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ELECTRICAL CONNECTOR ASSEMBLY

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FIG. 2.

FIG. 3

Fig 4

Fig. 5



FIG. 7

FIG. 10



FIG. 9.



FIG. 13.



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ELECTRICAL CONNECTOR ASSEMBLY

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This application is a division of application Serial No. 262,878, filed March 20, 1939.

This invention relates to acoustic devices such as transmitters and receivers and to connecting means for electrical apparatus especially adapted for use on receivers of small size

An object of this invention is to provide a small, thin connecting means suitable for use on a wide variety of devices but especially adapted for use on acoustic devices of small size intended for inconspicuous wear by individuals of impaired hearing.

Another object of this invention is to provide an improved construction for piezoelectric acoustic devices of small size.

Another object of this invention is to provide an improved means for connecting a piezoelectric unit to an acoustic diaphragm.

For the purpose of illustration the invention will now be described with reference to the accompanying drawing. In order to better illustrate some of the smaller parts, all of the figures are larger than the actual devices are apt to be made, but the invention should not be limited to any particular dimensions. Figures 6 to 11 inclusive are drawn on a larger scale than the remaining figures.

Fig. 1 is an edge elevation of an acoustic device embodying the features of this invention.

Fig. 2 is a plan view of the device of Fig. 1.

Fig. 3 is a view similar to Fig. 2 but with the connector removed to reveal the terminals of the acoustic device.

Fig. 4 is a plan view of the connector.

Fig. 5 is an edge elevation of the connector of Fig. 4.

Fig. 6 is a plan view of the acoustic device of Figs. 1 to 3, showing the opposite side, with some of the parts broken away to reveal inner construction.

Fig. 7 is a sectional view on the line 7, 7 of Fig. 6.

Fig. 8 is a sectional view on the line 8, 8 of Fig. 6.

Fig. 9 is a sectional view of an alternative diaphragm construction.

Fig. 10 is a plan view of the terminal side of the connector shown in Figs. 4, 5, 7 and 8, with some of the parts broken away to reveal inner construction.

Fig. 11 is a sectional view on the line 11, 11 of Fig. 10.

Fig. 12 is a plan view of a separate receptacle for the connector of Figs. 4, 5, 10 and 11.

Fig. 13 is a side elevation of the receptacle,

Fig. 14 is an edge elevation of the receptacle.

Fig. 15 is a sectional view taken on the line 15, 15 of Fig. 12 with a contact member shown in elevation.

Fig. 16 is a sectional view showing a receptacle in cross-section corresponding to that of line 16, 16 of Fig. 15, said receptacle being secured to a portion of a wall section of electrical apparatus.

In Figs. 1 to 11, the acoustic device comprises a cup-shaped housing 1 of hard rubber, Bakelite or any other suitable insulating material having a main wall section 1a and circular wall section 1b. Within the housing is disposed a substantially rectangular piezoelectric bimorph unit 2 of the bending type such as is disclosed in United States Letters Patent Reissue 20,213. The unit is supported at its ends on small blocks 3, 3 of soft material such as viscoloid or rubber, which are supported by the wall section 1a of the housing. The blocks 3, 3 may readily be secured to the unit and housing by cement. The ends of the unit are slightly beveled to permit use of a larger unit than would otherwise be possible.

The outer face of main wall section 1a carries a connector receptacle comprising connector retaining flanges 1c, 1c which may, as shown, be formed as integral parts of the housing 1. The receptacle further comprises thin strip-like terminal contacts 4, 5. The terminals 4 and 5 are mounted in channel-shaped recesses in the outer face of wall section 1a by forcing the terminal ends through suitable engaging recesses in the wall section. The end 4a of terminal 4 extends inwardly and terminates close to an edge of unit 2 while the other end 4b terminates flush with the inner surface of wall section 1a. Similarly, end 5a of terminal 5 extends inwardly and terminates close to the opposite edge of the unit 2, and the other end 5b terminates flush with the inner surface of wall section 1a. It is not necessary that the ends 4b, 5b extend into the wall section but such construction adds to the ruggedness of the assembly. For further strength, these ends may be made longer and bent over on the inner face of wall section 1a. The electrical leads 2a, 2b of the unit 2 are connected to ends 4a, 5a respectively of the terminals.

