invention will become more fully evident from the following description based on the accompanying drawings.

FIGURE 1 is an isometric view of the illustrative embodiment, with parts broken away to show certain details.

FIGURE 2 is a top view, FIGURE 3 an end view, and FIGURE 4 a side view of the improved card read-out device.

FIGURE 5 is a transverse sectional view taken on line 5—5 in FIGURE 4 and at a somewhat expanded scale.

FIGURES 6 and 7 are partial sectional views corresponding to FIGURE 5 but at still further expanded scale. In FIGURE 6 the device is conditioned to receive a punch card and in FIGURE 7 it is shown in the actuated condition with a card in place.

FIGURE 8 is a detail of an alternative switch and operable detent means in the device to perform the holding function.

As illustrated in FIGURE 1 through 7 an open-top box-like enclosure is formed by interconnected upright frame sides 10 and 12 and frame ends 14 and 16 along with the horizontal base plate 18 which fastens to inwardly directed flanges 10a and 12a on the frame sides, by machine screws 20. Base plate 18 is preferably of nylon or other insulating material and serves as a terminal board for the array or matrix of switches 22 housed within the enclosure. These switches in their il-

lustrated form constitute the subject matter of a companion patent application Serial No. 172,160 filed February 9, 1962, now abandoned, in the name of Norman N. Hansen, and entitled Switch Mechanism. Outside flanges 10b, 12b, 14b and 16b are intended to support the device in an open frame (not shown) or against the rim of a panel aperture (not shown) of a computer console, for example.

While reference may be made to said companion application for details of the switches, the following brief reference to them is made for convenience in understanding the present subject matter. Each switch as shown comprises two elongated resilient metal contact strips 22a and 22b maintained in parallel relationship extending through a hole in base plate 18 by means of an insulative tubular bushing 22c removably lodged in the hole and held there preferably by friction. The shank or guide rod 22d of the switch shuttle slides in the bushing whereas the head of the shuttle, designated 22e, slides between the contact points 22a' and 22b' so as to expose to these points alternately an insulating surface and a conductive surface on the shuttle head, the conductive surface comprising the conductive ring 22e'. An enlargement or stop 22f is carried by the shuttle head, and a truncated-conical tip 22g projects beyond the stop and serves as a probe or contact element engageable with the punch card to be described. A light bias spring 22h reacts between the ends of the bushing 22c and the head 22e to urge the latter away from the base plate 18. The opposite ends of the strips 22a and 22b project from the opposite side of the base plate (i.e., normally its lower side) and serves as soldering terminals for connecting electric wires W to the switches.

Within the space defined between the sides 10 and 12 three successively spaced platens 30, 32 and 34 are located in parallel relationship lying in planes perpendicular to the respective sides. The platen 30 comprises a card holder formed by two mutually superposed plates 30a and 30b having apertures therein aligned with the respective switch probes 22g so as to pass said probes through the card reception slot 30c formed between the plates 30a and 30b. In addition a cover plate 30d is placed over the plate 30a and is held there by screws 30e. The rows and columns of apertures 30a' and 30b' formed in the respective plates 30a and 30b correspond to the rows and columns of the switches 22 both in number and relative location. The platen 34 has apertures 34a therein through which the rod-like switch shuttle heads 22e freely pass and this platen is provided with ribs 34b extending along opposite sides thereof. Four machine bolts 36 interconnect the platens 30 and 34 at the respective corners of the device, such bolts being threaded into holes formed in the platen ribs 34b and having heads which are received in recesses formed in the top side of the upper platen 30, the bolt heads being normally concealed by the cover plate 30d as shown. These bolts maintain the two platens 30 and 34 rigidly in spaced superposed relationship. These platens are movable conjointly up and down by a mechanism to be described.

The intervening platen 32 comprises a stop device which is secured to the inwardly projecting flanges 10c and 12c joined to the sides 10 and 12. The platen 32 has apertures aligned with the respective switch plungers or shuttles to pass these freely but which are too small to pass the enlargements or stops 22f thereon, so that the shoulders 32b of the apertures limit the upward displacement of the switch shuttles 22e in response to the bias forces applied by springs 22h. Similarly, the holes 34a in platen 34 are too small to pass the shuttle enlargements 22f so that the shoulders 34b of the holes underlie the enlargements.

