Nov. 24, 1970 J. C. COLLIER 3,542,979

CARD READER CONTACT ASSEMBLY

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FIG.1.

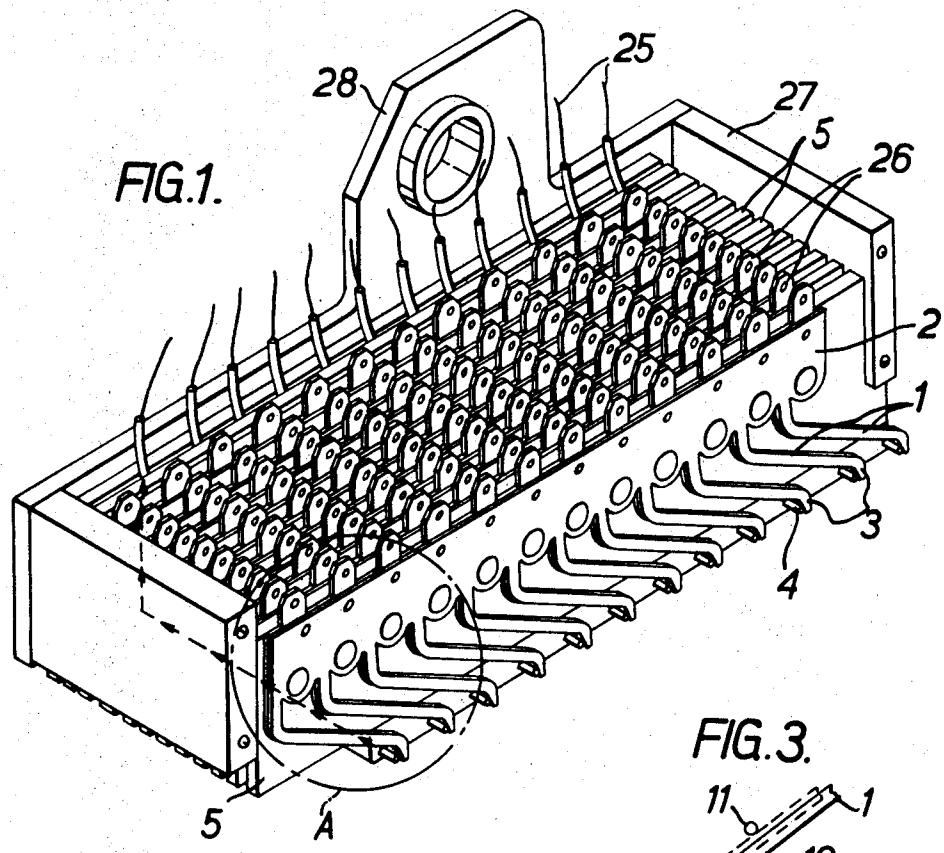


FIG.3.

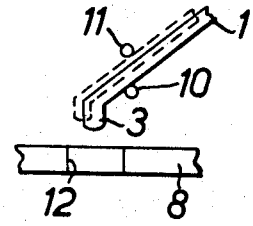


FIG.2.

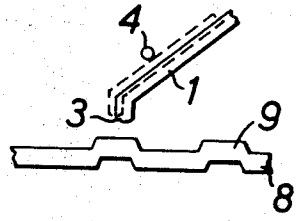
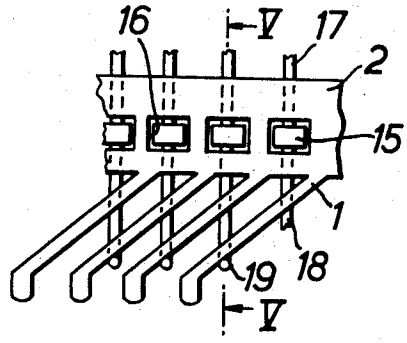


FIG.4.



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FIG. 1A.