In assembling such units of very small size, it is difficult to solder the connection without damaging the crystal unit by excessive heat. It has been found that the connections to piezoelectric units, such as unit 2, need not have the low resistance usually required in other devices as long as the connections are mechanically rigid.

A satisfactory connection may be made by wrapping the lead 2a several times around terminal end 5a and then applying a drop of cement or lacquer or other suitable binder. The binder may, if desired, contain particles of a conducting material.

On the outer face of unit 2, approximately midway between its ends, is cemented a ring 6 of yielding vibration conductive material such as viscoloid or rubber. A diaphragm 7 of suitable material such as Celluloid, aluminum, Bakelite or mica is secured to the wall section 1b of the casing by cement or other suitable means and at its inner face is cemented to the ring 6.

When a circuit supplying a voltage of sound frequency is connected to the terminals 4, 5 the piezoelectric unit 2 vibrates and through ring 6 causes diaphragm 7 to vibrate with resultant radiation of sound. Conversely, sound waves acting on diaphragm 7 apply a varying pressure through ring 6 to the unit 2, and as a result, an alternating voltage appears between terminals 4 and 5.

It has been found that when a ring-like member such as 6 in Figs. 6, 7 and 8 is substituted for other coupling means between a piezoelectric unit and a diaphragm, the ratio of acoustic output to applied voltage is increased and, consequently, a device using this new coupling means may be reduced in size. The increase in sensitivity probably results from the better distribution of forces over the diaphragm so that the net volume displaced by the diaphragm is greater, and from the more favorable mechanical impedance match between the piezoelectric unit and the diaphragm. Due to the thinness of the ring, very little motion is lost between the piezoelectric unit and the diaphragm, and due to the yielding nature of the ring, it does not appreciably constrain the flexing motion of the piezoelectric unit.

It is not necessary that the member 6, referred to for convenience in these specifications and the appended claims as a ring, be of circular form. Indeed, it may be square or elliptical or any other suitable geometric shape and of any suitable cross-sectional shape, the essential feature being a large area of contact with the diaphragm. Furthermore, the ring need not be a separate member cemented to the diaphragm. It may be formed as a part of the diaphragm, for example, as shown in the sectional view, Fig. 9. In this figure the diaphragm 7a is molded or otherwise formed with a ring 6a projecting from one side. The diaphragm 7a with its integral ring 6a may be substituted for diaphragm 7 and cemented ring 6 in the device of Figs. 1 to 6.

When used as an earphone, the device of Figs. 1 to 11 may be held close to the user's ear in any suitable manner. One convenient arrangement for an earphone of small size is to provide the phone with a metal shell 8 (shown in Fig. 1, and represented in dotted outline in Fig. 7) having a projection 8a which is adapted to engage a recess in an ear insert member or earpiece of the type commonly used with hearing aid devices. The shell 8 may be secured to the phone by providing threads on the outer surface of wall section 1b or simply by cementing to the phone. It may serve to clamp the diaphragm 7 to the wall section 1b, if the diaphragm is not cemented thereto. Alternatively, the shell 8 may be omitted and the earphone directly connected to the ear insert by cementing it thereto or by providing a threaded recess in the insert

and suitably engaging threads on the outer surface of wall section 1a.

