Feb. 24, 1953 J. C. MACY 2,629,763

ELECTRICAL CONNECTOR

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FIG. 1.

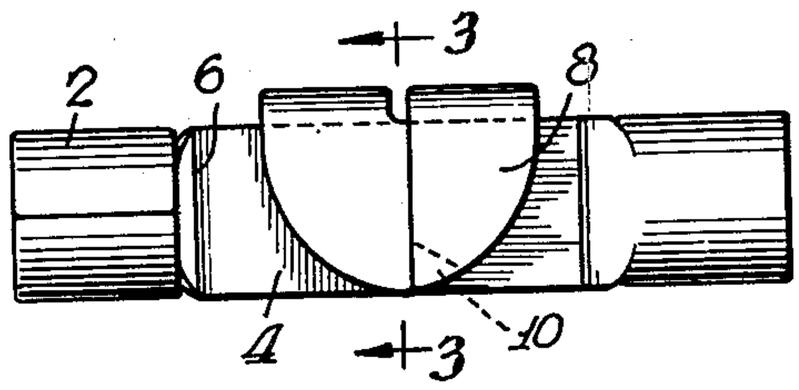


FIG. 2.

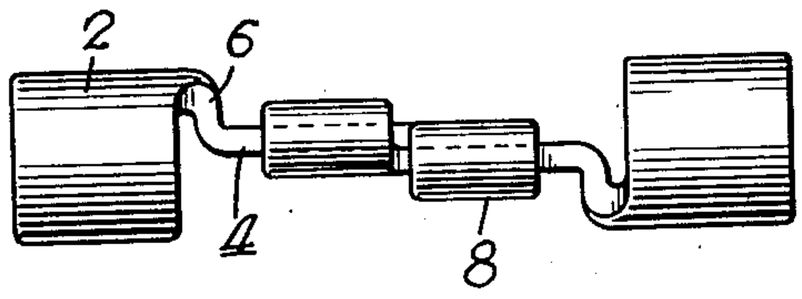


FIG. 4.

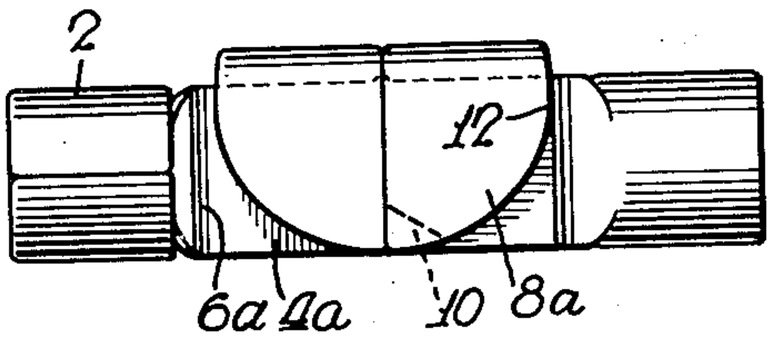


FIG. 3.

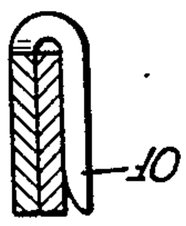
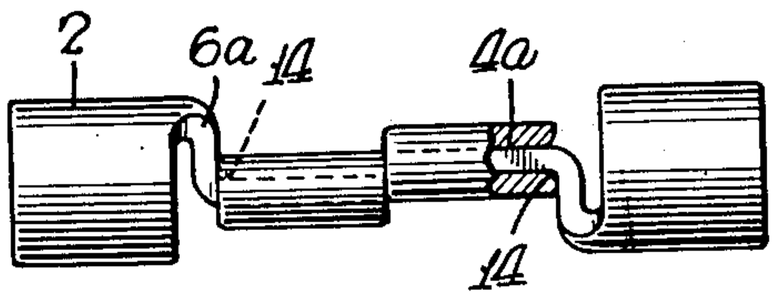


FIG. 5.



INVENTOR.
James C. Macy
BY
Curtis, Morris & Safford
ATTORNEYS

Feb. 24, 1953 J. C. MACY 2,629,763

ELECTRICAL CONNECTOR

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Fig. 6.

