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2,711,523

MULTI-CONTACT CONNECTOR

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FIG. 1

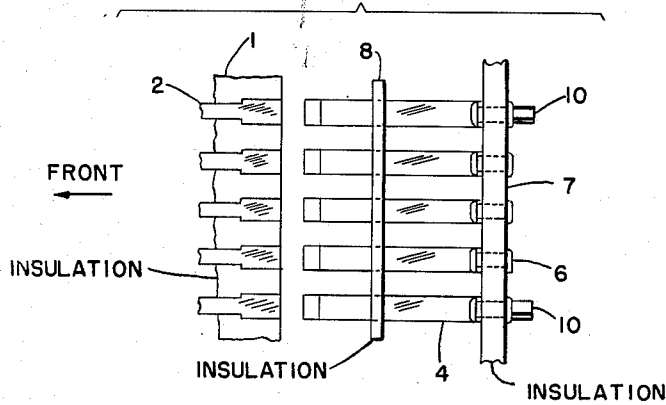


FIG. 2

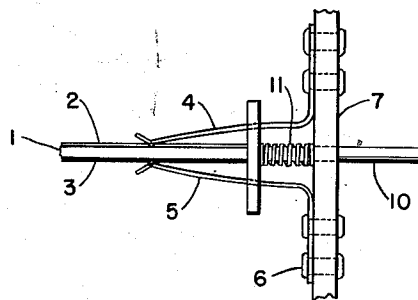
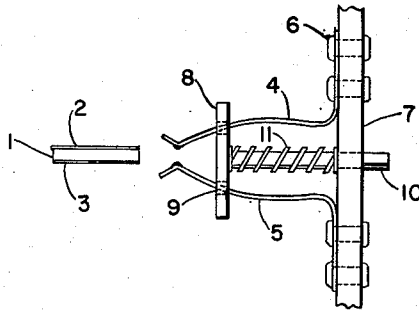


FIG. 3

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2,711,523

MULTI-CONTACT CONNECTOR

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5 Claims. (Cl. 339—253)

This invention relates to multi-contact connectors, and more particularly to an electrical connector of the plug-and-jack type wherein the plug element has contact terminals rigidly affixed to a flat plate of insulating material and the jack element is composed of flexible contact springs to be engaged with the terminals of the plug element.

An object of my invention is to provide an improved multi-contact connector of the type indicated above, the improvements being particularly concerned with a mode of controlling the pressure which the springs of the jack element exert upon the terminals of the plug element during the process of inserting the plug into the jack, a wiping contact being accompanied by an initial light pressure which is afterwards increased to insure good contact.

Another object is to provide a connector of the type indicated above wherein, during the process of inserting the plug into the jack, a wiping action is obtained between the surfaces of the mating contact terminals, to insure the maintenance of clean contacts.

Still another object is to provide a connector of the type indicated above wherein the contact terminals of the plug element may be protected against undue wear and injury, despite repeated insertion into the jack and removal therefrom.

Other objects and features of improvement will be suggested or implied in the more detailed description to follow. This description is accompanied by a drawing in which—

Fig. 1 is a plan view of the connector combination, the jack portion being confronted by the end of the plug element, part of the latter being broken away because it is not needed for the illustration of the invention; Fig. 2 is an elevation view of the connector; and Fig. 3 is another elevational view showing how the contact springs of the jack are flexed upon insertion of the plug element.

Referring generally to any or all of the figures according to their showing of the parts described, the plug element is composed of a flat sheet 1 of insulating material which supports a plurality of contact elements 2 on the upper side and similar elements 3 on the under side. In the embodiment of my invention which has been designed for a specific use the plug element is an integral part of an indicator unit having a settable indicator drum for displaying different digits or other characters selectively.

Such an indicator unit is shown and described in a co-pending application, Ser. No. 299,706, filed by George L. Bush and John W. Cornwell on July 18, 1952, and assigned to the assignee of this application. The indicator unit is of the so-called "plug-in" type. It is commonly used in assembly with many like indicators which constitute a display panel having electric selective setting means operatively associated therewith for remote control. For servicing or replacement of any of these indicator units it is obviously advantageous to

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arrange for their circuit connections to be instantly separable from the more permanently installed conductors of the indicator control system. An indicator unit replacement may thus be likened to the replacement of a radio tube in one of the sockets of a wired chassis.

The terminals 2 and 3 are preferably formed as etched or printed circuit conductors on the surface of the supporting plate of insulating material 1. They have very little thickness, usually of the order of .01" or less.

Where they make contact, therefore, with the mating contact springs of the jack, it is desirable to protect the conductors against injury or excessive wear. The ensuing description will make clear how this is accomplished.