To connect an external electrical circuit to the terminals 4, 5 a connector 9 is provided. It comprises a main body member 10 molded of suitable insulating material and having a flat face 10a. Outwardly projecting flanges 10b, 10b are adapted to engage connector retaining flanges 1c, 1c of the connector receptacle which are carried by the main wall section 1a of the acoustic device. Projections 10c, 10c at one end of the connector serve as stops which engage ends of retainer flanges 1c to locate the connector on the device. The connector is provided with two main recesses 11, 11 separated by a thin wall 12. Within each recess is disposed a generally U shaped spring strip contactor member, designated as 13 and 14, formed of thin spring brass or other suitable material. When the connector 9 engages the receptacle, the contactor members 13 and 14 register with terminals 4 and 5 and are slightly compressed so as to be held against said terminals under slight pressure. Two slots 15, 15 formed in the connector body 10 extend from one end face into the recesses 11 and outwardly toward the flat face 10a. Flexible lead wires 16, 16 fit into the slots with a tight press fit and are further held by a suitable cement 15a (Figs. 7 and 11). The wires are soldered to the inner ends 13a, 14a of the contactor members. In Fig. 10 part of contactor member 13 is broken away to reveal the soldered joint. The outer ends 13b, 14b of the contactor members fit into shallow extensions 11a, 11a of recesses 11, 11. A thin plate 17 of suitable insulating material is cemented into a registering cavity 17a to form an overhanging portion of the body which loosely holds the ends 13b, 14b of the contactor members in alignment in their recesses. In Fig. 10 the plate 17 is partly broken away to better reveal the inner construction.

It will be noted that an acoustic device embodying the features of this invention may be made very small and compact so as to be very inconspicuous when worn as an earphone. Several features contribute to this compactness. They include (a) the use of a thin piezoelectric actuating unit disposed in a shallow housing flatwise adjacent the main wall section, (b) the use of a thin ring of yielding vibration conductive material to couple the actuating unit to the diaphragm, (c) the use of a receptacle carried by the main wall section of the device and adapted to receive in sliding engagement a thin connector and (d) location of the ends of the receptacle terminals adjacent the edges of the piezoelectric unit in a space otherwise unoccupied and in positions adapted for ready connection to the leads of the unit.

The relatively long U shaped construction of the contactor members in the connector insures sufficient pressure to obtain good electrical connections and to hold the connector in place in the receptacle without requiring great accuracy in the fabrication of the parts. Since the wires 16, 16 are both pressed and cemented into the slots 15, 15 most of the stress on the wires is taken by the main body 10 rather than by the contactor members 13, 14.

It is usually unnecessary to provide polarized terminals for piezoelectric devices but it will be observed that the connector provided by this invention may engage the receptacle from either side thus facilitating reversal of polarity and rapid and easy connection. However, if desired,

the connector retaining flanges 1c, 1c may be provided with a barrier to prevent entrance of the connector from one side.

Although in many cases it is advantageous, in the interest of compactness and simplicity, to embody the connector retaining flanges as integral parts of the electrical apparatus and to carry the receptacle terminals in a wall section of the apparatus, as illustrated in the acoustic device of Figs. 1 to 11, it may be desirable in other cases to provide as a separate unit a connector receptacle which may be secured to electrical apparatus by screws or rivets. Figs. 12 to 16 illustrate such a separate receptacle. It comprises an insulating base 18, having connector retaining flanges 18a, 18a adapted to engage the flanges 10b of the connector. Generally, U shaped contact members 19 and 20 formed of thin sheet metal are carried by the insulating base and may conveniently be secured thereto by forcing their ends through suitable apertures in the base. If desired, the ends may be twisted as shown in Figs. 13 to 16. Holes 21, 21 are provided to accommodate screws or rivets for securing the receptacle to the electrical apparatus with which it is to be associated. When connector 9 is inserted in the receptacle, the contact members 19 and 20 engage contactor members 13 and 14 of the connector and sufficient pressure is maintained by members 13 and 14 to maintain good contact and to insure that the connector remains in position. To facilitate mounting of the receptacle, the contact surfaces of members 19 and 20 are made somewhat shorter than the corresponding contact surfaces of members 4 and 5 of the acoustic device so that the projecting ends are grouped within a relatively small space. To mount the receptacle on any device it is only necessary to provide three holes in the device, two of the holes registering with holes 21, 21 to accommodate mounting rivets or screws and the third hole providing clearance for the ends of contact members 19 and 20. In Fig. 16 the receptacle is shown riveted to a portion of a thin sheet-like member such as the housing of an amplifier used in a portable hearing aid. Eyelets 22, 22 secure the receptacle to the wall 23 and the extended ends of contacts 19 and 20 project through an opening 23a to a position permitting ready connection to the electrical circuit.

