Sept. 30, 1941. C. E. WADE 2,257,317

LINE CONNECTOR

Filed Aug. 15, 1938

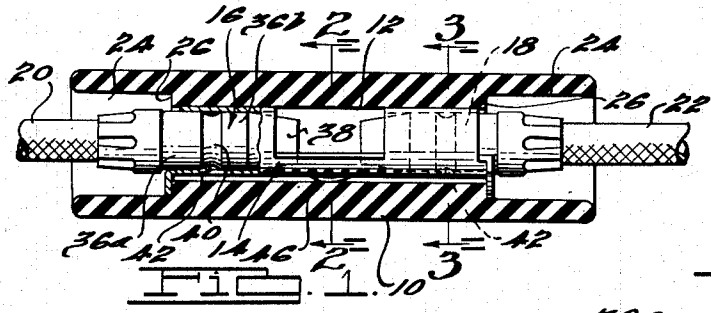


Fig. 1.

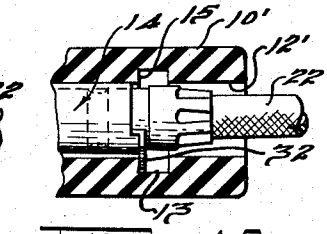


Fig. 1A.

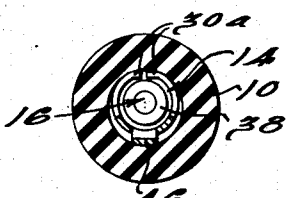


Fig. 2.

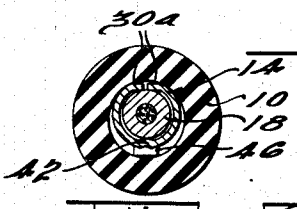


Fig. 3.

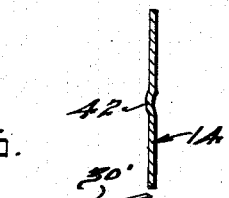


Fig. 5.

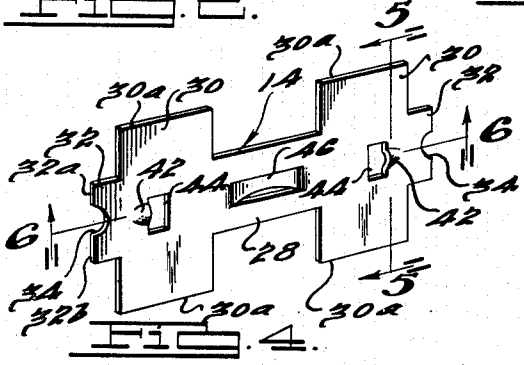


Fig. 4.

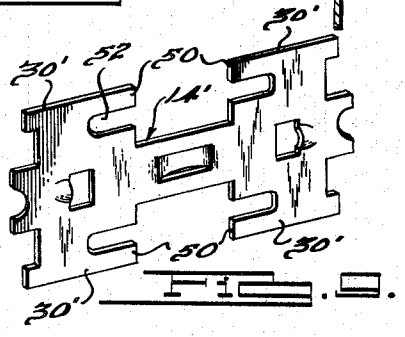


Fig. 9.

Fig. 10.

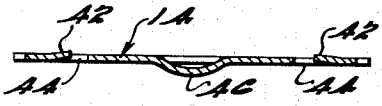
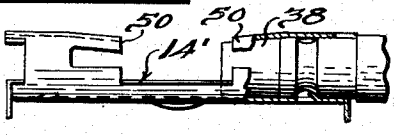


Fig. 6.



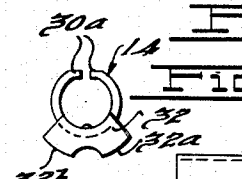


Fig. 8.

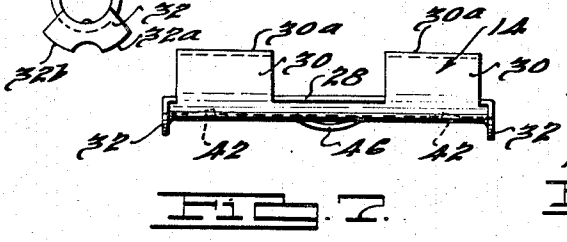


Fig. 7.

