United States Patent [19]

Michaels

[11] **3,745,515**

[45] **July 10, 1973**

[54] **TEE CONNECTOR FOR WIRING HARNESSES**

[75] Inventor: **Leonard H. Michaels,** Naperville, Ill.

[73] Assignee: **Molex Incorporated,** Downers Grove, Ill.

[22] Filed: **Apr. 7, 1972**

[21] Appl. No.: **242,055**

[52] **U.S. Cl.** ..... **339/156 R,** 339/206 P

[51] **Int. Cl.** **H01r 13/50**

[58] **Field of Search** ..... 339/32, 33, 59, 63, 339/153–159, 176 MP, 196, 200, 206, 210

[56] **References Cited**

UNITED STATES PATENTS

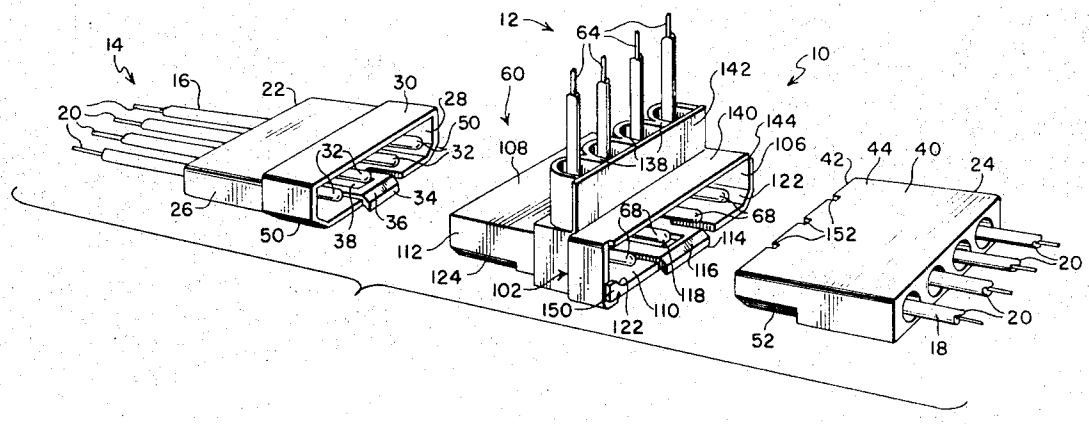
3,646,499	2/1972	De Lano et al.	339/156 R X
2,832,942	4/1958	French	339/217 R UX
3,335,393	8/1967	Anderson	339/176 MP X
3,668,615	6/1972	Bury	339/206 R
3,530,428	9/1970	Zak	339/217 S
3,193,787	7/1965	McGhee	339/176 MP X

Primary Examiner—Marvin A. Champion
Assistant Examiner—Lawrence J. Staab
Attorney—Richard D. Mason, Philip M. Kolehmainen et al.

[57] **ABSTRACT**

A tee connector is connected between adjacent end connectors of a pair of main circuit wiring harnesses in a modular wiring system to provide a branch circuit take off. The connector includes an insulating housing having coupling portions each engageable with one of the end connector housings, and further includes a plurality of conductive terminals engageable with terminals of the end connectors. The housing of the tee connector includes cavities containing the terminals, each cavity including a main passage extending between the coupling portions of the housing and a transversely extending branch passage. Each terminal includes a main body portion having electrical contact disposed at the ends thereof and a branch body portion including flanges crimpable about a branch circuit wire. The terminal includes stop means for holding itself in position in the insulating housing, and the housing includes a housing portion which is separable from the main housing in order to expose the inside of the terminal receiving cavities for mounting of the terminals.