The jack portion of the connector unit comprises a number of flexible contact springs 4 and 5 which are secured as by rivets 6, for example, to a base plate 7 of insulating material. The base plate 7 may be of any suitable size and may, if desired, be large enough to support a number of jack units arranged in a row or rows. In certain cases it may be desirable to assemble the contact springs 4, 5 and rivets 6 with a printed or etched circuit (not shown) having individual conductors some of which may be found to have a function which can be shared in common by a number of jack units. When this is not possible the circuits to which the contact springs of the jack will be connected will be individual and separately related to each indicator unit. For the sake of simplicity of this description only one plug and jack assembly need be considered.

A yoke member 8 of insulating material is provided for the purpose of deforming the springs 4, 5 when the plug element is inserted into the jack. Before insertion of the jack the springs 4, 5 are set to admit the terminals of the plug without pressing upon them. The plug end, however, confronts the face of the yoke and pushes it rearwardly upon insertion into the jack. Attached to the yoke are two plunger members 10 which pass through holes in the base plate 7 and which serve as guides or holders for helical springs 11. These springs are compressed between the yoke and the base plate when the plug is inserted. The yoke has orifices 9 through each of which one of the springs 4, 5 is passed. These orifices serve to guide the springs to control their pressure engagement with the terminals of the plug. The orifice dimensions are such that when the yoke member is moved forwardly or backwardly and the springs are flexed the tilt of the spring surfaces does not hinder the movement of the yoke. As a practical matter the space between the upper and lower walls of the orifice (if viewed in vertical cross section) is preferably made about three times as great as the thickness of the leaf-spring material of which the springs 4, 5 are composed, this material thickness being optionally of the order of .012".

It will be observed that the free end of the spring 4 is flared upwardly and that of the spring 5 is flared downwardly in order to facilitate the operation of "plugging-in." Contact points of the jack springs are each at the angle between the flared end and the adjacent portion of the spring.

The formation of the springs 4, 5 when they assume a natural "set," substantially free from flexure stresses, is somewhat as shown in Fig. 2. If stresses exist they tend to be restrained by contact of the springs against the inner walls of the orifices 9. The opening between the upper and lower springs is greater than the thickness of the plug element, that is greater than the distance between the upper face of terminals 2 and the lower face of terminals 3. Before insertion of the plug the yoke 8 assumes a relatively forward position of repose with the helical springs 11 expanded and the springs 4, 5 tending

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to lean toward each other, but being held apart by the walls of the orifices in the yoke 8.

As soon as the end of the plug 1 comes in contact with the yoke 8 and begins to drive the latter rearwardly it is apparent that the gap between upper and lower jack springs 4, 5 will be reduced, bringing their contact points into wiping engagement with the terminals 2, 3. The pressure is light at the start and gradually increases when the outer walls of the orifices in yoke 8 begin to bear against the outer surfaces of the opposed bowed, or divergent, portions of the jack springs of each pair thereof.

After the initial stage of insertion of the plug the action of the yoke 8 upon the jack springs 4, 5 is such as to straighten out their naturally bowed formation and thus to increase considerably the contact spring pressures against the terminals 2, 3. Fig. 3 illustrates the changes of spring formation and of pressure engagement with the terminals 2, 3 when the plug becomes fully injected into the jack. The helical springs 11 are now compressed, but their tendency to eject the plug is partly opposed by frictional holds then obtained (1) as between the surfaces of the contact springs 4, 5 and the outer edges of the orifices 9; and (2) as between the contact points of the springs 4, 5 and the faces of the terminals 2, 3 with which they make pressure contact. The chief means of restraint, however, against unwanted ejection of the plug is to be found in the arrangements for seating the indicator units in place. Such means cannot be claimed to be novel and for this reason it seems to be unnecessary to illustrate them in the drawing. Briefly described, however, the framework of the indicator panel has shelves or rails on which to rest each horizontal row of indicator units. At the front of this framework is a ledge, or bead which rises somewhat above the shelf level and serves to obtain an alignment of indicator window frames, the lower edge of each indicator front being seated on the shelf behind this ledge.

In an embodiment of the invention which has been constructed and operated under practical working conditions I have found the following advantageous features to have been exhibited: (1) The plug element while serving as an integral part of an indicator unit of the interchangeable type may be easily inserted into or removed from its mating jack without subjecting any part of the structure to undue strain or wear; (2) the formation of the springs 4, 5 is such that a wiping contact is made between each of them and the plug terminal with which it mates; (3) the contact pressure between contact springs of the jack and plug terminals is made very light at the outset of the plug insertion and is gradually increased to a maximum shortly prior to the completion of the injection process. This maximum pressure is then substantially maintained after the plug becomes fully inserted; and (4) means are provided for overcoming any tendency which might otherwise exist for the helical spring 11 to eject the plug after the plug has been fully inserted within the jack.