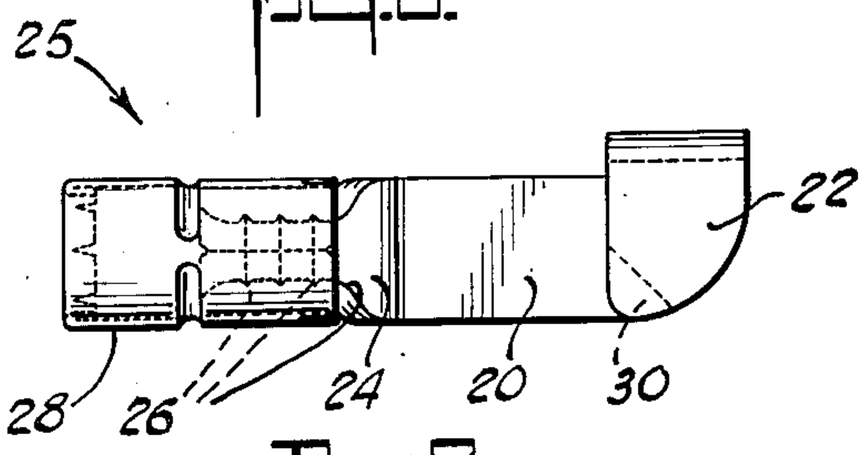


Fig. 7.

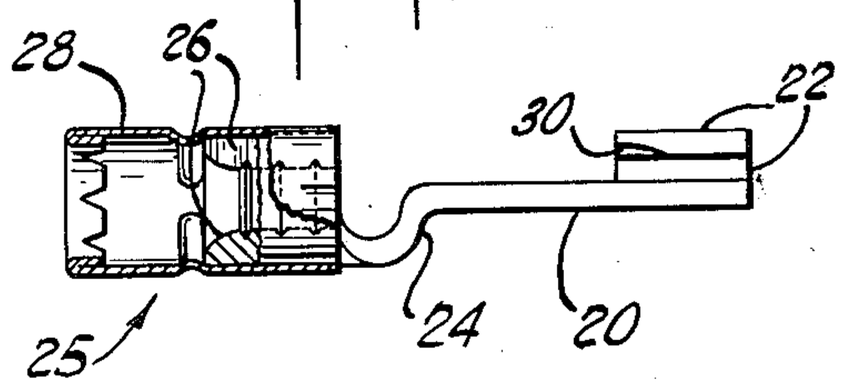


Fig. 8.

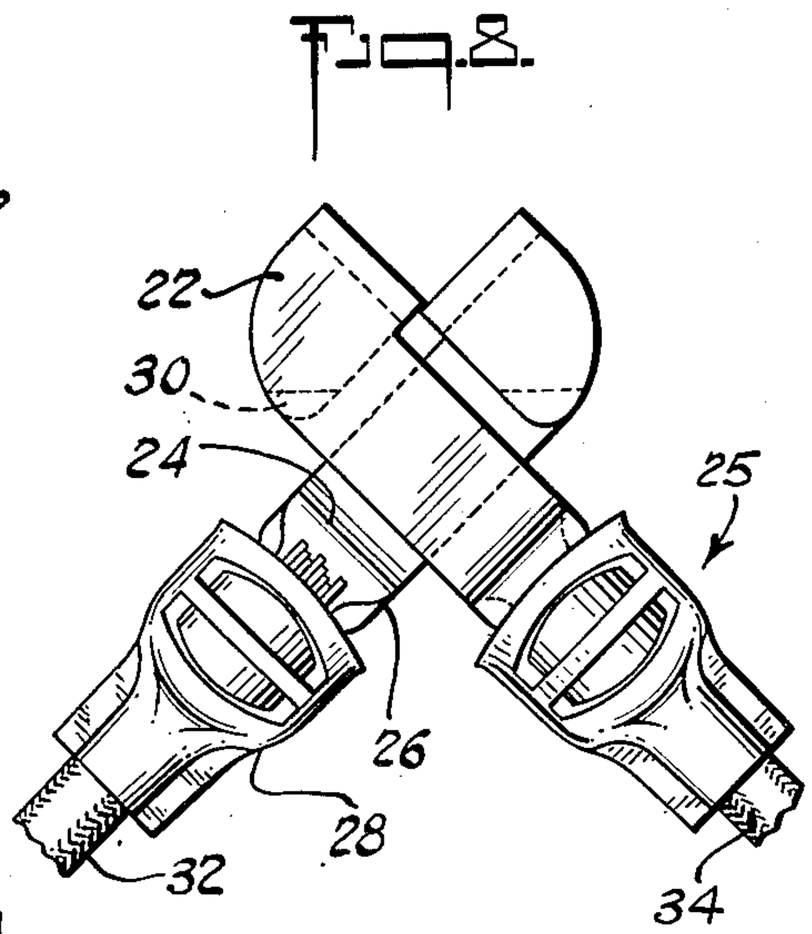


Fig. 9.