9 Claims, 8 Drawing Figures



PATENTED JUL 10 1973

3,745,515

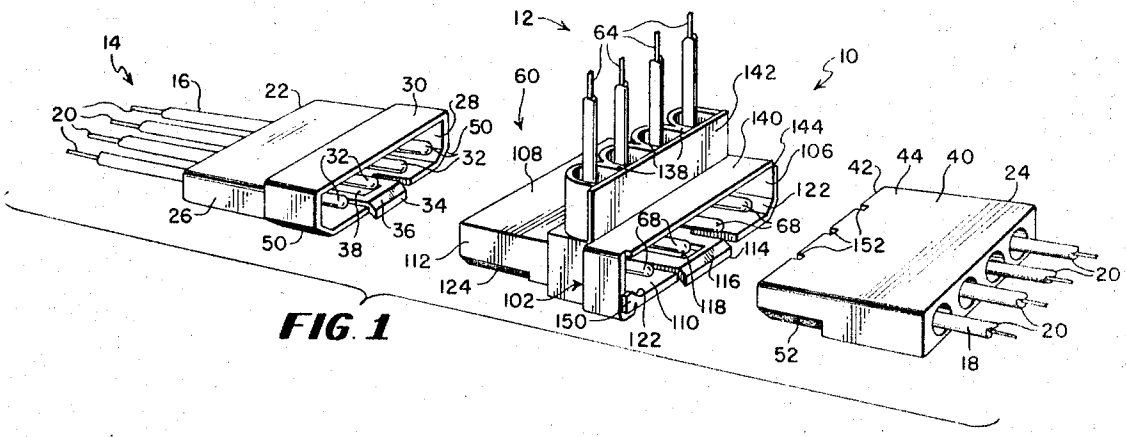
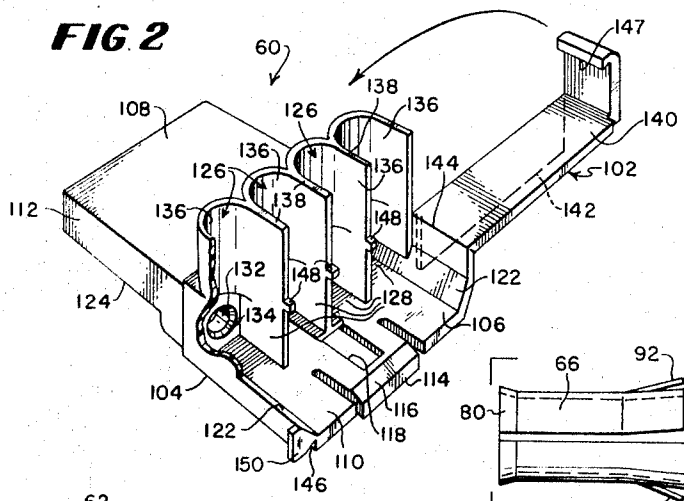


