Jan. 26, 1971 A. FREY 3,559,155

CONTACT DEVICE

Original Filed Jan. 9, 1967

Fig. 1.

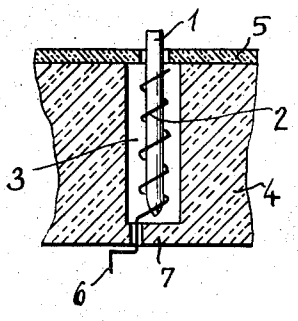


Fig. 2.

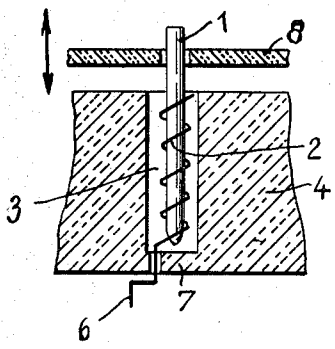
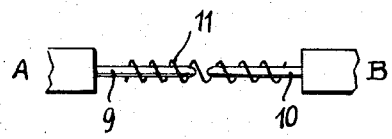


Fig. 3.



Inventor:

Arnold Frey

By Walter Frey.

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CONTACT DEVICE

Arnold Frey, Kronskamp 106, Wedel, Holstein, Germany

Continuation of application Ser. No. 608,103, Jan. 9, 1967. This application Oct. 18, 1968, Ser. No. 781,677
Claims priority, application Germany, Jan. 10, 1966, F 48,122
Int. Cl. H01r 13/12
U.S. Cl. 339—256 3 Claims

ABSTRACT OF THE DISCLOSURE

The present invention concerns a contact device, and more specifically, relates to an electrical plug socket connection characterized primarily by a helically coiled spring the inside dimensions of which in unloaded condition being slightly smaller than the outside dimension of an insertable plug. The penetrating plug which is provided with a tapered end widens the internal dimension of the spring by shortening its axial length and makes contact with the internal surface of the spring except at least the innermost coil of the spring because of its tapered end.

This application is a continuation of Ser. No. 608,103, filed Jan. 9, 1967, and now abandoned.

The invention is concerned with a contact device for making an electrical connection between a rigid plug member on the one hand, and a resilient socket member on the other hand. The contact device can be employed for detachable or undetachable contact making.

The requirement for readily detachable and nevertheless dependable connections, as well as for undetachable connections between components or subassemblies of widely varying kinds, is growing commensurately with the significance of electronics in all branches of engineering. A good, detachable contact should not only have the least possible contact resistance, that is not affected by numerous make and break operations, the contact should also be self-wiping, vibration-resistant, small, exhibit minimum susceptibility to troubles and be as simple as possible, i.e. cheap, to manufacture. Additional safety arrangements against unintentional interruption of connections are needed for many applications, as a result of which the contact device is frequently rendered complicated and costly.

In known detachable contact devices of the afore-stated type, springs are arranged subdivided on one or more planes about the rigid plug pin in the axial direction of the pin.

The disadvantage of these contact devices is that, in the course of time the springs suffer from fatigue or lose their shape, and that the contact faces get soiled or oxidise and that the insulating film thus formed is not automatically removed when contact is made. The result is a mechanically good, but an electrically poor contact, or there may be no electrical contact at all.

In other detachable contact devices known to the art the plug member is designed like a blade, and when making a connection the resilient socket-like member grips pincer-fashion, with high specific contact pressure, the rigid member on at least two faces simultnaeously, with its front edges running in parallel with the direction of make.

The said known contacts are self-wiping, comparatively large and highly uneconomic to manufacture.

The object of the invention is to provide a contact device that is self-wiping and small, and can be produced at low cost.

To achieve said object the invention provides for a

pin as known per se to be entered in at least one helically coiled spring dimensioned in accordance with the external dimensions of said pin, the inside dimensions of the unloaded helical spring being smaller than the outside dimensions of said pin and for said pin to be tapered at its extremity so that it does not make contact with at least the end coil of said helical spring.

The new contact device advantageously comprises a cylindrical pin and a cylindrically wound helical spring, whose internal diameter in the unloaded state is less than the external diameter of the pin.

The principle of the new contact device is based on the following: if pressure is exerted on a helical spring in the direction of its axis, among other things, torsional movement is induced. This results in an increase in the helical spring's diameter. If the pressure is partly or wholly relieved, the helical spring will endeavour to return to its rest position and to assume its original smaller diameter. The applicant's contact device utilizes this effect.

A typical form of the invention is shown in the drawing and is hereinafter described.

FIG. 1 shows a contact pin with a helical spring in a cavity, whose length corresponds to the length of said helical spring when unloaded.