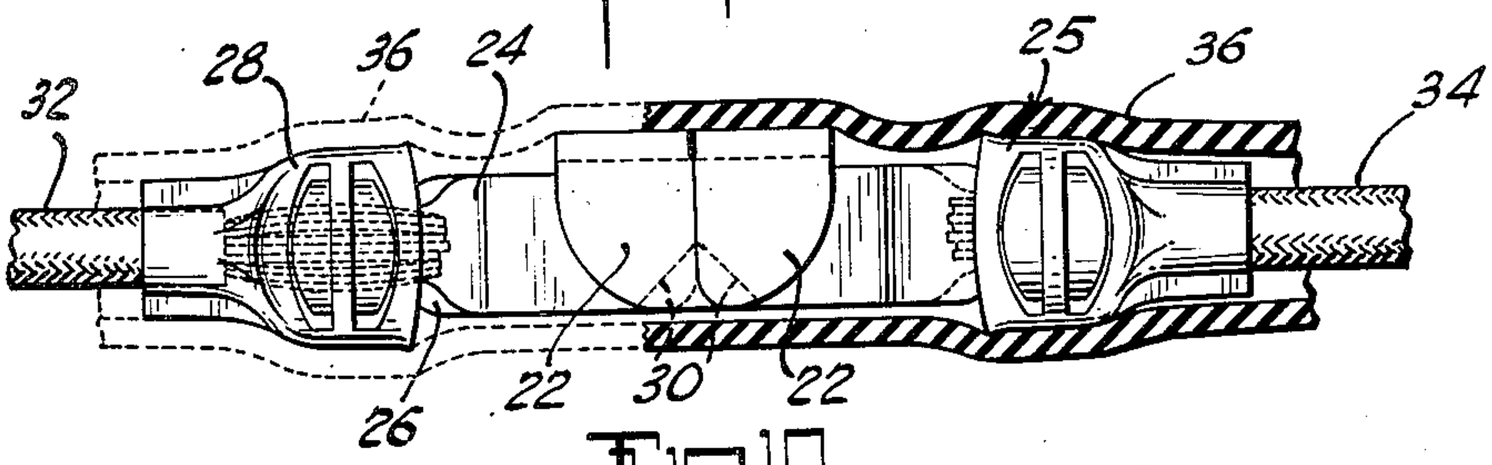


Fig. 10.

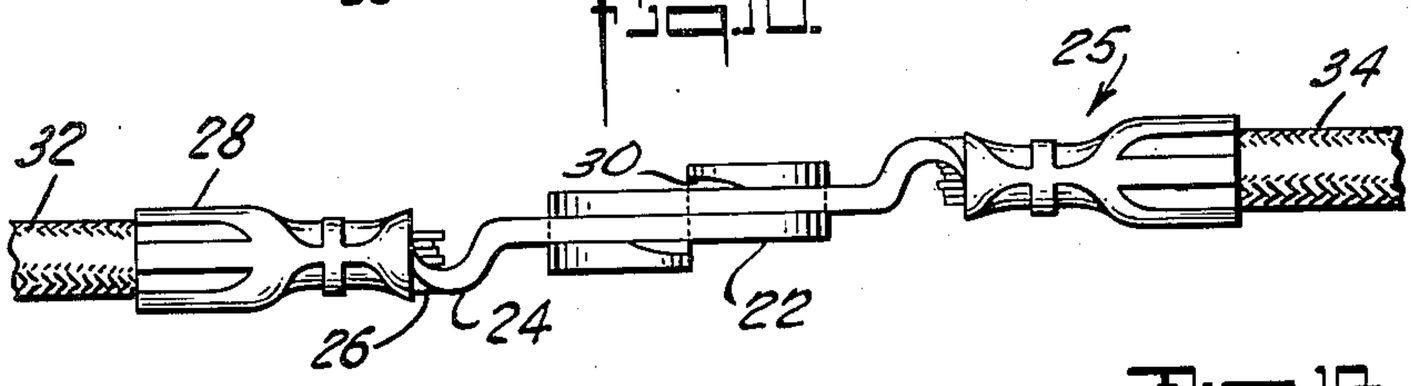


Fig. 11.

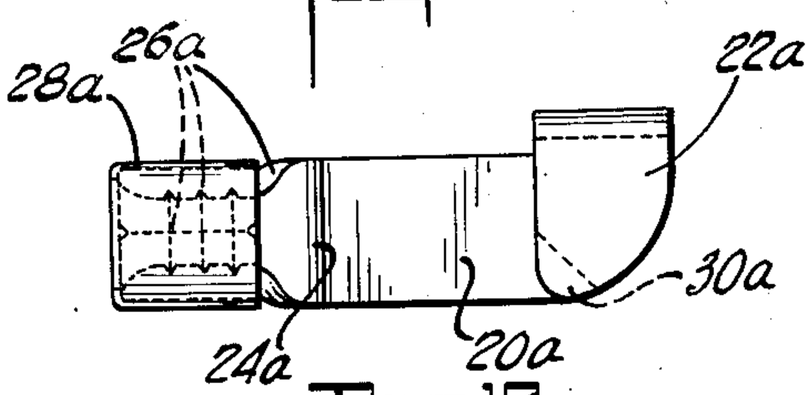


Fig. 12.