FIG. 1

FIG. 2



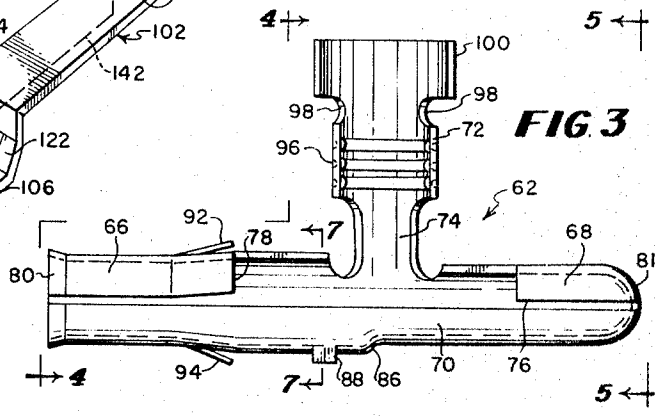


FIG. 3

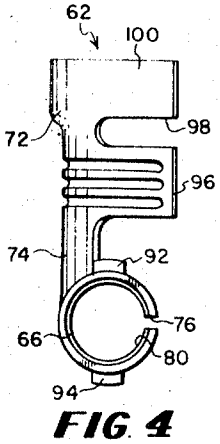


FIG. 4

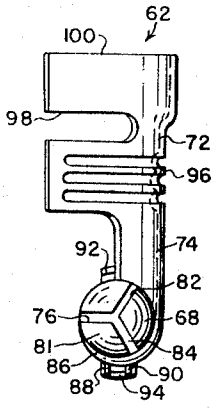


FIG. 5

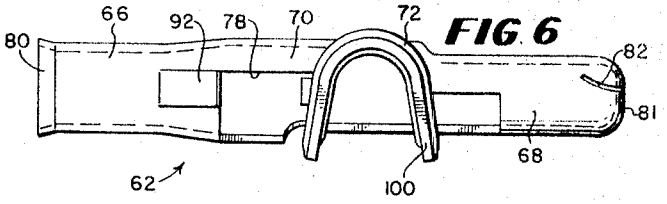


FIG. 6

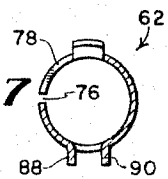


FIG. 7

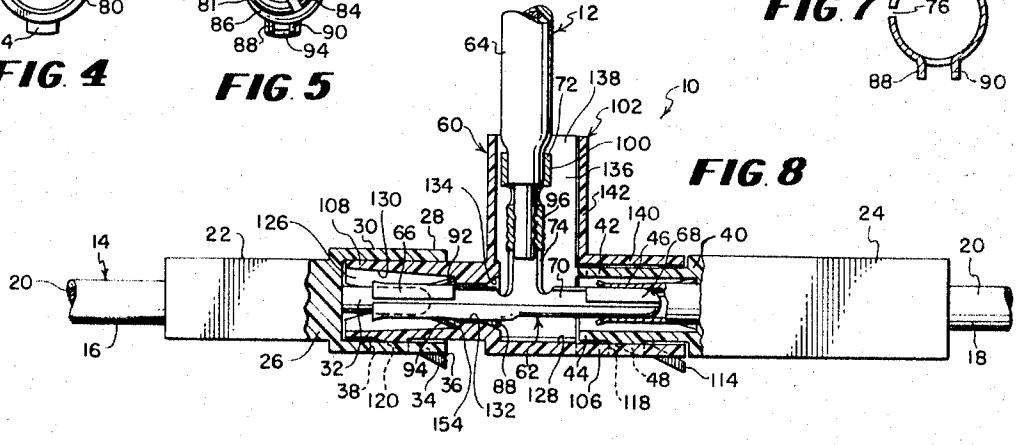


FIG. 8

TEE CONNECTOR FOR WIRING HARNESSES

The present invention relates to a tee connector for providing a branch circuit connection between connectors of wiring harnesses or the like.

The use of modular wiring harness units having easily assembled plug-in connectors is replacing traditional hand wiring of discrete wires in many areas. Among the advangages of the modular approach are centralized manufacture and assembly of the components, ease of assembly with consequent reduction in labor expense and installation time, and uniform quality of installation without wiring errors or the like. One example of an area in which the use of modular wiring techniques is currently receiving attention is that of home wiring. It would be desirable to be able to install the wiring in a home under construction using prefabricated assembled units plugged into one another without the services of expensive and highly skilled labor.

One approach to modular wiring that has been used in the past is to utilize wiring harnesses including several wire conductors and end connectors having housings that are connected together to extend the main wiring harness conductors to desired areas. Branch circuits for outlets, switches, fixtures and the like are connected to the main wiring harness at desired locations. In one arrangement, the insulation is removed from the main harness wires, and a connector is attached to the wires and branch wire conductors extend from from the connector. This approach is not satisfactory due to the necessity for stripping the harness wires and for assembling the branch circuit connector and conductors.

Among the important objects of the present invention are to provide an improved tee connector for use in modular wiring system; to provide a tee connector including a novel arrangement of a huosing and a plurality of terminals; to provide a novel terminal structure for use in a tee connector; to provide a novel tee connector housing which facilitates assembly of the complete tee connector; and to provide an improved tee connector capable of being plugged in between the end connectors of wiring harnesses to create a branch circuit connection.