It will be recognized by those skilled in the art that the novel features of my invention do not stem from the exercise of mere mechanical skill in the design of the multi-contact connector herein disclosed. While I have discovered is a new solution to the problem of effecting a dependable electrical contact engagement between plug terminals and jack springs without unduly impeding the plug insertion process. This solution is characterized by a control of the jack springs such that their pressure engagement with the plug terminals is first at a minimum, and then is gradually increased while the wiping contact is continued until it becomes a maximum shortly before the plug becomes fully inserted and remains at that maximum or substantially so at that point. The structure involved and the mode of cooperation between the elements is also believed to be novel. This structure

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contributes appreciably toward low cost fabrication of the device because of its simplicity.

The scope of the invention is such as to cover modifications which may readily be made by those skilled in the art, the teachings of this disclosure being available to them. The claims should, therefore, be given as broad an interpretation as their language will permit.

I claim:

1. A multi-conductor connector combination of mating plug and jack components, the plug being composed of a rigid flat insulating plate faced on both sides with conductive terminals, the jack comprising two rows of resilient contact springs disposed in pairs and insulatingly mounted in such manner as to enable insertion of the plug between the two rows and to provide a wiping contact between each jack spring and a corresponding plug terminal, the springs of each pair having opposed divergent portions intermediate the ends thereof, an orificed non-conductive yoke member disposed in and transversely to the gentry path of said plug, the orifices being arranged for said pairs of contact springs respectively to slip through said orifices, and resilient means operatively associated with said yoke member for opposing its rearward movement when pushed by the entering edge of said plug, said yoke member constituting means operative to draw closer together said opposed divergent portions of the contact springs of a pair during injection of the plug and gradually increase their pressure engagement with the plug terminals.

2. A multi-contact connector combination of mating plug and jack elements, the plug being composed of a flat printed or etched circuit device having conductive terminals extending on both sides of an insulating base-plate to an edge thereof which will first enter the jack, the jack comprising two rows of resilient contact springs disposed in pairs and insulatingly mounted in such manner as to enable insertion of the plug between the two rows and to provide a wiping contact between each jack spring and a corresponding plug terminal, the springs of each pair having opposed divergent portions intermediate the ends thereof, a non-conductive slotted member providing free passage of said contact springs through its slots, said member being disposed across the path of entry of said plug between the two rows of contact springs, and constituting means operable under the driving force of the plug as it enters the jack for drawing closer together said opposed divergent portions of the contact springs of a pair and thus introducing bending stresses into the contact springs whereby their pressure engagement with the plug terminals is increased.

3. A multi-conductor connector of the type wherein the plug element is a printed or etched conductor arrangement individual conductors of which terminate at the leading edge of a non-conductive base plate, and the jack element comprises two rows of resilient contact springs disposed in pairs and insulatingly mounted so as to enable insertion of the plug element between the two rows, the springs of each pair having opposed divergent portions intermediate the ends thereof, means comprising a non-conductive slotted plate having its face plane disposed transversely to and in the path of entry of the plug element into the jack element, individual pairs of contact springs being respectively slipped through different ones of the slots in said plate and said means for urging said divergent portions of the springs of a pair toward each other and serving to produce a wiping contact of gradually increasing pressure between the mating portions of the plug and jack elements as the plug is inserted, and helical springs subject to compression during the process of inserting the plug element, said helical springs being operative to press against said slotted plate in opposition to the driving force of the entering plug element.

4. A multi-conductor connector combination comprising a plug element the conductive terminals of which are affixed to both sides of a non-conductive flat plate, and a

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jack element having two rows of resilient contact springs disposed in pairs mounted on an insulating support and arranged for free admittance of the plug element between said two rows, the springs of each pair having opposed divergent portions intermediate the ends thereof, said jack element also including an orificed yoke member of non-conductive sheet material through each orifice of which a respective one of said pairs of contact springs is caused to pass, there being an alignment of orifices appropriate to each row, the plane of said yoke member being transverse to the entry path of said plug element between said contact spring rows, resilient means including helical springs for urging said yoke member toward the front of the jack when the plug element is removed, and said yoke member constituting means for urging said divergent portions of the springs of a pair toward each other for increasing the pressure engagement

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of said contact springs with mating plug terminals during insertion of the plug element into the jack.

5. The combination according to claim 4 and further characterized in that said yoke member and the resilient means which includes helical springs in cooperation with said yoke member coact to maintain separation between opposing contact springs of the two rows when the plug element is removed, thereby avoiding the possibility of short-circuiting such contacts.

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