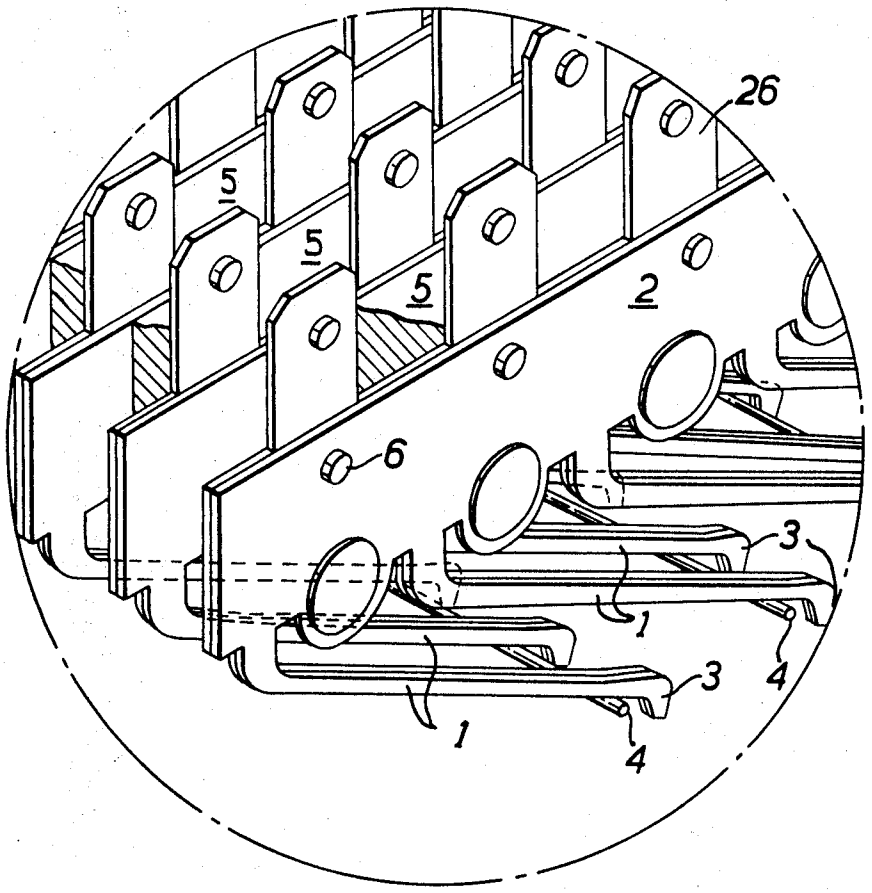


FIG. 5.

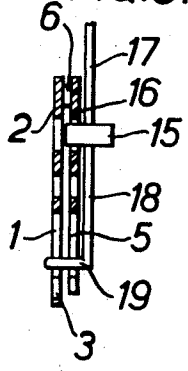


FIG. 6.

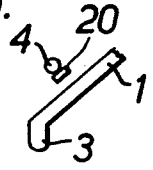
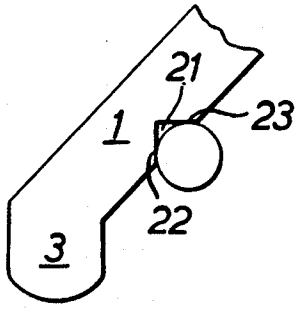


FIG. 7.



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CARD READER CONTACT ASSEMBLY

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Claims priority, application Great Britain, Aug. 15, 1967, 37,477/67
Int. Cl. H01h 43/08
U.S. Cl. 200—46 15 Claims

ABSTRACT OF THE DISCLOSURE

Data or card-reading apparatus comprises a movable contact assembly including contact means mounted to provide an array of parallelly disposed contact members located at the ends of flexible arms, contact areas along the flexible arms are arranged to be engaged with and/or to engage fixed contacts extending transversely to the direction of projection of the flexible arms. The contact members are caused to be operated in accordance with the coded areas of a data card when the contact assembly is moved into engagement with the data card to establish a distinctive electric signal pattern.

This invention relates to data reading apparatus such as card readers and to multiple contact assemblies in or for such data reading apparatus.

In data reading apparatus the data is carried on carrier or record such as a card or plastic sheet by punching holes or embossing characters on the carrier in predetermined locations. These locations are points on a grid aray and the data is translated into electric signals by subjecting the carrier to a reading process in a card reader. Card readers used for this purpose may employ light beams and photo-sensitive elements to read the data, but it is more usual to rely on mechanically moving electrical contacts. These contacts are in one known construction arranged in two sets which are movable relative to each other and the data carrier is able to be positioned between them. When the sets of contacts are moved together certain pairs of contacts meet through the holes to complete electric circuits and other pairs are separated by the carrier. Thus, a distinctive electric signal pattern is set up.

In a second known construction the two sets of contacts are formed in pairs in an array of contact elements. Each contact element is in the form of a pin and has a fixed contact and a spring-biased movable contact connected with a sensor part. When the data on a carrier is to be read, the sensor part engages the carrier, and, if it is a relatively raised part, the movable contact is moved against the spring bias to operate the contacts, while if it is not a raised part, or a hole, no contact movement takes place.