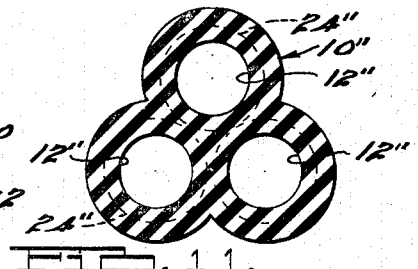


Fig. 11.

INVENTOR
Charles E. Wade.

BY
Harness, Dickey & Pierce.
ATTORNEYS.

Patented Sept. 30, 1941 2,257,317

UNITED STATES PATENT OFFICE

2,257,317

LINE CONNECTOR

Charles E. Wade, Sturgis, Mich.

Application August 15, 1938, Serial No. 224,851

6 Claims. (Cl. 173—328)

The present invention relates to devices for forming a connection between one or more pairs of electrical conductors, and in particular provides an improved device of the just mentioned character embodying a contact adapted to interlockingly receive and form a connection between the terminals associated with such conductors.

The principal objects of the present invention are to provide a device for forming a connection between one or more pairs or an odd number of related electrical conductors, which is extremely economical of manufacture; to provide such a device which enables the connection to be formed with or without the use of tools; to provide such a device which requires a very light pressure to form the connection, but requires a relatively substantial force to separate the connection; and to provide such a device arranged to provide an extremely good electrical contact between each pair of conductors, so as to minimize the millivolt loss through the device.

Further objects of the present invention are to provide a device of the above generally indicated character comprising a sleeve-like member, the opposite ends whereof are open and adapted to receive snap type terminals; to provide such a device including a spring-like contact member received within the body of the device, the opposite ends whereof are adapted to interlock with snap type terminals formed at the ends of the associated conductors; to provide such a device in which the contact member within the body of the device is so formed that certain parts thereof are held in spaced relation to the body of the device, whereby upon insertion of a terminal, such part is enabled to yield to receive the terminal; and to provide such a device wherein the means for securing the contact member within the body of the device also acts to hold such member in the just mentioned spaced relation.

With the above as well as other objects in view which appear in the following description and in the appended claims, preferred but illustrative embodiments of the present invention are shown in the accompanying drawing, throughout the several views of which corresponding reference characters are used to designate corresponding parts, and in which:

Figure 1 is a view in longitudinal transverse section of one embodiment of the invention;

Fig. 1A is a fragmentary view of a modification of the arrangement of Fig. 1;

Fig. 2 is a view in transverse section, taken along the line 2—2 of Figure 1;

Fig. 3 is a view in transverse section, taken along the line 3—3 of Figure 1;

Fig. 4 is a view in perspective of the contact device in a partially formed condition;

Fig. 5 is a view in section, taken along the line 5—5 of Fig. 4;

Fig. 6 is a view in section, taken along the line 6—6 of Fig. 4;

Fig. 7 is a view in elevation of the completely formed contact device;

Fig. 8 is a view in end elevation of the completely formed contact device;

Figs. 9 and 10 are views of a modified embodiment of the invention; and,

Fig. 11 is a view in perspective, illustrating the adaptation of the invention to line connectors of the so-called multiple type.

It will be appreciated from a complete understanding of the present invention that the improvements thereof may be embodied in line connectors or equivalent devices of widely differing forms and intended for use in widely differing applications. In an illustrative but not in a limiting sense, it is noted that devices of the kind in question are widely used in the lighting systems of automotive vehicles wherein, for example, it is desired to form a connection between a conductor initially assembled with the vehicle body and a conductor initially assembled with a vehicle frame.

The rapid production schedules and the highly competitive conditions in the automotive industry have made essential the production of a line connector which is extremely small, light in weight, low in cost, and which may be applied to the associated conductors entirely manually and with or without the use of any tools. Moreover, service conditions require that the line connector form a connection between the associated conductors which requires a substantial pull or force to separate the conductors and at the same time, the connector must be one to which the conductors can be connected with a minimum of effort, so as to avoid bending the relatively flexible conductors during the assembly process. In addition, the line conductor is required to provide an extremely efficient electrical contact, so as to minimize the millivolt drop through the connector. The present construction has been found in practice to fully meet the above requirements.