In brief, the above and other objects and advantages of the invention are attained by the provision of a tee connector including an insulating housing enclosing a pluraity of conductive terminals connectable to branch circuit wires. The housing includes two coupling portions engageable with cooperating coupling portions of end connectors of a pair of wire harnesses, and the terminals include contact portions engageable with cooperating terminals of the harness end connectors.

The tee connector housing includes cavities in which the terminals are received. To facilitate assembly, a portion of the housing may be opened to expose parts of the cavities so that the terminals may be inserted therein. Each cavity includes a first passage extending between the coupling portions of the housing and a branch passage extending to the exterior of the housing. Each terminal includes a branch portion extending into the branch passage with contact structure crimpable onto a branch conductor wire. Preferably the tee connector is preassembled to branch conductors, and if desired to a branch circuit component, so that plugging of the connector between end connectors of two wiring harnesses is all that is required at the site to complete the connection of the branch circuit.

The invention together with the above and other objects and advantages may best be understood from the following detailed description of an embodiment of the invention illustrated in the drawing, wherein:

FIG. 1 is a perspective view, with parts of the wiring broken away, of a tee connector constructed in accordance with the principles of the present invention and of a pair of wiring harness end connectors with which the tee connector may be used;

FIG. 2 is an enlarged partly broken away perspective view of the housing of the tee connector of FIG. 1;

FIG. 3 is an enlarged side elevational view of the tee connector terminal of the tee connector of FIG. 1;

FIG. 4 is an end elevational view of the terminal of FIG. 3 taken from the line 4—4 of FIG. 3;

FIG. 5 is an end elevational view of the terminal of FIG. 3 taken from the line 5—5 of FIG. 3;

FIG. 6 is a top plan view of the terminal of FIG. 3;

FIG. 7 is a sectional view taken along the line 7—7 of FIG. 3; and

FIG. 8 is an enlarged vertical sectional view of the tee connector and end connectors of FIG. 1, partly in section, and illustrating the orientation of structure when the branch circuit connection has been completed.

With reference now to the drawing, there is illustrated a tee connector designated as a whole by the reference numeral **10** and constructed in accordance with the principles of the present invention. Referring more specifically to FIGS. **1** and **8**, the tee connector **10** is used to provide a connection to a branch circuit indicated by the reference numberal **12** extending from an intermediate point along a main circuit generally designated by the reference numeral **14**.

The circuit arrangement illustrated in part in FIGS. **1** and **8** is a portion of a modular wiring system made possible through the use of the novel tee connector **10** of the present invention. Preferably the main circuits of the modular system, such as the main circuit **14**, are made up of a series of wiring harnesses which are plugged together in end-to-end relationship without the necessity of any on site preparation of or alteration of the harnesses. In FIGS. **1** and **8** there are illustrated portions of two such wiring harnesses which are identical to one another and which are designated by the reference numerals **16** and **18**. In accordance with the invention, the tee connector **10** is plugged between the harnesses **16** and **18** thereby establishing a connection to branch circuit **12** from main circuit **14** without the necessity of any on site wiring operations such as must be performed by a skilled electrician in conventional wiring systems.

Each of the harnesses **16** and **18** may be of conventional construction and includes, in the illustrated arrangement, a group of four conductors **20** extending between a pair of cooperating pluggable end connectors. Although only adjacent end connectors **22** and **24** of harnesses **16** and **18** are illustrated, it will be understood that each harness includes an end connector at each end and that each harness incudes one end connector **22** and one end connector **24**. The illustrated main and branch circuits **12** and **14** include four wires because this arrangement has advantages in typical home wiring systems. However, the invention is applicable to all types of modular wiring situations when more or fewer wires may be used.

End connector **22** (FIGS. **1** and **8**) includes a housing **26** formed of insulating material provided with a socket

28 defined by a circumferential wall 30. Recessed within the socket 28 are a series of four male pin type plug terminals 32 each electrically connected to a corresponding wiring harness conductor 20. The circumferential wall 30 of the housing 26 also defines a resiliently displaceable latching tongue 34 including an inclined cam surface 36 and a latch opening 38.