The first of these constructions requires some arrangement to be incorporated in the reader to ensure a mutual wiping action between mating contacts since their surfaces can easily become covered with dirt and dust from the carrier. In time the contact surfaces can wear due to continued wiping and the contact resistance can increase owing to an accumulation of oxide debris in the contact area. Further to this if the reader is used at low voltages, actual open circuits may occur. Thus, the overall number of operations which may be expected of a reader incorporating such a construction is limited.

The second known construction requires a form of contact assembly which is relatively complex compared with the first constrction and which is also time consuming and hence expensive to manufacture and assemble.

An alternative construction, which has been proposed

in an attempt to improve on the above constructions, has used a plurality of flexible arms carrying electrical contact area. One of the arms carries a transversely extending contact element which makes or breaks contact with the contact areas of the other arms when moved as a card is read. A modification of this construction employs fixed contact elements on a flexible arm. These contact elements move with the arm into or out of engagement with relatively fixed contact elements. Neither this alternative construction nor its modification enable convenient bussing of the fixed contacts or of compensation to adjust for wear.

Data reading apparatus according to the present invention and of the kind adapted to receive a data carrying record and to monitor the record is caused to be interrogated by an array of sensor members, the sensor members being associated with individual contact elements arranged to make or break electrical circuits, in accordance with the data carried by the record, each sensor member being carried at the end of a flexible arm which arm also carries along its length an electrical contact area arranged to contact a fixed contact extending longitudinally transversely to the direction of projection of the flexible arm.

The flexible arms are preferably mounted in rows, with each row insulated from each other and preferably contained in its own housing, the fixed contacts may then comprise rods or flexible tape or foil conductors extending transversely to the rows. The use of rods or flexible tape or foil conductors enables a bussing effect to be achieved, although, by suitable insulation, half-bussed or lesser-bussed contacts could be used. The fixed contacts can be supported in the housings and thus prevent dust and dirt from reaching the contact areas.

The contact area on each arm may be formed solely by the side of the arm, alternatively a contact pad may be carried by the arm. The contact area is preferably of a notched form so that it makes contact when used with a rod at least at two points to ensure good contact and a certain degree of wiping. Wiping can be assisted by making the fixed contacts movable along their length so as to be movable either occasionally by hand or on operation of the reader in which they are placed. This feature also can be used to adjust for periodic wear.

Alternatively, the fixed contact members may be formed by the ends of leads connected to an electrical component such as a diode. The end of the lead is then fixed adjacent the contact area of the arm and the rest of the lead with the component can extend outwardly from the apparatus between the rows of contacts. A component may be secured to the apparatus at the contact area in order to economize on space where the component is available in a suitable form such as a wafer diode.

An object of the invention is to provide a card reader contact assembly having movable contact members and stationary contact members constructed as a unitary and movable contact assembly.

Another object is the provision of a card reader contact assembly wherein the card to be read operates movable contact members out of and/or into engagement with stationary contact members on the contact assembly.

A further object is to provide a contact assembly having pairs of movable contact members thereby providing redundancy.

An additional object is the provision of a contact assembly having an electrical component connected to the stationary contact members and connected to or connectable with the movable contact members.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown

and described illustrative embodiments of the invention; it is to be understood, however, that those embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In order that the invention may be more readily understood, part of a data reading apparatus and various examples of multiple contact assemblies for use therein will now be described with reference to the accompanying schematic drawings. In the drawings:

FIG. 1 shows a perspective view of the multiple contact assembly in a frame part of the apparatus with one side of the frame removed;

FIG. 1A is an enlarged fragment of a section A of FIG. 1;

FIGS. 2 and 3 show details of different dispositions of the contacts;

FIG. 4 shows a modification of the embodiment shown in FIG. 1 to incorporate diode pins;

FIG. 5 shows a side sectional view on the lines V—V of FIG. 4;

FIG. 6 shows an alternative method of incorporating a diode; and

FIG. 7 shows a manner of increasing the contact reliability.

Referring first to FIGS. 1 and 1A, these figures show a perspective view of the contacts where it can be seen that the movable contacts are arranged in a grid array. One plane of movable contacts is clearly visible and each plane comprises flexible arms **1** connected at one of their ends to common or bussing section **2** and shaped at their other free ends to provide sensor members **3**. Each plane is stamped out of a lamina of spring copper or copper alloy material and the arms **1** are able to flex up and down about their fixed ends when pressure is applied to their sensor members **3**. Running transversely to the plane of the movable contacts are rods **4** forming fixed contacts. The movable contacts are held in position by insulating members **5** sandwiched between the bussing sections **2** and the planes of contacts are connected by bosses **6** passing through holes in the sections **2**. The rods **4** are also positioned by the insulating members **5** and are held, in his example, in a position such that the arms **1** contact them and they are slightly stressed. This stressing ensures good electrical contact at the area of engagement between the arms **1** and rod **4**.