Referring to the drawing, the connector comprises generally a tubular housing or sleeve 10, within the bore 12 of which a contact designated as a whole as 14 is secured, and is so formed as to yieldingly interlock with the conventional snap type terminals 16 and 18 which are provided at the ends of the conductors 20 and 22, respectively. It will be understood that the sleeve 10 may be formed of any suitable insulating material, such as rubber, or such as the condensation products known commercially as Bakelite or Tenite. It will be further understood that the sleeve 10 may be formed of any desired cross-

section such as circular, rectangular, or the like, a circular form being preferred and illustrated. The bore 12 of the sleeve 10 may be and preferably is of uniform cross-section throughout its length, so as to facilitate its manufacture, and in addition, the ends of the sleeve 10 are provided with counterbores 24, which define shoulders 26 which serve, as hereinafter described, to hold the contact 14 in place within the sleeve.

The arrangement shown in Figure 1A corresponds in all respects to the arrangement just described with reference to Figure 1, with the exception that in Figure 1A, the sleeve 10' is provided with a bore 12' which extends completely therethrough, and, in order to provide shoulders corresponding to the previously described shoulders 26, the bore 12' is provided with an annular pocket or recess 13, adjacent each end of the sleeve. One wall 15 of each pocket constitutes the just mentioned shoulder.

As clearly appears in Figures 4 through 8, the contact member 14 is preferably formed, by a stamping and rolling operation, from a single relatively thin sheet of good conducting and resilient material. In the present embodiment, the connector is adapted to receive a conductor at each end thereof, and the two ends of the contact are therefore similarly formed. The contact 14 comprises an intermediate portion 28 of reduced width, widened end portions 30 and extreme end portions 32 of substantially the same width as the intermediate portion 28. The extreme end portions 32 constitute flanges by which the contact 14 is secured within the sleeve 10, and to facilitate the bending over of these flanges, the portions 32 are preferably notched as indicated at 34 so as to define a pair of associated flanges 32*a* and 32*b*.

It is preferred to form the contact member 14 for interlocking engagement with the terminal tips 16 and 18 associated with the conductors 20 and 22, respectively. In the form illustrated in the drawing, the terminal tips 16 and 18 are of conventional construction, and comprise an elongated body, the nose 38 whereof is tapered, and which is provided at an intermediate point along its length with a reduced neck portion 40, the opposite sides whereof constitute shoulders, and which divides the body into spaced portions 36*a* and 36*b*. Accordingly, in the illustrated embodiment, the interlocking means on the contact member 14 are illustrated as comprising tongues 42 which are inwardly struck from the body of the contact immediately adjacent openings 44 therein. The openings 44 are preliminarily pierced, and thereafter (but preferably as a part of the same die operation) the tongues 42 are formed to have a generally arcuately shaped body, the front face of each of which is constituted by the deformed adjacent wall of the opening 44. The arcuate body formation lends strength to the tongues and the abrupt front faces thereof provide a positive interlocking action as hereinafter described.

As is described below, a part of the contact 14 extending throughout the length thereof and for a predetermined distance on either lateral side of the tongues 42 is held in spaced relation to the wall of the sleeve 10, so as to enable the contact 14 to grip the terminals 16 and 18 with a spring-like action. To assist in holding such portion of the contact 14 in spaced relation to the inner wall of the sleeve 10, it is preferred to provide the contact 14 with a support intermediate its length. In the illustrated embodiment of the invention, this support is constituted by a boss 46, which is struck outwardly from the body of the contact 14 by a simple piercing operation.

Prior to its assembly within the sleeve 10, the contact 14 is rolled into the generally circular shape shown clearly in Figs. 2, 3 and 8, and the outer marginal edges 30*a* of the portions 30 are bent radially inwardly to a slight extent so that such marginal edges lie in slightly spaced relation to the inner wall of the sleeve 10, which relation is clearly shown in Figs. 2 and 3. With this relation, such marginal edges do not tend to bind on the wall of the bore and at the same time, such inner marginal edges can yieldingly grip the adjacent points of the corresponding terminal tips.