End connector 24 (FIGS. 1 and 8) mates with end connector 22 and includes an insulating housing 40 having a nose or plug end portion 42 defined by a circumferential wall 44. Recessed within the plug portion 42 are a group of four female socket type terminals 46 each electrically connected to a corresponding one of the wiring harness conductors 20. The circumferential wall 44 of the housing 40 is provided with a latching protuberance 48 projecting outwardly from its external surface.

In accordance with known practice, a series of harnesses such as wiring harnesses 16 and 18 are connected in end-to-end relation by interconnecting end connectors such as the connector 22 with cooperating end connectors such as the end connector 24. The connectors 22 and 24 are provided with beveled corners 50 and 52 respectively (FIG. 1) to assure that the end connectors can be oriented in only one way with respect to one another thereby to assure that the conductors 20 maintain proper orientation throughout the run of the main circuit 14. When the connectors are plugged together, the nose or plug portion 42 of the housing 40 enters the socket 28 of the housing 26. The latch protuberance 48 engages the inclined cam surface 36 forcing the latching tongue 34 outwardly. Upon full insertion, the protuberance 48 is received within latch opening 38 to prevent separation of the connectors 22 and 24 until such time as the latching tongue 34 is lifted. When the connectors are joined, the pin terminals 32 enter the socket terminals 46 in order to provide an electrical connection between the coresponding wires 20 of the wiring harnesses.

In accordance with an important feature of the present invention, the tee connector 10 is capable of being plugged between the end connectors 22 and 24 to provide a take off for the branch circuit 12. For example, in a typical home wiring situation, the conductors 20 could comprise No. 10 or No. 12 AWG solid wire conductors capable of handling typical household current loads. Each harness may have a length such as ten feet or so providing a junction of end connectors at sufficient frequency so that service can be provided for a typical arrangement of sockets, switches, fixtures and the like. Where a branch circuit is desired for any such use, a tee connector 10 is connected between the end connectors 22 and 24.

Referring now more specifically to the structure of the tee connector 10, the connector includes a novel insulating housing designated as a whole by the reference numeral 60 and designed to mate with both the socket 28 of the housing 26 of the end connector 22 and with the plug portion 42 of the housing 40 of the end connector 24. In addition, the tee connector 10 also includes a series of four novel terminals each designated as a whole by the reference numeral 62. Each terminal 62 is constructed to provide connections to the pin terminals 32 associated with the end connector 20 and with the socket terminals 24 associated with the end connector 24 and also to provide connections to a series of branch circuit conductors 64 forming part of the branch circuit 12.

An important aspect of the present invention resides in the structure of the novel tee connector terminals 62, one of which is illustrated in detail in FIGS. 4–7. With reference more specifically to these figures of the drawing, the terminal 62 is formed from a blank of sheet metal such as cartridge brass, modified copper, steel, or the like. The terminal may be formed very economically in a series of high speed progressive die stamping operations carried out by conventional equipment.

In general, the tee connector terminal 62 includes a pair of spaced contact portions 66 and 68 each adapted to establish an electrical connection with terminals of the end connectors 22 and 24. The contact portions 66 and 68 are disposed at the opposite ends of a main body section 70 of the terminal 62. In addition, the terminal includes an additional electrical contact or connection structure 72 disposed on a transversely extending branch body portion 74. The electrical connection structure 72 is adapted to be interconnected with a corresponding one of the branch circuit wires 64.

The main body section 70 is substantially cylindrical in form. In the regions of the contact portions 66 and 68 the main body section 70 is substantially fully cylindrical and includes a longitudinal seam 76. In the central region of the main body section 70, a portion of the cylindrical body of the terminal is removed to provide an opening or recess 78 defined at one side by the seam 76. The contact portion 66 comprises a female socket type cylindrical contact sized to receive the male pin terminal 32 of the end connector 22 of the wiring harness 16. The outermost end of the contact 66 is provided with an outwardly tapered flare or bevel 80 to facilitate insertion of the pin terminal.