FIG. 2 shows a contact pin and a helical spring in a cavity, whose length corresponds to the length of the unloaded helical spring and whose end at which the spring is entered is open.

FIG. 3 shows two contact pins inserted in a helical spring.

In the contact device depicted in FIG. 1 a cylindrical pin **1** is inserted in a cylindrical helical spring **2** with coils of a specific pitch. The helical spring **2** is arranged in the cylindrical bore **3** of the housing **4** and is retained in position by the cover **5**. The lower extremity **6** of the helical spring **2** is axially passed through the bottom **7** of the housing **4** and is used as a connection. By this means the helical spring **2** is simultaneously secured in the housing **4**. The extremity **6** can also be led radially out of the housing **4**. The helical spring **2** extends the full length of the bore, and the pin **1** also extends to the bottom. The bottom end of said pin is tapered, so that it does not make contact with the end coil of the helical spring **2**.

When the helical spring **2** is in the rest condition its internal diameter is slightly smaller than the diameter of the pin **1**. As the helical spring **2** is wound with a comparatively large pitch, its diameter is immediately increased the moment it is compressed. As soon as insertion of the pin **1** is started in the helical spring **2** pressure is exerted by said pin. Starting at the point of pressure, the coils are compressed until the diameter of the pressure-exerting pin **1** is attained, whereupon said pin can be easily inserted in the helical spring **2**. Immediately the pressure ceases, i.e. when the pin **1** has been inserted, the helical spring **2** slips back to the extent permitted by the diameter of said pin. Helical spring **2** then firmly hugs pin **1** under pressure, so that good electrical contact is made over the entire length of said helical spring in contact with said pin. The cylindrical bore **3** is dimensioned so that its length corresponds to the length of said helical spring when not loaded. Consequently, when pin **1** is withdrawn the upper extremity of the helical spring **2** locates on the cover **5**. Thereupon the afore-described procedure for the insertion of pin **1** in helical spring **2** is reversed. As the end coil of helical spring **2** is free, tension on pin **1** will cause said helical spring to move towards and be compressed against the cover **5**, whereupon said helical spring will expand and pin **1** will readily slide out of said helical spring **2**.

FIG. 2 shows a version of the new contact device, which instead of the cover **5** has a movable annular disc

8 arranged at a specific distance from the housing 4. Apart from this the contact device disclosed by FIG. 2 has the same dimensions as the contact device depicted in FIG. 1. In particular, the length of bore 3 corresponds to the length of helical spring 2 in the unloaded state. All components having the same reference numerals are the same as those described for FIG. 1. Pin 1 of the contact device disclosed by FIG. 2 can be just as easily inserted in the helical spring 2 as in the case of the contact device shown in FIG. 1. But pin 1 cannot be removed after insertion. If an attempt is made to remove pin 1, tension will be exerted on helical spring 2 which is gripping it, which will be caused to tighten and the retaining pressure on the pin 1 will be increased. Thus effective and simple means are provided, at no extra cost or effort, for ensuring that the contact connection is not interrupted, either unintentionally or as a result of precipitate action. If the space between the housing 4 and the axially movable annular disc 8 is eliminated, by advancing the annular disc 8 to the housing 4, for instance, the aforesaid tension cannot occur and the connection is interrupted as described for FIG. 1.

If no cover 5 or annular disc 8 is fitted to the contact devices as shown in FIGS. 1 and 2, for the aforestated reasons an undetachable connection will be obtained, in that pin 1 cannot be withdrawn from the helical spring 2 without breaking the contact device.

In the contact device shown in FIG. 3, the two members A and B are each provided with connecting elements in the form of a cylindrical pin 9 and 10. According to the invention, a suitable helical spring 11 is placed on the aforesaid pins to make the contact. In this case too the connection can be broken only by applying force, unless the right end of the spring is held fast, then the connection can be very easily severed.

The advantages afforded by the invention are in particular that the helical spring hugs the pin over its entire length, as a result of which positive contact is given over a large area. If the pin and helical spring are cylindrical, both members can be precision manufactured at low cost. By suitably selecting the diameter of wire and pitch of the helical spring, the contact pressure can be varied at will, so as to obtain the least contact resistance. To increase the areas of contact, profiled wire for example can be used instead of round spring material. A good plug and socket connection is required to have self-wiping characteristics, which the applicant's contact device exhibits to the utmost. The self-wiping action is enhanced by the albeit slight spiral movement of the helical spring when it is compressed and released. No other contact known to the art exhibits in an equal area so large a simultaneously effective contact surface.