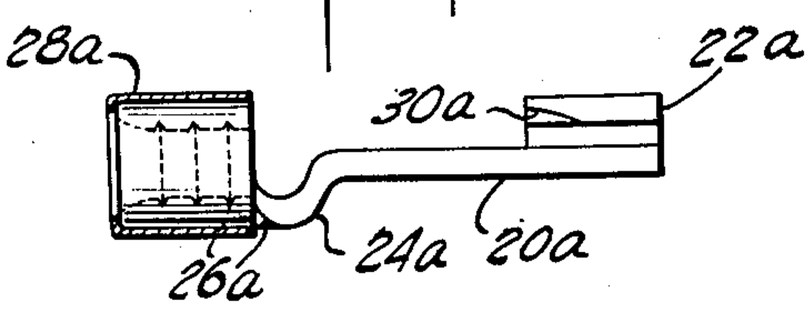
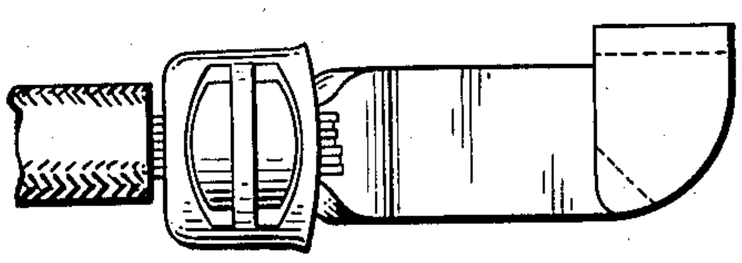


Fig. 13.



INVENTOR
JAMES C. MACY.
BY
Curtis, Morris & Safford
ATTORNEY

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ELECTRICAL CONNECTOR

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Fig. 14.

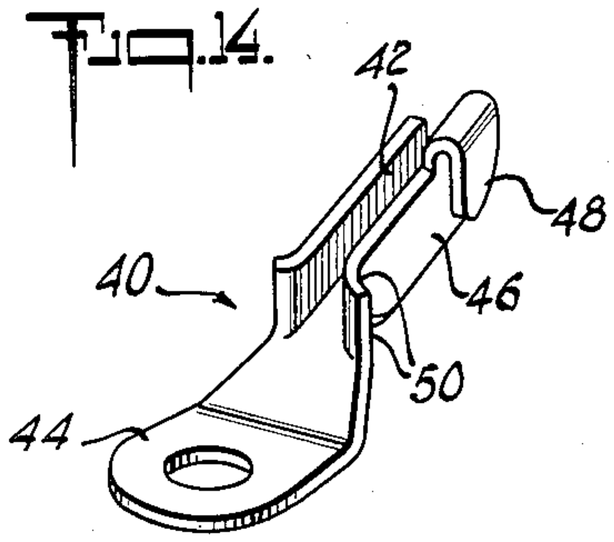


Fig. 15.

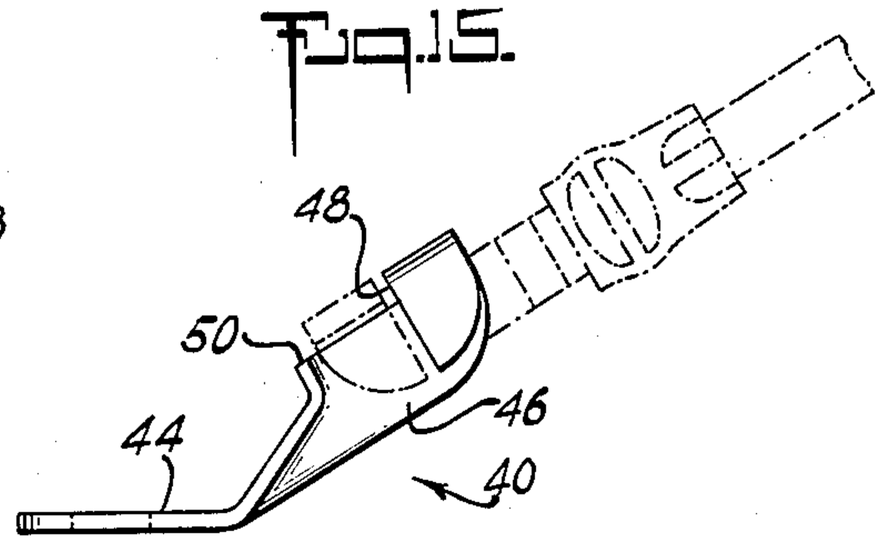


Fig. 16.