Following the just mentioned forming step, the contact 14 is bodily inserted in the bore of the sleeve 10, it being understood that the diameter of the generally circular portions of the contact 14 is such that the insertion thereof in the sleeve 10 can be accomplished relatively freely and without deforming the contact 14. At the same time, the dimensioning is preferably such that with the boss 46 in engagement with the wall surface of the bore 12, the portions 30*a* snugly engage the opposite wall of the bore 12.

After inserting the contact 14 within the sleeve 10, the flanges 32 thereof are bent radially outwardly to the positions shown in Figs. 1, 7 and 8, in which position they interlock with the shoulders 26 formed in the sleeve 10 and positively secure the contact 14 against axial movement within the sleeve 10. In addition, the proportioning of the flanges 32 is such that upon being bent to the assembled position, the outer marginal edges thereof abut the walls of the counterbored portion 24. Accordingly, the flanges 32 serve the purpose of securing the contact 14 in place axially of the sleeve and in addition, serve the purpose of cooperating with the boss 46 to maintain the previously mentioned spaced relation between the contact 14 and the wall of the bore 12 and also prevent rattle.

It will thus be observed that in the completely assembled condition of the contact 14, parts extending laterally and axially from the tongues 42 are supported in spaced relation to the wall 12 by means of the flanges 32 and the boss 46.

It will be appreciated that in assembling the contact 14 a sleeve of the form shown in Figure 1A, the contact is first inserted into the sleeve 10' to substantially correct axial position as previously described. Thereafter, expanding mandrels or the like are inserted into the opposite ends of the bore 12' of the sleeve to points at which they engage the inner surface of the flanges 32. The subsequent expansion of the mandrels bends the flanges into the pockets 13, and ultimately brings the marginal edge of each flange into abuting engagement with the base of the associated recess and also into abutting engagement with the wall 15 of each recess.

In assembling either the conductor 20 or the conductor 22 with the line connector, the associated terminal tip 16 or 18 is advanced through the counterbore 24 of the sleeve 10, into the bore of the contact 14. The nose 38 of the terminal tip, being smaller than the main body portion thereof, readily enters the generally circular bore of the contact 14. As the terminal is advanced into the just mentioned bore, portions of the nose 38 of increasing diameter are presented thereto and ultimately, a point is reached at which the surface of the tapered nose en-

gages the inner surface of the contact 14 at least the edges 36a thereof and the portions diametrically opposite such portions. The latter portions are relatively rigidly supported by the supporting flanges 32, so that the continued movement cams the edges 36a radially outwardly and also increases the angular spacing between such edges 36a, thus enlarging the inside diameter of the bore of the contact 14, by an amount sufficient to admit the body portion of the terminal tip. In the just enlarged condition, the contact 14 resiliently embraces the terminal tip and so tends to grip it and hold it against rotation relative to the contact 14.

As the terminal tip movement is continued, the nose 38 engages and rides over the associated interlocking part or tongue 42. Being arcuate in form in a plane at right angles to the direction of movement of the terminal tip, as clearly appears in Figs. 4 and 5, the interlocking part 42 is relatively rigid, and is not deformed by the passage thereover of the nose 38 or by the subsequent passage thereover of the body portion of the terminal tip. Instead, the force applied to the interlocking part 42 by the terminal tip causes that part of the contact which lies between the supporting flanges 32 and the intermediate supporting boss 46 to springingly flex downwardly toward the wall of the bore 12. As the movement of the terminal tip continues, the reduced neck 40 thereof is ultimately brought into registry with the interlocking part 42, allowing the above mentioned downwardly sprung area of the contact to spring upwardly, forcing the interlocking part 42 into the reduced neck 40. In the just mentioned position of the parts, which is shown in Fig. 1, the leading edge of the interlocking part 42 lies in blocking relation to the shoulder formed at one side of the neck 40, and is thus effective to cooperate with such shoulder to substantially but yieldingly resist a retracting or withdrawal movement of the terminal tip.