As a result of the entrapment of the stop collars 22f between the stop platen shoulders 32b and switch return platen shoulders 34b, when the two platens 30 and 34 are conjointly raised to their elevated position shown in FIG-

URE 6, thus to withdraw the card holder slot 30c above the level of the probes, the lower platen 34 positively raises the switch shuttles to a normal position preparatory to a succeeding operating cycle. In this position of the shuttles the stop collars 22f abut the underside of the stop platen 32, as shown. The mechanism thus assures proper initial positioning of the switch actuators or shuttles 22e in positive manner and avoids any problem of switches sticking or springs becoming too weak to effect switch return movement.

Being thus positioned in a common plane by the platen 32, the switches are prepared for simultaneous actuation by a card C placed in the slot 30c when the platen 30 is depressed. However, as shown in FIGURE 7, only those switches whose probes 22g bear against a solid area on the card C are depressed by downward movement of the platen 30 since the remaining probes are free to pass upwardly through openings or holes punched in the card, which they are caused to do by the detaining force exerted by the bias springs 22h.

Accompanying downward movement of the platen 30 to actuate selected switches with a card in the holder, the switch-return platen 34 retracts downwardly ahead of it, of course, and permits the positive downward displacement of selected switch shuttles by the card. On the other hand, upward or return movement of the platens 30 and 34 necessarily causes raising of the card away from the sensing probes 22g in order to permit positive upward return displacement of the switch shuttles 22e in the direction of force of the bias springs 22h as desired.

The preferred mechanism for thus actuating the two platens 30 and 34 conjointly comprises a pair of links 40 and 42 at each side of the device. Two longitudinally spaced vertically extending slots 10e and 12e are formed in the respective sides 10 and 12 and receive pins 44 and 46 connected to the ends of the links and serving as pivotal and slidable connections for these links to the respective sides. These same pins extend supportingly through the ribs 34b of platen 34 and thus serve as a support for the movable platen structure by which it is raised and lowered in order to operate the device. The upper ends of the links 40 and 42 at each side of the device have pins 48 and 50, respectively, which are received in a longitudinally extending slot 52 formed in each side of the machine as a means to slidably and pivotally connect these links to the sides 10 and 12, as shown. Links 54 interconnect the pins 48 and 50 at each side of the device and in turn are received in the respective slots 52 in order to slide lengthwise therein and thus maintain the links 40 and 42 in parallel relationship. Rigid extension arms on the links 40, such arms being designated 40', constitute operating levers by which the links 40 are actuated. A crossbar 60 rigidly interconnects the upper ends of the operating levers 40' and insures that the links 40 and 42 on one side of the device move conjointly and in predetermined relationship with the similar links on the opposite side of the device so as to raise and lower the platens through a succession of parallel positions.

In operation of the device a card is inserted in the slot 30c with the operating handle 60 in the depressed position shown by solid lines in FIGURE 4, in which the parts are positioned as shown also in FIGURE 6. In this position of the parts the switch shuttle probes 22g are maintained slightly below the card. Thereupon raising of the crossbar or handle 60 causes the slider links 54 to move from one end of the slots 52 toward the opposite end thereof and in the act of so doing causes the lower ends of the links 40 and 42 to move downwardly together in the guide slots 10e and 12e so as to depress the two platens 30 and 34 conjointly and through successive parallel positions. As a result, any sensing probes 22g which contact solid areas of the data card C are depressed positively against the force of their respective bias springs 22h, whereas switches which line up with holes in the

5

card are maintained in undepressed condition by their bias springs so as to project upwardly into the holes formed in the descending card holder platen 30 (FIGURES 5 and 7). Inasmuch as the weight of the platens 30 and 34 urges the lower ends of the links 40 and 42 downwardly in the particular slots 10e and 12e in which their pivot pins engage, the parts tend to remain in the actuated position as shown by broken lines in FIGURE 4, and by the positioning of parts in FIGURES 5 and 7. On the other hand, friction or, if desired, a separate return spring (not shown) normally tends to maintain the parts in the unactuated position shown by solid lines in FIGURE 4 and in FIGURE 6.

In FIGURE 8 a modified switch-holding arrangement is shown wherein a ferromagnetic ring 60 joined to the shuttle tip 22g' serves as a stop collar engaging stop platen 32 and establishing the upper or normal position of the switch shuttle tip 22g', and it also serves as a detent. To serve the latter purpose, stop platen 32 is magnetized as depicted at H and tends to draw and hold the stop ring 60 against it. However, application of pressure by a punch card C against the sensing tip 22g' breaks the magnetic hold and permits the shuttle to be displaced or to drop downwardly. Those sensing tips which align with holes in the punch card are retained in their upper position by the detent action as the card holder platen is depressed. Those which are depressed by the card are subsequently returned positively to detent position by upward movement of switch return platen 34. Magnetic attraction between the ferromagnetic collars 60 and the magnetized stop plate is or may be insufficient otherwise to return the shuttles to upraised normal position.

