ELECTRICAL CONNECTOR FOR WIRES SUBJECT TO FLEXING

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The present invention relates to an improved electrical connector for wires which are subject to flexing, and more particularly is directed to such a connector for use with wires extending through flexible vacuum cleaner hoses. The invention is especially directed to an electrical connector for use in completing an electrical control circuit which extends in part through a flexible vacuum hose and is operable from the free end of this hose.

In the prior art, various systems have been provided wherein electrical wires are extended through flexible vacuum hoses to establish control circuits operable from the free ends of the hoses. These systems have been provided both for use with vacuum cleaners of the portable canister type and with vacuum cleaners of the centrally located permanent installation type. Although the present invention is directed primarily to the latter type, it will be seen that it has application to both types. This application results because the problems overcome by the character of the present invention reside primarily in the hose structure, rather than the vacuum cleaner pump or blower structure, which hose structure is similar in large part for vacuum cleaners of both the canister type and the centrally located type.

The problem referred to is that of providing an electrical connector for flexible wires extending through a flexible hose, which connector will not be adversely affected by continuous flexing of the hose. More specifically, the problem is to provide such a connector which will not break down after the hose has been in use as a result of the stresses produced in the connector during hose flexing.

In the prior art, these stresses resulted primarily because the wires extending through the hoses were rigidly secured to connector elements, as by soldering or clamping. This in turn resulted in a concentrated stress at the securing point when the wire flexed relative to the connector, which stress eventually resulted in breaking of the wire. The stresses in the prior art devices were aggravated even more where the wires were embrittled and weakened by heating during soldering or deformation during clamping.

It is, accordingly, a principal object of this invention to provide an electrical connector for use with wires subject to flexing, which connector avoids the prior art shortcomings of the type developed above.

Another object of this invention is to provide a connector of the type described which lends itself to easy assembly by eliminating the requirements of soldering or clamping.

Yet another and more specific object of this invention is to provide an electrical connector which permits articulated movement between connected elements, which movement functions to maintain the contacting surfaces of the elements clean and electrically conductive.

Still a further object of the invention is to provide an electrical connector of the type described which may have a switch incorporated thereinto by simply positioning the switch terminals in juxtaposition to the connector elements.

Another object of the invention is to provide a connector of the type described which is well facilitated to have a jack probe incorporated thereinto.

Basically, the present invention is for use in combination with a flexible fluid conveying hose having a pair of flexible electrical wires secured thereto and extending therethrough in electrically insulated relationship, which wires have ends extending laterally from the hose. The improved connector comprises first and second electrical conductor elements, each of which has an opening therein received on one of the respective ends of the wires. The openings are so dimensioned relative to the ends of the wires as to be in constant electrical contact therewith while permitting the ends to articulate relative thereto.

The basic connector is completed by an insulator which maintains the conductor elements in spaced relationship and a device for maintaining the ends of the wires in the openings of the elements.

The foregoing and other objects of the invention and the detailed structure and operation thereof will be more apparent when viewed in light of the accompanying drawings, wherein:

FIG. 1 is a perspective view of the hose and connector combination, together with a vacuum inlet for use therewith, which inlet is shown schematically connected to a central vacuum device;

FIG. 2 is an elevational sectional view of the FIG. 1 inlet having the mating hose connection inserted thereinto;

FIG. 3 is an elevational sectional view of the hose connector shown in FIG. 2, with parts thereof omitted for the sake of clarity; and,

FIG. 4 is an elevational sectional view of the electrical connector and switch on the nozzle end of the flexible hose opposite the connector shown in FIGS. 2 and 3.

Referring now to the drawings in detail, the numeral 10 therein designates a flexible hose having a wall supported by internally disposed electrically conductive resilient wires 11 and 12. As can be seen from FIG. 3, the wires 11 and 12 are helically wound so as to run along the length of the hose in side by side relationship. The hose 10 has secured to one end thereof a male vacuum connection 13 and to the other end thereof a vacuum nozzle 14.

The hose 10 is adapted to be connected to a suction inlet plate 15 mounted on a wall 16. The plate 15 includes a vacuum inlet opening 17 which is removably securable with a vacuum pump 20 through a pipe 12. The opening 17 may be selectively opened or closed by a lid 19, which lid is secured to the plate 15 by a spring hinge 22 normally urging it to a closed condition. In closed condition, a seal 23 on the lid assures that the pump 20 will not draw through the opening 17.