What I claim is:

1. A connector comprising a relatively thin body member of generally rectangular shape bounded partially by a flat face of greater length than width, and by an end face, said body member having recesses therein extending inwardly from said flat face, said recesses comprising a first pair of parallel elongated grooves of generally rectangular cross-section and of greater length and depth than width extending lengthwise of said face and spaced from each other and from the bounding edges of said faces, a second pair of parallel elongated grooves of smaller cross-section extending between the ends of said first pair of grooves and the said end face of said body, a relatively shallow transverse recess of greater length and width than depth disposed with its length crosswise of said second grooves, a bent spring-strip contact of generally U shape disposed in each of said first pair of grooves with one leg of said U resting upon the base of said groove and the other leg protruding beyond the surface of said flat face along a portion of the length of said groove, the end portion of said protruding leg being offset inwardly and extending

beyond the nearest edge of said transverse recess, a lead-wire disposed in each of said second grooves and in electrical engagement with a leg of the contact, a relatively thin plate disposed in said transverse recess with the lower face thereof in engagement with the said offset end portions of said contacts.

2. An assembly particularly adapted for interconnecting electrical circuits, said assembly comprising the combination of: a base section having a plate-like wall of insulating material; a slider section of insulating material adapted for sliding movement on a face thereof while said face is in flatwise relationship to a face of the wall of said base section; interlocking means on said base and on said slider section adapted for mutual interlocking relationship to constrain the slider against motion out of said face to face relationship with said wall while permitting the slider to be connected to and disconnected from the base by sliding it rectilinearly over the said wall; contacts disposed on said wall in symmetrical relation to said interlocking means; contactors on said slider section for engagement with the contacts of said wall when the two sections are interlocked in mutual sliding engagement in said face to face relationship; conductors secured in electrical engagement with said contactors and passing outwardly from said slider in a direction paralleling the sliding direction of the latter; stop means on said slider section for limiting the motion of the latter in the direction of strain on said conductors.

3. An assembly particularly adapted for interconnecting electrical circuits, said assembly comprising the combination of: a plate-like base section of insulating material having at least a pair of elongated strip-like contacts disposed on an outer face thereof in substantial parallelism and in spaced-apart relationship; a slidable plate-like removable section having a flat face adapted for sliding movement over the outer face of said base; means on said base and on said slidable section adapted for mutual interlocking engagement to constrain the slider against motion out of its face to face relation to said outer face of the base, while permitting the slider to be connected to and disconnected from the base by sliding it in directions paralleling the longitudinal axes of said contacts, said means being disposed symmetrically with respect to said contacts; contactors on said removable section for engagement with the contacts of said base when the two sections are mutually interlocked in sliding engagement; conductors secured in electrical engagement with said contactors and passing outwardly from said slidable section in a direction paralleling the sliding direction of the latter; stop means on said slidable section for limiting the motion of the latter in the direction of strain on said conductors.

