March 10, 1970 E. M. JONES ET AL 3,500,285

MULTIPLE CONTACT CONNECTOR

Filed Nov. 1, 1967

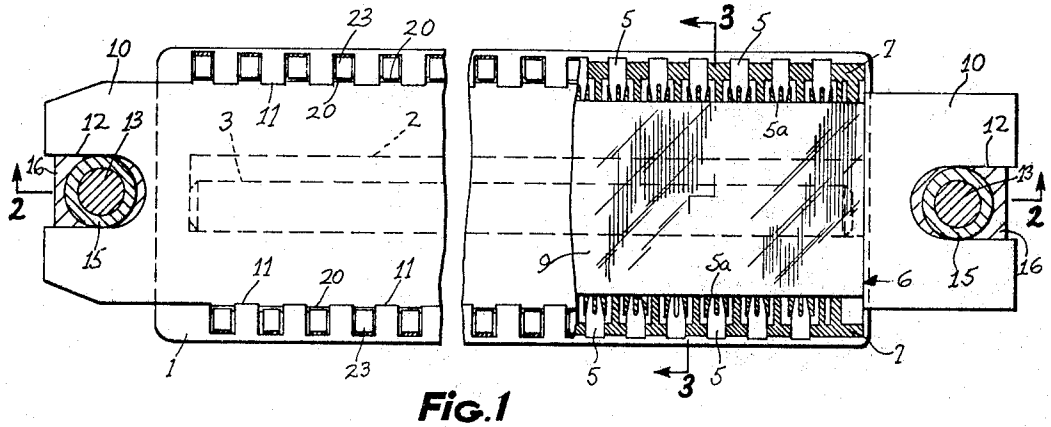


FIG. 1

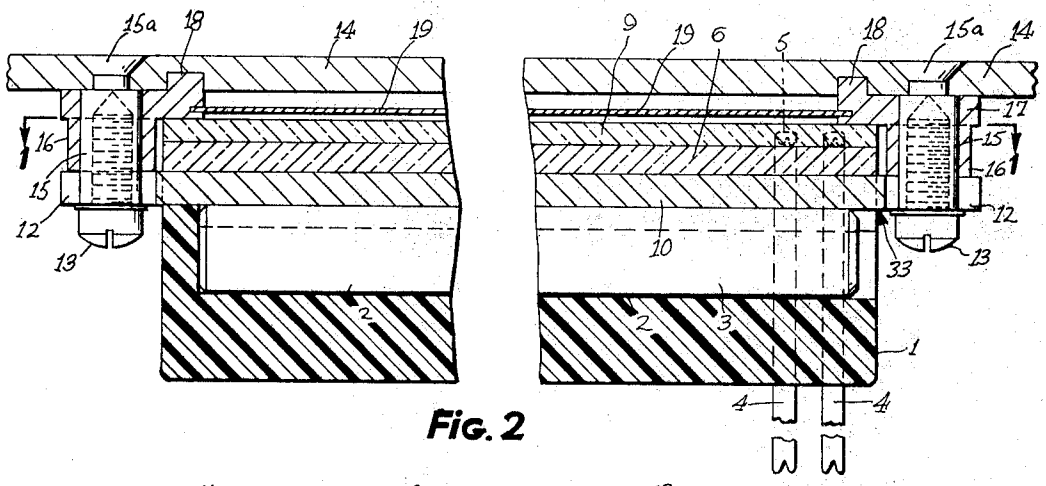


FIG. 2

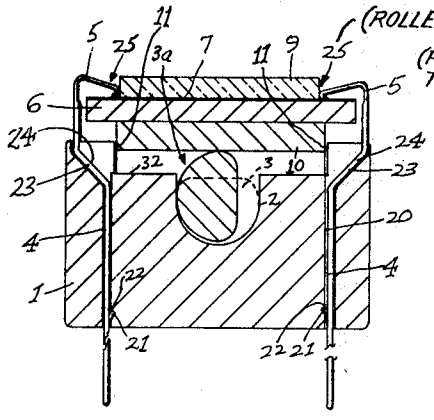


FIG. 3

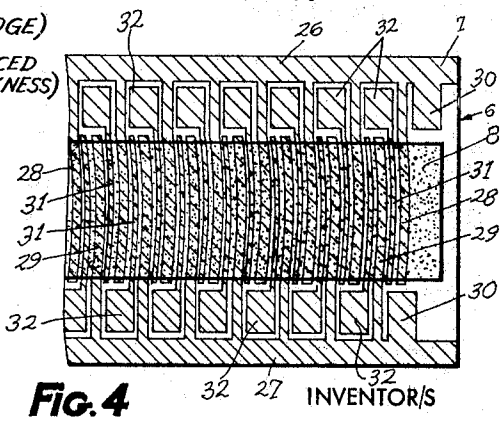


FIG. 4

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MULTIPLE CONTACT CONNECTOR

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U.S. Cl. 339—17 15 Claims

ABSTRACT OF THE DISCLOSURE

A multiple contact connector particularly suited for a photocell array but applicable for other uses wherein electrical connections are required between a plurality of contact points, the structure comprising an elongated connector body mounting a multiplicity of hook-shaped contact arms arranged in a pair of spaced apart rows with the hooked ends of the contact arms overlying a substrate having coacting contacts or electrodes, the substrate being carried on a supporting plate adapted to be inserted axially between the rows of contact arms without scraping their hooked ends, the elongated body of the connector mounting a clamping rod acting, upon rotation, to effect relative movement between the supporting plate and the hooked ends of the contact arms so as to make positive contact between the electrodes carried by the sbustrate and the contact arms.

BACKGROUND OF THE INVENTION

This invention is directed to an improved connector for a photocell array of the type taught in United States Patent 3,249,678, issued May 3, 1966 and entitled "Photoelectric Organ and Appurtenances." Such photocell arrays are particularly suited for use in photoelectric organs and comprise a substrate, which is usually glass, although ceramics and other insulative substance may be used, on which a metallic substance is deposited to form electrodes. Normally there are common electrodes having interdigitating branches, and between each pair of the interdigitating branches there is located a third electrode. The electrodes have enlarged areas extending along the opposite side edges of the substrate with which electrical contact can be made. The branches of the electrodes lying between the enlarged areas are covered by a common coating of a photosensitive substance which is in turn covered by a protective transparent cover glass.