The pump 20 has incorporated thereinto a motor (not illustrated) controlled through a relay 24. The relay 24 has power lines 25 extending thereinto; output lines 26 extending to the motor of the pump 20; and control lines 27 extending to a jack 30 mounted on the plate 15. As can be seen from FIG. 2, the jack 30 is of conventional character and includes a sleeve contact 31 and a central contact 32, both of which are adapted to cooperate with a jack probe 33 mounted on the connector 13, the details of which probe will be developed subsequently. The contacts 31 and 32 are separated by an electrical insulator disc 29.

The structure of the suction inlet plate 15 and the pump and electrical circuitry cooperating therewith is completed by a warning light 34 mounted on the plate. Although not illustrated, this light is preferably operable through circuitry cooperating with the relay 24 to indicate when the pump 20 is in operation. This warning light is desirable because the pump 20 typically services a plurality of stations, each of which is provided with a suction inlet plate corresponding to the plate 15. In this case, if more than one plate is being used to effect vacuuming, the vacuum to each plate is necessarily decreased. Thus, if the user wishes full vacuum, he will only oper-
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3 ate his inlet when the light 34 indicates no one else is using the system. The structure of the vacuum inlet in the wall 16 and the pump and control structure cooperating therewith is generally known in the art and, accordingly, is not the subject of the present invention. The invention is, however, directed to the hose 10, connectors 13 and nozzle 14 which cooperates with the jack 30 to complete the control circuit. The latter structure includes the pair of resilient electrical conductor wires 11 and 12 extending through the hose 10, and electrical connectors secured to these wires in both the vacuum connector 13 and vacuum nozzle 14.

The electrical connector in the vacuum connector 13 is adapted to be secured to upstanding ends 35 and 36 on the wires 11 and 12, respectively, which ends extend generally radially from the hose 10. This connector comprises a pair of electrical conductor blocks 37 and 40, which blocks have openings 41 and 42, respectively, formed therein for slidable reception on the ends 35 and 36. The openings 41 and 42 are so dimensioned relative to the ends 35 and 36 as to permit articulation therebetween while at the same time maintaining electrical contact. In actual practice, it has been found preferable to form the openings of a diameter exceeding that of the wire received therein by only a few thousandths of an inch and of a depth sufficient to receive a wire end over a length at least twice its diameter. The blocks 37 and 40 are separated by an electrical insulator block 43 interposed therebetween, and are received, together with this insulator block, in a cavity 44 formed in the vacuum connector 13. It is noted that the connector 13 is of annular configuration and is formed of a resilient material, such as rubber. The connector 13 is mounted on the hose 10 through means of a rigid tube 45 extending therethrough into the secured engagement with the hose. Thus, when the blocks 37, 40 and 43 are received in the cavity 44, as shown in FIG. 2, the resilient character of the connector 13 functions to force these blocks towards the tube 45 and maintain the ends 35 and 36 into engagement with the openings 41 and 42, respectively.

The electrical connection to the blocks 37 and 40 is completed by the jack probe 33 which extends through the connector 13 and is adapted to be received in the jack 30, as illustrated in FIG. 2. The jack probe 33 simply comprises an electrically conductive outer sleeve 50; an electrically conductive rod 51 extending conductively through the sleeve 50 and having a head 52 thereon; and, an insulator sleeve 53 interposed between the sleeve 50 and rod 51. In the assembled condition, the sleeve 50 is soldered in electrical contact with the block 49 and the rod 51 is soldered in electrical contact with the block 57, with the insulator sleeve 53 extending through both the blocks 49 and 57. When the connector 13 is forced into the opening 17 and the jack probe 33 is inserted into the jack 30, as illustrated in FIG. 2, the head 52 engages the contact 32 and the sleeve 50 engages the contact 31, thus establishing electrical connection between the wires 27 and the wires 11 and 12.

FIG. 4 illustrates electrical connector in the vacuum nozzle 14 and a switch cooperating therewith. This connector is similar to the aforesaid described electrical connector in that it is received on radially extending ends 54 and 55 formed on the wires 11 and 12, respectively. The ends 54 and 55 are slidable received in electrically conductive eyelets 56 and 57, respectively, mounted in separated relationship on an insulator board 60. The eyelets 56 and 57 define openings having dimensional characteristics relative to the ends of the wire extending therethrough which correspond to those of the openings 41 and 42 formed previously. These openings provide for articulated movement of the wires relative to the eyelets while maintaining electrical contact therebetween. The nozzle 14 is secured to the hose 10 by sleeve 62 fixed to the hose and extending through the nozzle in secured engagement therewith. In the assembled condition, the wire ends 54 and 55 are interposed between the sleeve 62 and the nozzle body and thus are maintained in engagement with the eyelets 56 and 57, as illustrated.