In both the present specification and appended claims it will be appreciated that the operative movements, displacements or bias referred to are relative in the sense that they do not depend, and are not intended to depend on a stationary reference or base. In other words it is intended that displacement or motion can be taken with reference either to a moving reference or to a stationary reference even though this is not expressly indicated in the claim or descriptive passage.

These and other aspects of the invention will be recognized by those skilled in the art based upon the foregoing disclosure of the presently preferred practices thereof.

We claim as our invention:

1. In combination, a switching element, means yieldably biasing the switching element, stop means normally limiting displacement of the element under force of the biasing means, and conjointly reciprocable switch operating and switch return members, said switch operating member operating to drive the element in the direction opposing the biasing means so as to displace the element positively against the bias thereof, and alternatively to retract from the element, and said switch return member operating to drive the element in the direction of the biasing means so as to displace the element positively with the bias thereof, and alternatively to retract from the element, and said stop means, operating member, and return member respectively comprising three successively spaced members, the first of which is interposed between and spaced from the second and third, and the first and third of which are apertured and have the switch element projecting therethrough toward the second such member.

2. The combination defined in claim 1, wherein the operating member comprises a punch card holder open to receive a punch card and apertured transversely to its opening and in alignment with the switch element to provide access for contact of the switch element with such card.

3. The combination defined in claim 2 wherein the switch element comprises an elongated rod-like shuttle passing freely through the apertures and having a transverse projection thereon adapted to abut the stop means and return member alternatively.

6

4. The combination according to claim 3 wherein the stop means and return member are disposed on opposite sides of the shuttle's transverse projection.

5. The combination defined in claim 3, further comprising a plurality of similar additional switch elements and biasing means therefor, support means rigidly connected to the stop means, spaced from said three successively spaced members and positioning and guiding the switch elements for longitudinal displacement thereof in parallel relationship, including spring means individual to the switch elements yieldably biasing them against the stop means, said three successively spaced members comprising plate-like members disposed in parallel relationship, and means operable to effect relative movement between said stop means on the one hand, and said operating and return members on the other hand, in a direction transverse to said members.

6. The combination defined in claim 5, further comprising parallel sides rigid with the support means and between which at least certain of successively spaced members are disposed, elongated longitudinal slots in said sides extending parallel to said spaced members, a pair of elongated transverse slots in each of said sides located on respective individual transverse lines parallel to the longitudinal slots, with the slots being disposed with their length dimension transverse to that of the longitudinal slots, two pairs of links each having elements pivotally and slidably connecting their respective ends to a longitudinal and a transverse slot, means interconnecting the links at the end thereof connected with the longitudinal slots to constrain them to move conjointly, and means connecting the links by their opposite end to the operating and return members.

7. The combination defined in claim 6, wherein the means to effect movement of the links comprises lever arms rigidly joined respectively to at least one link at each side and wherein the means interconnecting the links comprises links extending lengthwise of the respective sides and interconnecting the links at such sides, and a cross member rigidly interconnecting the lever arms.

8. A punch card read-out device comprising a plurality of reciprocative switch elements mounted in a substantially coplanar array, means individually yieldably biasing the switch elements, stop means normally limiting displacement of said elements under force of the biasing means, and reciprocative operating means for said switch elements including a punch card holder movable against the switch elements in a direction opposing the biasing means and operable thereby to displace selectively and positively against the biasing means those elements contacting solid areas of the punch card while passing those elements presented to punched areas of the punch card, and return means movable in drive relationship against the switch elements in a direction with the biasing means and operable thereby to displace the switch elements positively with the biasing means toward said stop means, said punch card holder and return means comprising two multiply apertured platens joined in spaced relationship to pass the switch elements through aligned apertures thereof, said stop means comprising a multiply apertured platen disposed between and spaced from said two platens to pass the switch elements through apertures therein, and said switch elements including stops thereon which are alternatively abutable against mutually adjacent faces of the stop means platen and the return means platen.

9. The device defined in claim 8, wherein the switch elements comprise elongated rod-like shuttles, an insulative base plate spaced from the other platens and having holes therein to support and guide the switch elements to reciprocate lengthwise, and bias springs reacting between the individual switch elements and said base plate, said base plate carrying sets of electrical switch contacts elements cooperable with the respective switch elements.