It has hitherto been suggested to make contact with the various enlarged contact areas of the photocell array either directly, as by soldering wires directly to the contact areas, or by using clip-like elements which engage about the side edges of the substrate and make contact with one or more of the contact areas. Alternatively, it has been proposed to provide spring fingers which are biased into engagement with the contact areas of the substrate. Such assemblies have heretofore been permanent in the sense that the substrate was permanently mounted in a holder and, once assembled, could not be readily adjusted or replaced.

SUMMARY OF THE INVENTION

The instant invention provides a multiple contact connector which includes an electrode or contact mounting substrate adapted to be readily inserted in the connector and brought into positive electrical contact with the hooked ends of a plurality of coacting contact arms. Yet the substrate is readily removable for replacement and, while being either inserted or withdrawn, it is free from scraping contact with the contact arms until clamping pressure is applied. To this end, a clamping rod having a flat side is rotatable in a partial bore in the connector

body underlying the support plate on which the substrate is mounted, rotation of the clamping rod serving to cam the support plate and substrate into positive uniform contact with the contact arms throughout the length of the substrate.

The hook-shaped contact arms are constructed to provide maximum resiliency and strength. Their hooked ends are bifurcated to provide two contact points, and their opposite ends may be provided with locking tongues to hold them against axial displacement relative to the connector body.

The connector body is so designed that it will furnish support for the hooked ends of the contact arms, which may be either molded into the body or inserted separately so that a defective arm may be readily replaced. In addition, the connector body is provided with a longitudinal groove which receives the support plate for the substrate and holds it against transverse movement during the rotation of the clamping rod, thereby preventing undesirable side bending stresses on the contact arms.

DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a horizontal sectional view of the connector assembly taken along the line 1—1 of FIGURE 2 with parts broken away to illustrate the various underlying parts.

FIGURE 2 is a vertical sectional view taken along the line 2—2 of FIGURE 1, the view also illustrating the manner in which the connector assembly may be mounted for use in a photocell array.

FIGURE 3 is a vertical sectional view taken along the line 3—3 of FIGURE 1.

FIGURE 4 is an enlarged fragmentary plan view of the substrate showing an exemplary arrangement of electrodes as used in a photocell array.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The basic components of the connector assembly comprise a connector body **1** having a channel **2** extending lengthwise thereof in which the clamping rod **3** is rotatably received. Contact arms **4** extend through the opposite sides of the insulator in aligned rows, the contact arms having hook-shaped upper ends **5** which are adapted to contact the opposite top sides of a substrate **6** having common electrodes **7** formed thereon. The central portion of the substrate is coated with a photosensitive substance **8** which is covered and protected by a cover glass **9**. The substrate is mounted on a support plate **10** adapted to be received in a groove **11** in the connector body. The support plate is of a length greater than the length of the connector body and is provided at its opposite ends with open-ended slots **12** which receive mounting screws **13** by means of which the connector assembly may be secured to a base plate **14** forming a part of a photoelectric organ or other device with which the photocell array is being used. In the embodiment illustrated metallic stand-off guides **15** are riveted to the base plate at **15***a*, the guides being internally threaded to receive the mounting screws **13**. In order to accurately space the support plate from the base plate, the guides **15** are surrounded by spacing sleeves **16** which may be cemented to the guides. The sleeves may be made of either metal or a plastic material, such as nylon. If desired, the spacing sleeves may be formed as an integral part of a mounting bracket **17** which may be keyed to the base plate at **18**, the mounting bracket serving to slidably mount a shutter mechanism **19** utilized in conjunction with the photocell array.

At the outset, it will be understood that the size of the connector assembly does not constitute a limitation on the invention; its size will normally be dictated by the number of connections which are to be made. In an ex-

emplary embodiment, the connector body will be about 4 to 4¼ inches in length, about ¾ to 1 inch in width, and about ½ to ¾ inch in height. Such connector will mount thirty or more contact arms along each of its sides.

The connector body may be formed from any suitable material having dielectric properties. Various thermosetting resins may be used, or a material such as Fiberglas. The contact arms, which are preferably formed from a material such as beryllium copper or Phosphor bronze, may be either molded into the connector body or inserted in arm receiving slots, such as the slots **20**. In order to prevent longitudinal displacement of the contact arms in an upward direction, it is preferred that the arms mount barbs **21** which engage shoulder **22** adjoining the lowermost ends of slots **20**.

It is also preferred to support the hook-shaped ends of the contact arms by means of inclined shoulders **23** which contact the inclined base portions **24** of the hooked ends of the contact arms. Such construction resists downward displacement of the contact arms and also assists in maintaining the hooked ends of the contact arms against sidewise displacement relative to the substrate **6** and hence in positive electrical contact with the electrodes carried by the substrate. It is preferred to split the ends of the contact arms, as at **5***a* (see FIGURE 1), thereby in effect providing two contact points for each arm. It will also be noted that the split ends of the contact arms are rolled, as indicated at **25**, to further insure good electrical contact with the substrate, the rolled ends of the contacts being biased so that, if they abut the cover glass **9**, their contact points will be spaced from any fillets of adhesive formed along the edge of the cover glass when it is cemented to the substrate.

It has been found that the resiliency and useful life of the contact arms can be materially enhanced by reducing their thickness beyond base portion **24**. That is, if the contact arm has an initial thickness of .020 inch, the hooked portion lying beyond inclined base portion **24** will be reduced in thickness to .008 inch or less. Such reduction has been found to enhance the resiliency of the contact arms and at the same time avoid fatigue in the critical bending areas at each end of the base portion **24**.