4. An assembly particularly adapted for interconnecting electrical circuits, said assembly comprising the combination of: a plate-like base section having an open-ended channel-shaped chamber whose base is of insulating material and is substantially flush with an outer face of said plate-like base; a pair of contacts in said chamber disposed symmetrically on opposite sides of the longitudinal center line of said chamber; a slidable plate-like removable section having a substantially rectangular face, and adapted for sliding movement into said chamber from either end of the latter in a direction parallel to an edge of said face while the latter is

in face to face relation to the base of said chamber; contactors on the removable section to engage with the contacts of the base section when the removable section is slidably positioned in said chamber; conductors secured to said contactors and passing outwardly from said slidable section in a direction parallel with the sliding direction of the latter; means in said chamber and on said slidable section adapted for mutual interlocking engagement to constrain the slider against motion out of its face to face relationship with the base of said chamber while permitting the slidable section to be connected to the base section by rectilinear sliding motion in the direction of strain on said conductors, and to be disconnected therefrom by rectilinear sliding motion opposite to the direction of strain on said conductors; and stop means on said slidable section for limiting the motion of the latter in the said direction of strain, and to position said slidable section in said chamber with its contactors in electrical engagement with said contacts.

5. An assembly particularly adapted for interconnecting electrical circuits, said assembly comprising the combination of: a base section having a plate-like wall of insulating material; a pair of elongated strip-like contacts disposed flatwise on an outer face of said wall in substantial parallelism and in spaced-apart relationship, opposite ends of said contacts extending through said wall to the inner face thereof; a pair of elongated upstanding guides disposed on said outer face on opposite sides of said contacts and in symmetrical relationship thereto, to define with said wall an open-ended channel-shaped chamber, the base of which is flush with said outer face; a plate-like slider section adapted to slide into said chamber from either end thereof while having one of its faces disposed in face to face relationship with the base of said chamber; a pair of resiliently mounted contactors embedded in said slider for engagement with said contacts when said slider is assembled with said base section in the said face to face relationship with the base of said chamber; a pair of conductors secured in electrical engagement with said contactors and passing outwardly from said slider in a direction paralleling the sliding direction of the latter; interlocking flanges on said guides and on opposite sides of said slider for constraining the slider against motion out of said face to face relationship with the base of said chamber while permitting the slider to be connected to the base section by rectilinear sliding motion in the direction of strain on said conductors, and to be disconnected therefrom by rectilinear sliding motion opposite to the said

direction of strain; and lateral stop means on said slider adapted for engagement with an end of a guide to limit the motion of the slider in the said direction of strain and to position said slider in said chamber with its contactors in electrical engagement with said contacts.

6. A connector adapted for connection with a receptacle by rectilinear sliding motion and comprising: a relatively thin body member bounded partially by a flat face and contiguous side faces, said body having a pair of elongated recesses extending inwardly from said flat face and thence extending longitudinally under an overhanging portion of said flat face; a pair of bent spring-strip contacts disposed one in each of said recesses and adapted to be joined electrically to lead-wires which enter said body through one of said side faces and extend longitudinally into said recesses, each of said contacts having an intermediate portion thereof resiliently mounted to project outwardly beyond the surface of said flat face and having an end portion adjacent said intermediate portion disposed under the overhanging portion of said flat face to limit the projection of said resilient intermediate portion; and a pair of flanges adapted to interlock with complementary flanges on said receptacle, said flanges being disposed in substantial parallelism on opposite sides of said flat face so as to be in symmetrical relation to said pair of recesses.

7. A connector adapted for connection with a receptacle by rectilinear sliding motion, said connector comprising: a body member bounded by a flat face and an adjoining end face, said body member having a pair of elongated recesses extending inwardly from said flat face and thence extending longitudinally under an overhanging portion of said flat face, said recesses being of generally rectangular cross-section; a pair of bent spring-strip contacts of generally "U" shape disposed one in each of said recesses with one leg of said "U" above the other, with a surface portion of said upper leg projecting outwardly beyond the surface of said flat face, and with the end portion of said leg restrained under said overhanging portion; a pair of conductors disposed longitudinally in said recesses in electrical engagement with said lower legs and extending out of said body through an end face thereof; and a pair of flanges adapted to interlock with complementary flanges on said receptacle, said flanges being disposed substantially in parallelism on opposite sides of said flat face and of said recesses so as to be in symmetrical relation with the latter.

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