A great advantage is the fact that the pressure of the contact device remains constant for a practically unlimited number of make and break operations, as with the very small amounts of expansion and contraction the helical spring is almost immune to fatigue. This is a particularly attractive asset when corrosion-resistant and high-grade, detachable points of contact are required. The precious metals and precious metal alloys employed to not, unfortunately, exhibit very considerable mechanical hardness, and as a result thereof, only minimum elastic properties. Consequently, such specific contact metals or alloys are mostly employed in the form of facings only; or when solid contacts thereof are used, almost only when the contact is subjected to compressive stress alone. But when a helical spring is the contact member, the torsional movement when making contact is so small that definable deformation of such a contact occurs only after a very large number of make and break operations. Moreover, a spring material such as steel or bronze can be faced or clad. As the pin and helical spring will for the most part be of cylindrical cross-section, they can be easily coated with a relatively thin massive layer of precious metal by the drawing method.

The pin and helical spring can be produced by the simplest means with a high-grade surface, at very low cost, and no finishing operation is required. Compared with conventional contact-making devices, greater resistance to abrasive wear is ensured.

Many of the millions of valves (tubes), relays and other exchangeable components of electronic systems still require the use of complicated, expensive, heavy and cumbersome means for preventing the disconnection of contact-making devices. The new contact device, as shown in FIGS. 1 and 2, for instance, enables the space requirement for detachable plug and socket connectors to be reduced to a minimum. The cylindrical cross-section of the new contact device enables a larger number of connectors to be accommodated in a given space than was hitherto possible, without reducing the length of insulating path or the cross-sectional area required for current-carrying and mechanical strength reason. Thus, the same number of contacts can be provided in a smaller space. By way of example, it is possible to produce pins and helical springs having diameters of a few tenths or hundredths of a millimetre. Contact devices fabricated from such small pins and helical springs can be actuated; this would scarcely be possible with the known V-type contacts, for instance, of equal size.

From the economic aspect, such contact devices can be manufactured at low cost and with maximum precision. Cylindrical pins can be produced more accurately and cheaply than conventional profiled pins, as mostly incorporated in V-type connectors. Similarly, precision cylindrical helical springs are considerably cheaper to manufacture than blanked, formed and ground profiled springs. The requisite helical springs can be advantageously produced in a continuous length and then cut into sections. The tooling for the plastic holders is also simplified and can be manufactured to closer tolerances, in that only cylindrical dies are needed. The insulating elements are consequently easier to injection mould and to eject from the dies.

The helical spring is an extremely flexible member, and as the end coil is free, because of the tapered point of the pin, such a contact is highly insensitive to shock and vibration, and is thus largely shakeproof.

In electronic engineering a large number of heat-sensitive and other component parts have to be connected with other members in a manner to ensure good conductivity. As soldered joints are out of the question, contact devices as disclosed by the invention and as illustrated in FIG. 3, for example, can be employed to advantage in place of screw or crimp connections, which are both inconvenient and give rise to the possibility of defective contact.

For those applications calling for maximum economy of space and weight, the usual plug-in connection for valves (tubes), relays and many other exchangeable elements can be dispensed with by employing helical springs, to give a contact arrangement according to the invention. Instead of relatively long connecting wires required for thermal protection, transistors and diodes can also be provided with short pins, if contact is made with the aid of helical srpings according to the invention.

What is claimed is:

1. A contact device for making an electrical connection, which includes: a socket member comprising a helically coiled cylindrical spring, a rigid plug member comprising a substantially cylindrical pin for insertion into and establishing electric contact with said spring, said spring when not engaged by said pin having an inner diameter slightly less than the outside diameter of that portion of said pin upon which introduction into said spring is to establish electric contact therewith, said spring when not engaged by said pin having adjacent convolutions space from each other by distance permitting an axial travel of its convolutions toward each other to such an extent as to increase the inner diameter of said

spring beyond the outer diameter of that pin portion which when introduced into said spring is to establish electric contact therewith, said socket member comprising a block of insulating material having a cavity provided with a bottom portion and an open end, and housing said helical spring, said cavity having a length corresponding at least to the length of the helical spring when not engaged by said pin, said helical spring having one end portion secured to said socket member at said bottom portion of said cavity, and abutment means arranged at said open end of said cavity and provided with a passage for said pin but having a diameter less than said spring, said abutment means being adapted to engage the other end of said spring, said abutment means being formed by disc means axially movable from a first position spaced from said open end of said cavity and said spring to a second position adjacent said open end of said cavity for engagement with said spring when said pin is being withdrawn from the latter.

2. A contact device according to claim **1**, in which said pin is tapered in that end thereof which during the introduction of said pin into said spring first enters the latter.

3. A contact device according to claim **1**, in which adjacent convolutions of said spring are spaced from each other by at least the thickness of an individual winding of said spring.

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MARVIN A. CHAMPION, Primary Examiner

J. H. McGLYNN, Assistant Examiner