The arrangement of the electrodes **7** does not constitute a limitation on the invention, and it will be understood that the electrodes formed on the substrate will be so arranged as to provide any desired interconnection between the opposing sets of contact arms. In the embodiment illustrated in FIGURE 4, which represents a typical photocell array, there are common electrodes **26** and **27** having interdigitating branches **28** and **29**. Preferably the common electrodes **26** and **27** will have enlarged contact areas **30** at each end positioned to underlie the hooked ends of the endmost contact arms **4**. Between each pair of the interdigitating branches **28** and **29** are located the third electrodes **31** which have enlarged contact areas **32** positioned to underlie the hooked ends **5** of the other contact arms **4**. Each individual photocell comprises a first electrode which is part of one of the common electrode structures, a second or intermediate electrode **31** and a third electrode which is a branch of the other common electrode structure. The branches of the common electrode structures serve as electrodes for adjacent photocells. When the electrodes are covered by the common coating **8** of a photosensitive substance, the individual photocells in the array will be rendered operative by electrical polarization.

In making up the electrodes, the usual practice is to deposit a suitable metallic substance upon the substrate **6**, in the manner described in the aforementioned United States Patent 3,249,678. The branches of the electrodes are then covered with the layer of photosensitive substance **8** whereupon the cover glass **9** is applied to protect the photosensitive area from moisture, harmful gases and the like. Preferably, the cover glass will be held in place by an interposed layer of cement disposed along the periphery of the cover glass. The cover glass will be narrow enough to expose the contact areas lying along the opposite sides of the substrate for contact with the contact arms.

As will be apparent from FIGURE 3, support plate **10** is of the width to fit just nicely within the groove **11** in the top of the connector body. When the support plate is inserted, its lowermost edge will slide along the surface **32** of the connector body and the substrate **6** will be displaced downwardly from the overlying ends of the contact arms. The clamping rod **3** will be in the position shown in dotted lines in FIGURE 3. When the support plate is fully inserted and the contact areas on the substrate aligned with the overlying hooked portions of the contact arms, the clamping rod will be rotated so as to assume the position illustrated in solid lines at **3***a*, thereby camming the rolled ends **25** of the contact arms into positive contact with the electrodes on the substrate. It will be understood that the exposed end of the clamping rod will be provided with a slot or other tool receiving socket so that the rod may be readily rotated. Since the rod effectively extends the full length of the connector body, it will make positive contact with the support plate throughout its effective length and hence will apply uniform clamping pressure. When it is desired to remove the substrate, the clamping rod will be rotated so as to release the support plate for downward movement in groove **11**, whereupon the substrate may be removed without the ends of the contact arms scraping over the contact areas **30** and **32**. Lateral displacement of the support plate and substrate is prevented by the side edges of the groove **11** which restrain the support plate against lateral movement during rotation of the clamping rod. Inadvertent longitudinal movement between the support plate **10** and the connector body as, for example, that which might be caused by a pull on the cable of leads connected to the lowermost ends of the contact arm **4**, may be prevented by a small pin or spot of cement at point **33** indicated in FIGURE 2.

The spacing of the stand-off guides **15** relative to each other will be such that the assembled connector may be adjusted longitudinally relative to the base plate by means of the slots **12** in the support plate, thereby permitting the photocells to be precisely aligned with the sources of illumination. The connector body also may be initially moved longitudinally relative to the substrate to provide precise alignment between the tips of the contact arms and the contact areas on the substrate, whereupon a pin or a spot of cement will be applied to point **33**.