10. The device defined in claim 9, further comprising parallel sides rigid with the base plate, and between which the platens are accommodated, elongated longitudinal slots

extending in the respective sides parallel to said platens, a pair of elongated transverse slots in each of said sides located on a line which is parallel to the first slots, with the individual transverse slots disposed with their length dimension transverse to that of the longitudinal slots, two pairs of links each having elements on their ends pivotally and slidably connecting them to a longitudinal and transverse slot, means interconnecting the links at the end thereof connected with the longitudinal slots to constrain them to move conjointly therein, and means connecting the links by their opposite end to the operating and return platens.

11. In combination with a yieldably detained switching element, holding means normally detaining the element in an initial sensing position, and conjointly reciprocable switch operating and switch return members operatively associated with the element, said switch operating member operating to displace the element positively out of said initial position against the action of its holding means and alternatively to retract therefrom, and said switch return member operating to drive the element positively back toward its initial position for detention again by said holding means and alternatively to retract therefrom, said holding means including stop means, and said stop means, operating member, and return member respectively comprising three successively spaced members, the first of which is interposed between and spaced from the second and third, and the first and third of which are apertured and have the switch element projecting through the same toward the second such member.

12. The combination defined in claim 11, wherein the operating member comprises a punch card holder open to receive a punch card and apertured transversely to its opening and in alignment with the switch element to provide access for contact of the switch element with such card.

13. The combination defined in claim 12 wherein the switch element comprises an elongated rod-like shuttle passing freely through the apertures and having a transverse projection thereon adapted to abut the stop means and return member alternatively.

14. In combination, a switching element, means yieldably biasing the switching element, stop means normally limiting displacement of the element under force of the biasing means, and conjointly reciprocable switch operating and switch return members, said switch operating member operating to drive the element in the direction opposing the biasing means, while the switch return member is retracted in said direction independently of the element, and said switch return member thereafter operating to drive the element in the direction of the biasing means, while the switch operating member retracts in said latter direction with the element.

15. The combination according to claim 14 wherein the switch operating member comprises a read-out element holder which is operable to displace the switch element from the stop means by contact of the switch element with a read-out element in the holder.

16. The combination according to claim 14 wherein the stop means and the return member have oppositely disposed transverse shoulders operating to limit the displacement of the element under force of the biasing means, and to drive the element in the direction of its bias, respectively.

17. The combination according to claim 14 wherein the stop means includes a stationary stop member.

18. In sensing apparatus, a switching element, means

yieldably biasing the switching element, means normally limiting displacement of the element under force of the biasing means, and conjointly reciprocable drive means for operating the element, one of which operates to drive the element in the direction opposing the biasing means, while the other is retracted in said direction independently of the element, and said other of which thereafter operates to drive the element in the direction of the biasing means, while the one drive means retracts in said latter direction with the element.

19. A punch card read-out device comprising a plurality of reciprocative switch elements mounted in a substantially coplanar array, means individually yieldably biasing the switch elements, stop means normally limiting displacement of said elements under force of the biasing means, and conjointly reciprocable operating means for said switch elements including a punch card holder movable against the switch elements in the direction opposing the biasing means and operable thereby to displace selectively and positively against the biasing means those elements contacting solid areas of the punch card while passing those elements presented to punched areas of the punch card, and return means caused to move in conjunction with the punch card holder in the direction opposing the biasing means, but independently of the switch elements, to take up a ready position for returning the elements, and thereafter to move in drive relationship against the elements in the direction of the biasing means, to return the elements to the stop means.

20. In sensing apparatus, the combination with a yieldably detained switching element, yieldable holding means normally holding the element in an initial sensing position, and operating means for said element including sensing means to displace the element positively out of said initial sensing position against the action of said holding means, and return means which operate independently of the element to take up a ready position for returning the element to the initial sensing position, and which thereafter operate separate from the holding means to drive the element positively back toward said initial position for redetention by said holding means.

21. In combination with a yieldably detained switching element, holding means normally detaining the element in an initial sensing position, and conjointly reciprocable switch operating and switch return members for operating the element, said switch operating member being operable to displace the element positively out of said initial position against the action of the holding means, while the switch return member is caused to retract in the direction of displacement independently of the element, and said switch return member thereafter being operable to drive the element positively back toward its initial position for redetention by the holding means, while the switch operating member retracts in the direction of drive with the element.

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