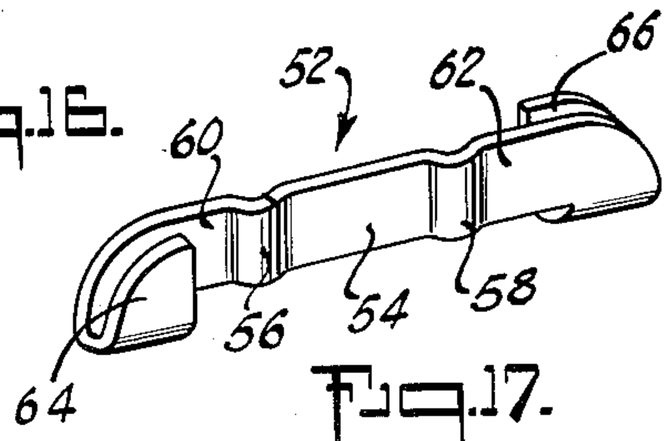


Fig. 17.

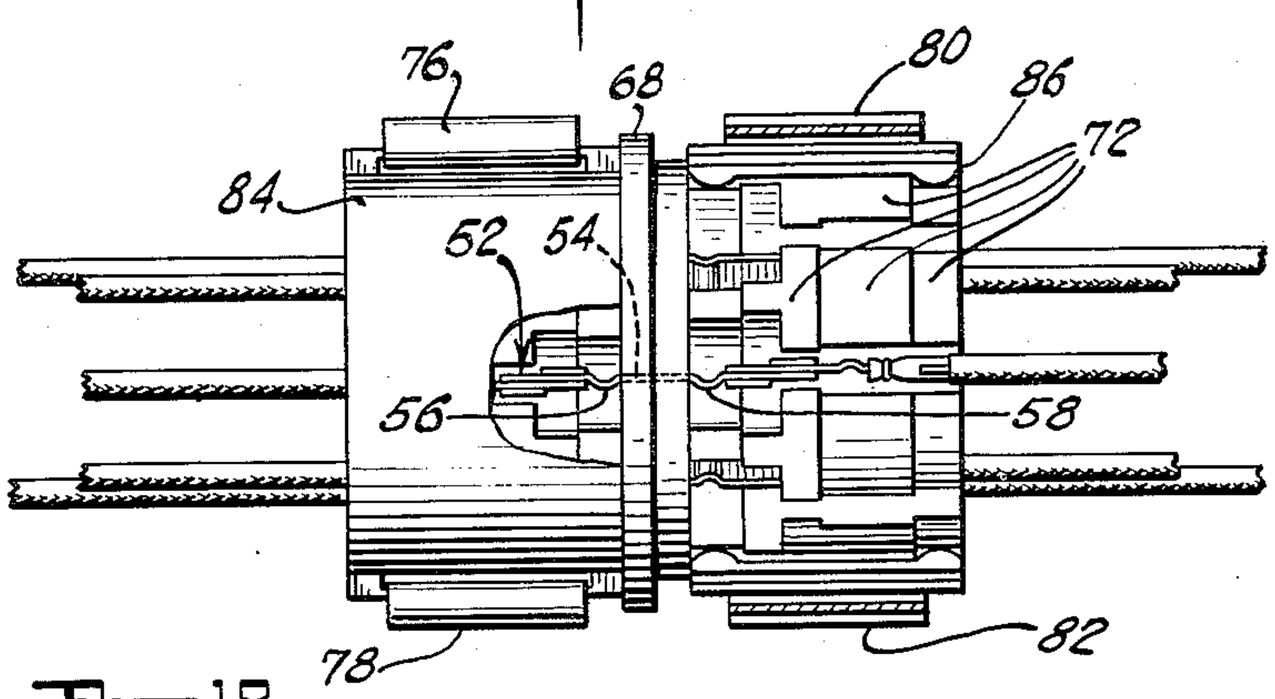
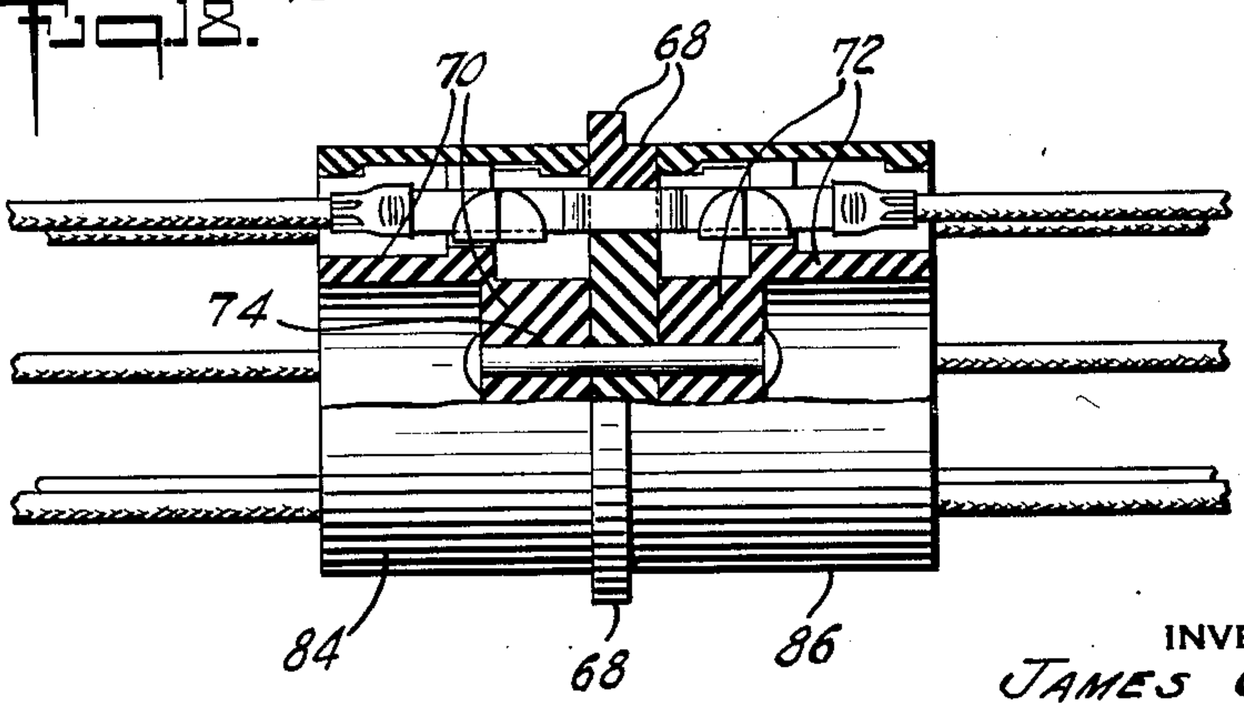