Contact portion 68 comprises a male pin type contact sized to cooperate with the female socket terminal 46 of the end connector 24 of the wiring harness 18. The pin contact 68 is provided with a rounded or tapered nose portion 81 and, as can be seen in FIGS. 3, 5 and 6, the seam 76 extends to the nose portion where it joins a pair of additional symmetrically located side seams 82 and 84.

The diameter of the contact 66 is somewhat larger than the diameter of the contact 68 in order that the contacts may accommodate the cooperating terminals of end connectors 22 and 24. Intermediate the contact portions 66 and 68 the main body section 70 of the terminal 62 includes a flared, transitional section 86 (FIG. 3) providing the necessary increase in diameter. In order to hold the terminal 62 within the housing 60 of the tee connector 10 in a manner described in more detail below, the main body section 70 is also provided with a stop structure in the form of a pair of flanges 88 and 90 struck outwardly from the metal of the terminal. In addition, immediately inwardly of the contact portion 66, the wall of the terminal is provided with a pair of resilient, inwardly deflectable, outwardly angled arms or wings 92 and 94.

As indicated above, the contact or connection structure 72 disposed on the branch body section 74 serves the purpose of interconnecting the terminal 62 with a wire 64 of the branch circuit 12. For this purpose, the connection structure 72 is provided with a wire gripping section 96 preferably in the form of crimpable flanges. In accordance with known practice, the wire

gripping section includes grooves or serrations to assure firm contact between the terminal 62 and a wire to which the terminal is connected. Outward of the wire gripping section 96, and separated therefrom by a pair of notches 98, is an insulation gripping section 100 in the form of a pair of crimpable flanges somewhat larger than the flanges of the wire gripping section 96. The insulation gripping section 100 prevents the insulation from working back away from the terminal to expose bare wire and provides strain relief.

Referring now to FIG. 8, the terminal 62 is illustrated after a connection has been made to a corresponding wire 64 of the branch circuit 12. It can be seen that the wire gripping section 96 is crimped around the wire conductor, while the insulation gripping section 100 is similarly crimped around the insulation surrounding the conductor. An advantage of the present invention is that the terminal 62 can be crimped to the wires 64 in an automatic operation capable of being performed by available terminal crimping equipment. One type of commercially available machine can be used to cut the branch circuit wires to a desired length, to strip the insulation from an end of the wire, and to attach the terminal 62 to the end of the wire. As a result, the branch circuit including the wire 62 and the tee connector 10 can be prefabricated easily and inexpensively to permit connection on site at a later time by a simple plug-in operation. In addition, if desired, the wires 64 of the branch circuit may be preconnected to a switch, socket, fixture, or the like which is energized by the branch circuit.

Another important aspect of the present invention relates to the structure of the tee connector housing 60. In accordance with the invention, the housing 60 includes a portion or segment generally designated as 102 separable from the main or principal portion of the housing in order to facilitate mounting of the terminals 62 within the housing.

Referring more specifically to the structure of the housing 60, the housing includes a main body section 104 including at the opposite ends thereof a socket 106 and a nose or plug 108 engageable respectively with the end connectors 24 and 22 of the wiring harnesses 18 and 16. The socket 106 is formed by a circumferential wall 110, and the socket is sized to receive the nose or plug portion 42 of the housing 40 of the end connector 24. The nose or plug section 108 is defined by a circumferential wall 112, and is sized to be received within the socket 28 of the housing 26 of the end connector 22.

The walls 110 and 112 disposed at the oppsoite ends of the main body section 104 are provided with latching structure for holding the tee connector 10 in place between the end connectors 22 and 24. More specifically, the wall 110 is provided with a resiliently deflectable latching tongue 114 similar to the tongue 34 of the housing 26 and including an inclined cam surface 116 and a latch opening 118 capable of receiving the latch protuberance 48 of the housing 40. Conversely, the circumferential wall 112 includes a latching protuberance 120 (FIG. 8) similar to the latching protuberance 48 of the housing 40 and receivable in the latch opening 38 of the end connector 26. Proper orientation of the end connectors 22 and 24 with the tee connector 10 and thus with one another is assured by the use of beveled surfaces 122 and 124 associated respectively with the walls 110 and 112.