As should now be evident, the instant invention provides a multiple contact connector in which a multiplicity of contacts may be rapidly effected by utilizing an electrode carrying substrate, the substrate being readily removable for repair or replacement without sliding contact between the contact arms carried by the connector body and the contact areas on the substrate. Yet when the unit is fully assembled, the substrate is maintained in positive tight contact with the contact arms, thereby assuring good electrical contact between the arms and electrodes. At the same time, the substrate may be shifted axially with respect to the contact arms to secure fine adjustment; and similarly, the support plate may be shifted axially relative to its mounting screws to afford adjustment of the assembly relative to the base plate or other support on which it is mounted. It should be noted that the clamping movement between the connector body and the support plate is relative, depending upon which of the parts is fixedly secured to a support. In the embodiment illustrated, the support plate is adapted to be mounted to a supporting surface and consequently it will remain stationary and the connector body carrying the contact arms will be displaced relative to the plate. It will be equally evident, however, that if the connector body is fixedly secured to a supporting surface, the support plate will move relative to the connector body.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A multiple contact connector comprising an elongated dielectric body mounting a plurality of contact arms projecting upwardly from each side of the connector body, said contact arms having hook-shaped upper ends overlying said connector, a longitudinally extending groove in the upper surface of said connector, a support plate slidable in said groove, said plate mounting a plurality of electrodes adapted to make contact with the hook-shaped ends of said contact arms, said connector body and said support plate being displaceable relative to each other from an inoperative position in which said support plate and the electrodes carried thereby lie beneath and in spaced relation to the hook-shaped ends of said arms to an operative position in which said electrodes are in contact with the hook-shaped ends of said arms, and means on said connector body for effecting relative movement between said connector body and said support plate.

2. The connector claimed in claim 1 wherein said connector body has an upwardly opening longitudinal channel underlying said longitudinal groove, and where a clamping rod is rotatably received in said channel, said rod having a cam defining surface operative upon rotation of said rod to move said parts from one position to the other.

3. The connector claimed in claim 2 wherein said support plate includes means lying beyond the ends of said connector body for securing said connector to a supporting surface.

4. The connector claimed in claim 1 wherein the hook-shaped ends of said contact arms have inclined base portions, and wherein said connector body has inclined shoulders positioned to contact and support the said inclined base portions of said arms.

5. The connector claimed in claim 4 wherein said contact arms have downwardly extending distal portions received in slots in said connector body, and barbs on said distal portions engageable with shoulders in said slots.

6. The connector claimed in claim 5 wherein the hook-shaped ends of said contact arms extending beyond said inclined base portions are of a lesser thickness than the inclined base and distal portions of said arms.

7. The connector claimed in claim 1 wherein said support plate mounts a substrate on which said electrodes are formed, wherein a cover plate overlies the central portion of said substrate, and wherein the hook-shaped ends of said connectors terminate in rolled ends the edges of which lie in spaced relation to the opposite side edges of said cover plate.

8. The connector claimed in claim 7 wherein said substrate and the electrodes thereon comprise a photocell array.

9. A multiple contact connector comprising a dielectric body mounting a plurality of contact arms having end portions overlying a surface of said body, a support plate mounting a plurality of electrodes adapted to make electrical contact with the end portions of said contact arms when juxtaposed thereto, the said surface of said connector body having a groove therein of a width to receive said support plate, the opposite side of said groove acting to hold said plate against lateral displacement, but said support plate being slidable longitudinally in said groove so as to align said electrodes with the overlying end portions of contact arms but with said electrodes free from contact with the end portions of said arms, and means for effecting relative movement between said support plate and said connector body to bring said electrodes into contact with the end portions of said arms.

10. The multiple contact connector claimed in claim 9 wherein said means for effecting relative movement between said support plate and said connector body comprises a cam.

11. The multiple contact connector claimed in claim 10 wherein said cam comprises a cam rod received in a channel formed in the said connector body underlying and opening upwardly into said groove.

12. The multiple contact connector claimed in claim 9 wherein said support plate projects beyond the opposite ends of said connector body and is slotted at its opposite ends to receive mounting screws, wherein mounting screws extend through said slots and are received in internally threaded stand-off guides mounted on a base plate.

13. The multiple contact connector claimed in claim 12 wherein spacing sleeves surround said stand-off guides to accurately space said support plate relative to said base plate.

14. The multiple contact connector claimed in claim 13 wherein mounting brackets for a shutter mechanism lie between said support plate and said base plate.

15. The multiple contact connector claimed in claim 14 wherein said spacing sleeves are integrally formed with said mounting brackets.

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