When a card is to be read, it is placed beneath the sensor members **3** on a support (not shown) and aligned with them. The card contains data in the form of punched holes at predetermined locations. To read the card, the sensor members **3** are moved towards the card. In those areas of the cards where holes exist the sensor members **3** pass through the holes, in those areas where no holes exist the sensor members are forced upwards causing arms **1** to flex and move out of engagement with the rods **4** thus breaking the electrical contact therebetween. Hence a pattern of electrical signals is set up depending on those contacts which are open and those which are closed and corresponding to the data on the card being read.

When the card is removed from the reader, those sensor members which were raised spring back into their original positions as shown to remake contact with rods **4**.

The converse of this operation can apply if all the contacts are to be normally open when a card is not being read. A detail showing this is illustrated in FIG. 2 where a data card **8** being read is shown as having raised embossed portions **9** instead of holes to record the data. When the reader is not operated, the flexible arm **1** and sensor part **3** are in the position shown in full lines. When the part is brought into engagement with the card, the embossed portions **9** engage with the sensor part **3** and raise the arm to engage rod **4** and complete an electrical circuit. This arrangement will suffer from the disadvantage that the contacting areas on arms **1** and rods **4** will be exposed to the atmosphere during most of the life of the reader and hence are more likely to become dirty than a normally closed arrangement as shown in FIG. 1. However, this disadvantage is minimized if the insulating members **5** are formed as housings encasing the arms **1** and rods **4**.

In FIG. 3 a detail is shown of a variation combining both the embodiments of FIGS. 1 and 2. Two contact rods **10, 11** are used; one rod **10** is placed below the arm **1** and in the normal nonoperated position is in engagement with this rod, while the other rod **11** is only engaged if the sensor member **3** is lifted to the position shown by dotted lines. In FIG. 3 the sensor member **3** is shown in a position in which it would project through a hole **12** in the card **8** when the reader is closed and would stay in engagement with the rod **10**. The use of two rods enables alternative contacts to be established which can be useful for binary coded information or connecting different voltage levels or polarities to an output.

In many card reader applications, it is desirable to ensure that no stray currents appear on the outputs due to unusual connections. To guard against this, unidirectional elements, such as diodes, are incorporated in the connection paths so that if a polarized voltage source is used, any current of reverse polarization will not effect the information read out. Such elements can easily be incorporated in the multiple contact assembly of the invention as is shown in FIGS. 4 and 5. A diode **15** is mounted in a hole **16** in the insulating member **5** and has an external lead **17** projecting from the top of the insulating member. The other lead **18** connected to the diode is bent at its lower end **19** to pass through the insulating member and to form the equivalent of the rods **4** in FIG. 1. An arm **1** connected to a commoning strip **2** rests on this end **19** and makes contact with it. Bussing can be arranged by externally connecting the leads **17** of the diodes in adjacent rows.

An alternative form of diode connection is shown in the detail of FIG. 6 where a wafer **20** of rectifier material is attached to the rod **4** of the embodiment of FIG. 1 at a position such that the contact area of the arm **1** engages one side of the wafer **20** and current will only flow unidirectionally through the contact when made.

The quality of electrical contact can be improved by providing a notched contact area on the arm **1**. This can most easily be achieved by forming a V-notch **21** in the arm **1** as shown in FIG. 7. The rod **4** then fits into this notch and engages it at two points **22, 23** instead of only one point. To avoid weakening the arm **1** too much, an external notched contact pad could alternatively be secured to the arm **1**.

As shown in FIGS. 1 and 1A, a card reader is made up of a plurality of rows of sections **2** with associated arms **1** arranged parallelly to form a sensor matrix. The rods **4** extend parallelly across the whole width of the reader and each rod **4** is contacted by a correspondingly positioned arm **1** in each row. Thus, the rods **4** constitute full bus bars. If the reader is required to be only half or partially bussed, the rods **4** would be split along their length and the various split parts isolated from each other electrically. Separate connections would then be made to each part.

To improve reliability, the sections **2** are duplicated for each row of the card reader. The rods **4**, when fully bussed, are made to be movable over a short distance in a direction along their length so as to enable contact wiping to be carried out and for different parts of the rod to constitute a contact area after wear of one area has occurred.