In order to receive the tee terminals 62, the interior of the tee connector housing 60 is provided with a series of four substantially identical cavities 126. Each such cavity includes a first passage 128 extending from the socket 106 through the body of the housing 60 to the region of the nose or plug portion 108. A cross sectional view of one such through passage appears in FIG. 8 where in can be seen that adjacent the nose or plug portion 108 the passage includes a flared or truncated cone shaped segment 130. Adjacent the socket 106, the passage 128 opens into the region or recess defined by the circumferential wall 110. Between this region and the segment 130 of the passage, there is provided a reduced diameter opening 132, one end of which is provided with an entrance bevel 134.

Each cavity 126 also includes a transversely extending branch passage 136 intersecting and extending away from the main passage 128 adjacent the reduced diameter opening 132. In order to prevent undesirable contact betwene adjacent terminals 62, the passages 128 are separated from one another by intermediate portions of the housing 60 and the branch passages 136 as well as parts of the passages 128 are separated from one another by walls 138. The intermediate walls 138 are discontinued in the region of the socket 106 in order to provide clearance for insertion of the nose or plug portion 42 of the end connector housing 24.

Assembly of the tee connector 10 is facilitated by the arrangement of the housing 60 including the separable housing portion 102. A comparision of FIG. 1 and FIG. 2 indicates that the separable housing portion 102 includes a substatnial portion of the circumferential wall 110 defining the socket 106, this portion being designated by the reference numeral 140. In addition, separable portion 102 also includes a wall designated by the reference numeral 142 common to each of the branch passages 136.

In order to permit separation of the housing portion 102 from the main housing 60, an integral hinge 144 is formed at one of the corners of the socket 106. In order to hold the housing in its closed, operational position, there is provided a latching recess 146 (FIG. 2) adjacent the opposite corner of the socket 106. A latch protuberance 147 (FIG. 2) carried by the free end of wall 140 seats in the recess 146 when the portion 102 is in the position illustrated in FIG. 1. The material of the connector housing 60 is sufficiently resilient to permit latching and unlatching of separable portion 102. Rigidity of the fully assembled structure is assured by a series of support shoulders 148 projecting from the intermediate walls 138 and engageable with the underside of the wall 140. In addition, axial movement of the portion 102 is prevented by engagement of the wall 142 with the sides of walls 138 and by engagement of the wall 140 with a support flange 150 disposed adjacent the end of the recess 146 (FIGS. 1 and 2). As shown in FIG. 1, the housing 40 of end connector 24 is provided with notches 152 to prevent interference iwth the support shoulders 148.

As indicated above, the branch circuit wires 64 are preassembled to tee terminals 62, and if desired to other components of the branch circuit. In order to complete assembly of the tee connector 10, the separable portion 102 is unlatched from the main housing 60 and moved to the open position illustrated in FIG. 2. Since the separable portion 102 includes substantial portions of the housing 60 defining the main and

branch passageways **128** and **136**, these passages are exposed to a large extent when the separable portion **102** is opened.

At this point, the terminal **62** may be inserted into the housing **60** of the tee connector **10**. More specifically, the socket contact portion **66** of each tee terminal **62** is sized to fit within the reduced diameter opening **132** of the main passage **128**. Entrance bevel **134** facilitates this loading operation. As the contact **66** is inserted, the resilient arms or wings **92** and **94** are depressed inwardly by engagement with the housing **60** and are capable of being moved through the reduced diameter opening **132**. As can be seen in FIG. **8**, upon full insertion these arms or wings resiliently snap back to their initial position to engage a shoulder or surface **154** (FIG. **8**) formed at the juncture of the opening **132** and the flared passage segment **130**. These arms or wings **92** and **94** therefore prevent withdrawal of the terminal from the housing.