The electrical connection in the nozzle 14 is completed by a switch 63 having terminals 64 and 65 juxtaposed in electrical contact with the eyelets 56 and 57, respectively. The switch 63 is maintained in juxtaposed relationship with the eyelets by a cap 66 extending thereover and secured in place by screws 66 threadedly engaging nuts 61 fixed to the body of the nozzle 14. Positioning and ease of assembly of the switch 63 under the cap 65 is facilitated by ears 67 and 70 having openings therein (not illustrated) received on the screws 66. The board 60 is similarly positioned by U-shaped notches 71 and 72 formed in the ends thereof and slidably received on the nuts 61. Once the connection to the nozzle is complete and the connector 13 is seated in the opening 17, as shown in FIG. 2, the control circuit for the motor of the pump 20 is complete and the pump may be readily turned on to initiate the operation of the switch 63.

To conclude, from the foregoing description it is believed apparent that the present invention enables the accomplishment of the objects initially set forth herein. In particular, an electrical connector is provided wherein the connected elements are slidable engaged for movement relative to each other, thus providing for such movement without strain. The slidable nature of the engaged elements is particularly desirable, since it facilitates ease of assembly without the necessity of the steps involved where soldering or clamping connections are used. It is noted that the subject connector is particularly well suited for use in establishing electrical connections to the resilient coil supporting wires for vacuum hoses, since it utilizes the resilient characteristics of these wires to enhance the electrical connection. Specifically, the resilient nature of these wires tends to force them into contact with the walls of the connector openings in which they are engaged. This results because these wires are resiliently held in spaced relationship with respect to each other and any disturbance of this relationship, such as that which may occur when the connection is made or the hose is flexed, is resiliently resisted.

It is to be understood that the invention is not intended to be limited to the details of the specific embodiment illustrated and described, but rather is defined by the following claims.

What is claimed is:
1. In combination with a flexible fluid conveying hose having a pair of flexible electrical wires secured thereto and extending therealong in electrically insulated relation, said wires having ends extending laterally from said hose, an improved electrical connector for said wires comprising:
   (a) first and second electrical conductor elements, each of which has an opening therein slidable received on one of the respective ends of said wires, said openings being so dimensioned relative to said ends as to be in constant electrical contact therewith while permitting said ends to articulate relative thereto;
   (b) insulating means maintaining said elements and the ends of said wires in spaced relationship; and,
   (c) securing means maintaining the ends of said wires slidable received in the openings in said elements.
2. A combination according to claim 1, wherein:
   (a) the ends of said wires extend substantially radially from said hose; and,
   (b) said securing means comprises:
      (1) a substantially rigid sleeve secured in axial alignment with said hose to the interior of said ends;
(2) an annular member extending around said sleeve; and,
(3) biasing means on said annular member forcing said conductor elements towards said sleeve.

3. A combination according to claim 2, wherein:
(a) said annular member is resilient; and,
(b) said biasing means comprises a pocket formed in said annular member and extending over said conductor elements in snug engagement therewith.

4. A combination according to claim 1, wherein:
(a) each of said wires forms a resilient helix disposed to support the wall of said hose; and,
(b) the resiliency of said helicities functions to bias the ends of said wires against the interior of the openings of the respective conductor elements in which said ends are received.

5. A combination according to claim 1, wherein:
(a) said insulating means comprises a block of insulating material; and,
(b) said first and second conductor elements are juxtaposed to opposed sides of said block with the openings therein facing in the same direction.

6. A combination according to claim 5, including a plug-in probe comprising:
(a) an electrically conductive sleeve fixed in electrical contact with said first element and extending laterally therefrom away from said insulating block;
(b) an electrically conductive rod extending through said sleeve, first element and block into fixed electrical contact with said second element; and,
(c) an electrically insulating sleeve interposed between said conductive sleeve and said rod, said insulating sleeve being effective to electrically isolate said rod from both said conductive sleeve and said first element.

7. A combination according to claim 1, wherein:
(a) said insulating means comprises a board of insulating material;
(b) said first and second conductor elements each comprise an electrical conductive eyelet mounted in and extending through said board, said eyelets being mounted in spaced relationship on said board; and,
(c) the openings in said first and second conductor elements are defined by the eyes in said respective eyelets.

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