As shown in FIGS. 1 and 1A, the card reader contact assembly of this embodiment makes up the sensor matrix of the multiple contact assembly by arranging a plurality

of rows of sections **2** and associated arms **1** in parallel and providing the rods **4** in a parallel manner across the width of the assembly. Each rod **4** is thus fully bussed across the width of the assembly and electrical leads **25** are connected to the rods at one end. In order to increase reliability, each flexible arm **1**, sensor member **3** and section **2** is provided in duplicate by forming the sections **2** as two identical laminae mounted side-by-side and between two insulating members **5**. If one arm **3** is engaged by a poor contact area of the rod **4**, the other arm **3** is able to make contact, thus there is built in redundancy. If less than full bussing or no bussing of the contact rods **4** is to be required, then individual leads **25** must be lead up to the top of the assembly in a manner similar to that shown in FIGS. 4 and 5 when discussing diode controlled leads. One advantage of bussing over the whole width of the assembly is that the rods can be mounted so as to slide longitudinally. This enables fresh areas of contact to be presented to the flexible arms so that after a period of use any wear can be accounted for. By the incorporation of suitable linkage mechanisms, there rods can be made to move during closure of the reader during a card reading operation to give a wiping action between the two contacting areas.

Connections to the flexible arms **1** are made by electrical receptacles attached to leads (not shown) which are clipped onto tabs **26** projecting from and forming part of the sections **2**. The whole contact assembly is contained in a frame **27** which has a flange **28** mounting it on the rest of the apparatus.

In an alternative construction (not shown) of the multiple contact assembly, the rods **4** are replaced by the bared ends of a length of tape or foil cable. In such an arrangement the cable lies easily within the frame **27** and does not require much room. In order to present sufficient rigidity for the contacting part of the cable, a backing piece of rigid insulating material has to be provided.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

The invention is claimed in accordance with the following:

1. A multiple contact assembly for use in a data-reading apparatus for reading information of a data-carrying card comprising frame means, contact elements mounted on said frame means, insulation means between said contact elements, flexible arm means extending outwardly from said contact elements, contact members at free ends of said flexible arm means and extending outwardly beyond said insulation means for sensing the information on the data-carrying card, said contact elements including said flexible arm means and contact members being stamped from sheets of conductive material and said flexible arm means and contact members of each of said contact elements being in the same plane of each of said contact elements, contact area means along said flexible arm means, and fixed contact means mounted on said frame means in a transverse direction with respect to respective rows of said flexible arm means and disposed to contact said contact area means thereof.

2. A multiple contact assembly as claimed in claim **1**, in which the fixed contact means is of rod form.

3. A multiple contact assembly as claimed in claim **1**, in which the flexible arm means are of a conductive material and the contact area means are provided on one side of the flexible arm means.

4. A multiple contact assembly as claimed in claim **1**, in which the contact area means are provided as separate contact members secured to the side of the flexible arm means.

5. A multiple contact assembly as claimed in claim **1**, in which the contact area means comprises notch means formed in the flexible arm means.

6. A multiple contact assembly as claimed in claim **1**, in which the fixed contact means comprises a strip of conductive material.

7. A multiple contact assembly as claimed in claim **1**, in which the flexible arm means are mounted in rows and adjacent rows are separated from each other by said insulating means.

8. A multiple contact assembly as claimed in claim **7**, in which each row of flexible arm means is formed by two adjacent laminae of stamped material.

9. A multiple contact assembly as claimed in claim **1**, in which the flexible arm means are arranged in grid array and in which the fixed contact means provide columns which are bussed by forming the fixed contact means as common conductors.

10. A multiple contact assembly as claimed in claim **1**, and including means for adjusting the fixed contact means in their longitudinal direction to present fresh contact areas for engagement by the contact area means carried by the flexible arm means.

11. A multiple contact assembly as claimed in claim **1**, and including an electrical component connected to said fixed contact means, the electrical component being contained within the frame means.

12. A multiple contact assembly as claimed in claim **11**, in which the electrical component is connected at the contact area means.

13. A multiple contact assembly as claimed in claim **11**, in which the electrical component is connected in a lead to the fixed contact means.

14. A multiple contact assembly as claimed in claim **1**, in which a plurality of fixed contacts are provided relative to each flexible arm means, and each of said flexible arm means includes a corresponding plurality of contact area means.

15. A contact assembly comprising rows of contact means, insulation means between the rows of contact means, each row of contact means having a planar member provided with a plurality of flexible arms extending outwardly from said planar member in the same plane thereof, contact members at the free ends of said flexible arms and extending outwardly from said insulation means, contact areas along said flexible arms, and stationary contact members disposed in said insulation means transversely to the direction of said flexible arms and arranged to contact said contact areas thereof.

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HERMAN O. JONES, Primary Examiner

U.S. Cl. X.R.

200—166; 235—61.11