As also appears in FIG. **8**, the flanges **88** and **90** struck from the body of the tee terminal **62** engage the other end of the reduced diameter opening **132** to limit insertion of the terminal to the desired extent. In the illustrated arrangement, the flanges **88** and **90** engage the entrance bevel segment **134** of the reduced diameter opening **132**.

After the tee terminal **62** and attached branch circuit conductor **64** have been assembled by insertion of the terminal through the reduced diameter opening **132**, the segment **102** of the housing **60** of the tee connector is moved from the open position of FIG. **2** to the closed position illustrated in FIGS. **1** and **8**. This completes the assembly of the tee connector **10** and at this point the tee connector is ready for connection between the end connectors **22** and **24** of main circuit wiring harnesses **16** and **18**. The fully assembled arrangement is illustrated in FIG. **8** where it can be seen that the branch circuit wires **64** are electrically connected to both of the corresponding main circuit conductors **20** by the tee terminal **62**, and the tee terminal housing **60** is held firmly in position between the end connector housings **26** and **40**.

In some situations it may not be necessary to extend all four main circuit wires into the branch circuit. In this case, one or more of the tee terminals **62** may be inserted in a blank condition i.e., without being connected to a branch circuit conductor **64**.

Although the invention has been described with reference to details of the illustrated embodiment, it should be understood that other modifications and alterations may be devised by those skilled in the art. Such details should not be understood to limit the invention as defined in the following claims.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A tee connector for use with wiring harnesses of the type including mating plug and socket connectors having male and female socket and pin terminals of mating configuration, said tee connector comprising:

a housing formed of insulating material and including a main circuit portion and a branch circuit portion extending transverse to said main circuit portion;

a plug and a socket disposed at opposte extremities of the main circuit portion and adapted to be connected respectively with a wiring harness socket connector and a wiring harness plug connector;

a plurality of substantially straight, parallel main circuit passages in the main circuit portion of said housing extending between said plug and said socket, each main circuit passage including a reduced diameter neck portion flanked on both sides by passage portions of larger diameter than said neck portion;

a plurality of parallel branch circuit passages extending from said main circuit portion of said housing through the branch circuit portion of said housing to the exterior of said housing, each branch circuit passage intersecting one said main circuit passage at an intersection adjacent said neck portion;

a plurality of identcial tee terminals each having a main circuit segment slidably receivable in one said main circuit passage and each having a branch circuit segment receivable in one said branch circuit passage,

said housing including a separable segment attachable to said housing after insertion of said tee terminals and composed of a first wall common to each of said branch circuit passages and extending throughout the entire length of said branch circuit passages and a second wall transverse to said first wall, said second wall being common to each of said main circuit passages and extending from said intersections to the ends of said first passages opposite said neck portions;

pin and socket contacts of mating configuration formed on oppsoite ends of each said main circuit segment engageable respectively with the wiring harness socket and pin terminals;

a wire crimp contact disposed on the end of said branch circuit segment; and

said main circuit segment of each said tee terminal including retaining means engageable with said housing adjacent said neck portion of each said main circuit passage for holding said tee terminal in said housing prior to attachment of said separable segment.

2. The tee connector of claim **1**, further comprising latch means for releasably holding said separable segment against said housing.

3. The tee connector of claim **2**, an integral hinge interconnecting said housing and said separable segment.

4. The tee connector of claim **1**, said retaining means including first and second projecting stop means spaced from one another and disposed along the main circuit segment of said tee terminal.

5. The tee connector of claim **4**, one said stop means comprising at least one resilient, inwardly displaceable latch finger permitting mounting of the terminal through said neck portion.

6. The tee connector of claim **1**, said socket including a circumferential wall formed in part of a wall of said separable segment.

7. The tee connector of claim **1**, said tee terminal touching said housing only in the region of said neck portion.

8. The tee connector of claim **3**, said integral hinge being parallel with said main circuit passages.

9. The tee connector of claim **1**, said main circuit passages all lying in a first common plane, and said branch circuit passages all lying in a second common plane normal to said first common plane.

* * * * *