Fig. 18.



INVENTOR
JAMES C. MACY.

BY
Curtis, Morris, & Safford.
ATTORNEYS

Patented Feb. 24, 1953

2,629,763

UNITED STATES PATENT OFFICE

2,629,763

ELECTRICAL CONNECTOR

James C. Macy, Westfield, N. J., assignor to Aircraft-Marine Products Inc., Harrisburg, Pa.

Application September 16, 1950, Serial No. 185,221

2 Claims. (Cl. 173—363)

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This invention relates to connectors for wires, cables and the like and particularly to improvements in connectors of the type which comprise counterpart terminals having respectively, when connected, interengaging clips.

In the connectors shown in Watts Patent 2,478,143 a blade part of each terminal is formed by a direct continuation of one side of a ferrule by which the respective terminal is secured to and electrically connected with a wire; and the clip part of each of the terminals is formed from an integral lateral extension of the blade and is of substantially uniform width. Since the two terminals have to be brought into an angular relation to each other when assembling, the clip design necessitates a somewhat greater spacing of the clip part of each terminal from the ferrule thereof than the mere width of said clip in order to permit the angular movement of the terminals required for the interengaging of the two clips and blades. The present invention has as one object the reduction of this excess length with corresponding reduction in weight and expense.

The present invention further aims to provide an improved connector construction which, without undue increase in length, will provide a stop for the end of the conductor or cable, etc., inserted in the ferrule; and which will also prevent substantial endwise movement of the terminals relative to each other when in their assembled condition; and which will also provide a rubbed pressure contact which both improves electrical conduction and adds security to the mechanical connection.

The invention aims further to provide a construction of the terminals such that, in their assembled condition, their ferrules and the enclosed conductor ends can be in substantially axial alignment with, or other desired relation to, each other, thus making a better appearance and requiring less space at the connection than would be the case if they were substantially offset laterally.

Other objects and important features of the invention, to which reference has not been made hereinabove, will appear in the following description and claims.

Although in the accompanying drawings I have shown a preferred embodiment of my invention and have described the same and various modifications thereof in this specification, it is to be understood that these are not intended to be either exhaustive or limiting of the invention, but, on the contrary, are chosen for the purposes

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of illustrating the invention in order that others skilled in the art may so fully understand the invention, its principles and the application thereof, that they may embody it and adapt it in numerous forms, each as may be best suited to the requirements of its particular use.