At the same time, the upward spring movement of the previously sprung area of the contact 14 enables such area to frictionally grip the leading body portion 36b of the terminal tip. The rear body portion 36a of the terminal tip remains frictionally embraced by the adjacent part of the contact 14 in the manner described above.

With the terminal tip in the completely assembled position shown in Fig. 1, it will be appreciated that it is retained in assembled position by the contact 14, in part, by the frictional engagement between the body portions 36a and 36b of the terminal tip and the adjacent wall portions of the contact 14, and, in major part, by the abutting engagement between the interlocking part 42 and the shoulder of the neck 40. In addition, the frictional engagement between the body portions 36a and 36b and the adjacent parts of the contact 14 tends to prevent rotation of the terminal tip within the contact 14. An extremely good electrical contact is thus provided between the terminal tip and the contact 14, having a minimum millivolt drop therethrough and at the same time, a very substantial force is required to withdraw the terminal tip from the contact. It will be appreciated of course that a retracting movement of the terminal tip causes the shoulder associated with the neck 40 to bear against the interlocking parts 42, and forces the above mentioned springable part of the contact 14 downwardly by an amount sufficient to enable the interlocking part 42 to clear the body portion 36b.

The insertion of the terminal tip within the contact 14 requires a force which is only a minor fraction of the force required to withdraw it therefrom for the reason that during the inserting movement, the downward camming movement of the interlocking part 42 is effected by the gradually sloping nose 38 of the terminal tip, whereas during a retracting movement, the just mentioned downward movement of the interlocking part 42 is effected by the relatively abrupt shoulder associated with the neck 40. For this reason, it has been found in practice that the terminal tip may be inserted within the contact 14 by engaging the associated conductors 20 or 22 at a point spaced conveniently rearwardly of the terminal tip, without danger of bending the conductor.

It will be appreciated that the insertion and removal, as well as the retaining action, for both terminal tips 16 and 18 is the same. It will further be appreciated that when the two terminals are connected through the line connector the electrical circuit extends from one terminal through the body of the contact 14 to the other terminal tip.

The contact 14' shown in Figures 9 and 10 corresponds generally to the previously described contact 14, with the exception that the contact 14' is provided with a plurality of fingers 50 which in the completely formed device, are bent slightly radially inwardly and resiliently grip the tapered nose 38' of the associated terminal tip. In the illustrated arrangement, the fingers 50 are formed by providing axially extending notches such as 52 in the transversely extending body portions 30' of the contact 14'. As in the previously described instance, the contact 14 is formed of spring-like material, and in rolling the contact 14' to the generally cylindrical form shown in Figure 10, the fingers 50 are bent radially inwardly by an amount so that the insertion of the terminal tip forces these fingers radially outwardly. A positive spring engagement is thus afforded between the fingers 50 and the terminal tip. In all other respects except those just noted, the construction mode of operation of the contact 14' preferably conforms to that described above with reference to the contact 14.

In many cases it is desirable to form line conductors of the above described type of so-called multiple form arranged to form a connection between a plurality of pairs or odd numbers of conductors. The present construction is readily adaptable to the multiple relation, by providing the insulating sleeve or outer body with a plurality of bores, each whereof is adapted to receive a contact element associated with a particular pair of conductors. An illustrative multiple arrangement is shown in Fig. 11, wherein the outer body 10' of the multiple connector is constituted by three generally circular, tubular portions, arranged in generally triangular relation. Each portion is provided with a bore which receives a contact of the form shown early in the other figures.

Although only two specific embodiments of the invention have been described in detail, it will be appreciated that various modifications in the form, number and arrangement of parts may be made within the spirit and scope of the invention.