In the accompanying drawings:

Figure 1 is a side elevation of a pair of connectors embodying the present invention in assembled or interconnected condition;

Figure 2 is a plan view;

Figure 3 is a section on the line 3—3 of Figure 1;

Figure 4 is a view similar to Figure 1 of a modified form of the invention;

Figure 5 is a view similar to Figure 2 but of the connectors shown in Figure 4;

Figure 6 is a side elevation of a connector illustrating another embodiment of the invention;

Figure 7 is a view of the connector of Figure 6 taken looking upwardly from below;

Figure 8 is a side elevation of a pair of connectors of the embodiment shown in Figure 6 but after they have been crimped onto conductors and as they appear when being interconnected;

Figure 9 is a side elevation of the connectors of Figure 8 when fully interconnected and also showing part of a length of insulating tubing enveloping the connection;

Figure 10 is a view of the connectors of Figure 9 taken looking upwardly from below;

Figure 11 is a view similar to that of Figure 6 but showing still another embodiment of the invention;

Figure 12 is a view of the connector of Figure 11 taken looking upwardly from below;

Figure 13 is a view similar to that of Figure 11 but showing the connector crimped onto a conductor;

Figure 14 is a perspective view of another form of terminal embodying the invention;

Figure 15 is a side view of the terminal shown in Figure 14 interconnected with a connector of the type illustrated in Figure 8;

Figure 16 is a perspective view of yet another form of connector element embodying the invention;

Figure 17 is a view partly in section illustrating a multiple connector unit embodying the invention; and

Figure 18 is a view similar to that of Figure 17 but illustrating a different partial cross section through the unit.

In the first illustrative embodiment of the in-

vention, each of the terminals of the present invention is a counterpart of the other and comprises a ferrule **2**, and a tongue or blade portion **4** extending from one side of said ferrule but bodily offset to bring the respective ferrules of the two connectors into alignment. This leaves a bent-over or shoulder portion **6** extending over the outer end of the ferrule. The blade portion **4** of each terminal has an integral extension bent over the end of the tongue to form the clip **8**, the blade portion **4** of each terminal acting as a receptor which is received between the blade and clip portions of the other terminal in the assembled connection.

The maximum width of the clip **8** on each terminal is at least substantially equal to or only slightly less than the distance between the inner edge of the clip **8** and the shoulder or abutment **6** so that, when the two terminals are in the assembled relation shown in Figure 1, the clip of one will fit substantially between the clip **8** of the other terminal and the shoulder **6** thereof. The end of the blade **4** and/or the clip **8** is curved, as shown at **10**, so that it can cam against the shoulder **6** of the other connector to bring the parts into the intended relation when they are swung from perpendicular to aligned relation. The shoulder **6** serves to limit passage of wire beyond the ferrule **2** so as to prevent interference by such wire with the proper interconnection of the terminals.

As in the connector of the Watts patent hereinabove referred to, connection or disconnection of the two terminals which make up the connection requires movement thereof into an angular relation (see also Figure 8), approximately perpendicular relation in the case shown, before they can either be connected or disconnected. It will be seen that disconnection cannot be effected merely by an endwise pull or by an endwise push or by any ordinary lateral strain and that therefore the terminals are securely interlocked against unintentional separation.

The clip **8** adjacent the bend where it is attached to the blade **4** is spaced a distance accurately equal to the thickness of the blade. Beyond the bend the blade and clip normally converge so that, when assembled as shown in Figure 3, the blade is gripped with a compressive force resulting from deflection of the clip **8**. This aspect of the construction is more particularly described and is claimed in the Watts patent aforementioned.

If the length of the clip **8** and the form of the cam face **10** are accurately controlled, the cam face will make pressure contact against the shoulder **6** sufficient to scrape into the oxide surface layer and give a low resistance electrical connection. This arrangement, which is shown in Figures 4 and 5, has the further advantage that the cam first springs the shoulder bend **6***a* and then, as the point **12** of longest radius moves in from the edge, the resilient pressure on the cam holds the connectors latched together.

With the arrangement shown in Figures 4 and 5 it is important to have the blade **4***a* and the bend at which it joins the ferrule accurately formed, so that no part of the bend tends to hold the clip **8***a* away from the blade. To this end the edges of the clip and/or blade are rounded as indicated at **14**. With space allowed, as shown in Figures 1 and 2, the forming at the bend can be less exact. In any event the bend sets a limit to the extent to which the cylindrical conformation of ferrule **2** may merge into and run along the blade portion. If good face-to-face contacts between clip and blade faces of two interconnected terminals are to occur then the receptor part of the blade should be planar, and free of any merging into cylindrical shape adjacent the ferrule as may occure with the unbent terminal disclosed in the Watts patent.

The clip is shown in Figures 4 and 5 on the same side of its blade as the shoulder **6***a* formed by the bend in the blade. This has the advantages of bringing the cam pressure directly on the end of the blade, and of bringing the shoulder **6***a* farther across the end of the ferrule **2** to give a more effective stop for limiting insertion of a wire therein. With the relationship illustrated in Figure 5 the two aligned clips are held under a slight lengthwise compression between shoulders **6***a*; this compression tends to maintain the locked relationship because, in effect, the parts have been moved past a dead center across which they must be returned to permit unlocking. At the exact dead center lengthwise compression on the clips between shoulders **6***a* is, of course, a maximum. A satisfactory connection is made, however, with the clip bent to the opposite side, as shown in Figures 1–3.