What is claimed is:

1. In an electrical connector for association

with a conductor terminal, the combination of a supporting body having an opening extending thereinto, the outer end of said opening being recessed so as to define a shoulder spaced inwardly from the end of said opening, a single integral contact member bodily movable into and received within said opening, a holding part formed integrally with said contact member and engaged over said shoulder so as to limit movement of said contact member in a direction opposite to that in which said shoulder faces, said holding part engaging the wall of said recess so as to support a portion of said contact member in spaced relation to said wall of said opening, said contact member having a terminal receiving receptacle formed in part by said portion and comprising spaced surfaces which receive between them a said terminal, said portion being engaged by a said terminal when the latter is in place in said contact member and being deflectable toward said wall upon insertion of said terminal into said contact member.

2. In an electrical connector for association with a conductor terminal, the combination of a supporting body having an opening extending thereinto, the outer end of said opening being recessed so as to define a shoulder spaced inwardly from the end of said opening, a single integral contact member bodily movable into and received within said opening, a holding part formed integrally with said contact member and engaged over said shoulder so as to limit movement of said contact member in a direction opposite to that in which said shoulder faces, said holding part engaging the wall of said recess so as to support a portion of said contact member in spaced relation to said wall of said opening, said contact member having a terminal receiving receptacle formed in part by said portion and comprising spaced surfaces which receive between them a said terminal, said portion being engaged by a said terminal when the latter is in place in said contact member and being deflectable toward said wall upon insertion of said terminal into said contact member, and means forming a second supporting connection between said contact member and the wall of said opening spaced inwardly of said opening from said shoulder so as to assist in maintaining said portion in said spaced relation.

3. In an electrical connector for association with a conductor terminal, the combination of a supporting body having an opening therein, a single integral contact member bodily movable into and received within said opening, means comprising holding means adjacent one end of said contact member for engaging said body to secure said contact member within said opening, said holding means having a laterally offset part which engages a side wall of said opening so as to hold a portion of said contact member in spaced relation to said wall of said opening, said contact member having a terminal receiving receptacle formed in part by said portion and comprising spaced surfaces which receive between them a said terminal, said portion being engaged by a said terminal when the latter is in place in said contact member and being deflectable toward said wall upon insertion of said terminal into said contact member, and means forming an additional supporting connection between said contact member and said wall of said opening to assist in holding said portion in said spaced relation.

4. In an electrical connector for association with conductor terminals, the combination of a supporting body having an opening extending therethrough, contact means received within said opening, holding means adjacent the respective ends of said contact means for engaging said body to secure said contact means within said opening, said holding means being laterally offset from said contact means and engaging a side wall of said opening so as to hold portions of said contact means in spaced relation to said wall of said opening, said contact means having a terminal receiving receptacle adjacent each end thereof for receiving respectively a said terminal projected into the connector from the corresponding end, each receptacle including a corresponding one of said portions and comprising spaced surfaces which receive between them a said terminal, said portions being positioned between said holding means and being deflectable respectively toward said wall upon insertion of a said terminal into the corresponding receptacle, and interlocking means carried by said contact means for interlocking engagement with said terminals.

5. In an electrical connector for association with conductor terminals, the combination of a supporting body having an opening extending therethrough, contact means received within said opening, holding means adjacent the ends of said contact means for engaging said body to secure said contact means within said opneing, said holding means being laterally offset from said contact means and engaging a side wall of said opening so as to hold a portion of said contact means in spaced relation to said wall of said opening, said portion being positioned between said holding means and being deflectable toward said wall upon insertion of a said terminal into said contact means, interlocking means carried by said contact means for interlocking engagement with said terminals, and means located between said holding means for forming an additional supporting connection between said portion and said wall.

6. In an electrical connector for forming a connection between a pair of conductor terminals, a combination of a supporting body having an opening therein and having shoulders adjacent the ends of said opening, contact means received within said opening, flanges at the ends of said means turned over said shoulders to secure said means in place in said body and engaging the side wall of said opening so as to hold spaced portions of said means in spaced relation to a wall of said opening, said spaced portions being between said shoulders and being deflectable toward said wall upon insertion of said terminals into said contact means, interlocking means projecting from said contact means for interlocking engagement with said terminals respectively, and means forming a supporting connection between said body and said contact means intermediate said spaced portions for cooperating with said flanges to hold said portions in spaced relation to said wall.

CHARLES E. WADE.