Another embodiment of the invention is illustrated in Figures 6–10. As best shown in Figures 6 and 7, the terminal includes a blade portion **20** provided at its outer end with a clip **22** and at its inner end with a shoulder portion **24**. In this embodiment the ferrule, generally indicated by **25**, is of the composite laminated construction disclosed and claimed in Buchanan Patent 2,379,567. It comprises a split cylindrical ferrule part **26** integral with shoulder portion **24** and a thin cylindrical seamless sleeve **28** of suitable metal, such as copper, telescoped over the split cylindrical ferrule part with a snug fit as shown which holds the pieces in permanent assembly. The cylindrical sleeve **28** extends beyond the ferrule part **26**, to the left as viewed in Figures 6 and 7, so as to be in a condition to embrace a substantial end portion of the insulation sheath of the conductor to which the terminal is later crimped, as illustrated in Figures 8 and 9. In the illustrative embodiment of Figures 6–10 the seamless sleeve **28** per se is of the type described and claimed in Carlson et al. Patent 2,405,111 and preferably is made by the process described and claimed in Carlson et al. Patent 2,468,169.

The end of the clip is provided, as by a swedging operation, with a region of clearance **30**. The purpose of this region of clearance is for facilitating easy assembling of two terminals (see Figure 8). As pointed out in Watts Patent 2,478,143 and also in the description above of the terminal of Figures 1–3, the distance (see Figure 7) from the lowermost surface of overhanging clip **22** to the opposing upper surface defined by the outer end of blade portion **20** is less than the thickness of the blade. So when two terminals are properly interconnected the shank or receptor part of the blade of one terminal will be grasped between the clip and the outer end of the blade of the counterpart terminal. The clearance region **30** facilitates assembling two counterpart terminals because it enables the receptor part of the blade of one terminal to make an easier entrance into the receptacle-forming space between the clip and the outer end of the blade of the counterpart terminal. As pointed out above, face-to-face contact can best be accomplished if the blade portion **4**, **20**, etc., be-

tween the shoulder and clip which forms the receptor part of the terminal is maintained in planar condition. The receptor part of the blade is assured a planar condition by the abrupt bend which forms the shoulder because the bend not only eliminates any merging of the cylindrical configuration of the ferrule into the receptor part but also injects a region which may bend first under forces perpendicular to the planar faces of the receptor so that the receptor tends to remain flat even during prolonged hard use.

In Figure 8 a pair of terminals are illustrated one being crimped onto the end of an insulated electrical conductor 32 and the other being crimped onto the end of an insulated electrical conductor 34. It is to be observed in each instance that the end of the seamless sleeve 28 which extends beyond the ferrule part 26 is telescoped over the end of the insulation sheath of the electrical conductor and there compressed in place so as to form an insulation support. The other end of the cylindrical sleeve 28 along with ferrule part 26 is crimped solidly on the stripped end of the electrical conductor so as to make a permanent electrical contact. The type of crimped connection illustrated in Figure 8 is the one impressed by the normal use of the tool disclosed and claimed in Carlson Patent 2,359,083, which simultaneously secures the insulation-supporting part of the ferrule over the end of the insulation sheath of the conductor and permanently crimps the contact-forming part of the ferrule to the stripped end of the electrical conductor.

Figure 9 illustrates the present invention embodied in a pair of interconnected terminals enclosed within a removable piece of seamless insulating tubing 36 similar to that illustrated in Figure 1 of Watts Patent 2,478,143. It will be appreciated that when a piece of seamless tubing is slipped over a pair of interconnected terminals, extending from one end of the interconnection to the other, it is not possible to move the terminals from the relationship illustrated in Figure 9 into the relationship illustrated in Figure 8, and accordingly that the terminals must remain locked together so long as the tubing is in place. In order so to lock the terminals the length of tubing is slipped over one of the terminals to a location along the length of the electrical conductor and the terminals are then interconnected in the ordinary manner (see for example Figure 8). Thereafter the length of tubing is slipped along the electrical conductor toward the connection until it embraces both of the interconnected terminals within it.

It is to be observed that when a terminal is crimped as illustrated onto the end of an electrical conductor, the crimped contact-forming portion of the ferrule which includes the ferrule part 26 has the greatest overall transverse width of any portion of the terminal. If the insulating tubing is of the semi-elastic type commonly employed for insulation, such as an extruded vinyl chloride compound tubing, which inherently tends to assume its original circular cross section whenever flattened, the ferrule portions of maximum width engage the inner faces of the tubing when the tubing tends to return from its flattened configuration to circular cross section and thus the flattened ferrule portions offer a resistance to longitudinal movement of the tubing. To a marked extent this action locks the tubing in position over the connection.

Figures 11 and 12 illustrate a terminal similar to that illustrated in Figures 6 and 7 except that in this instance the seamless sleeve 28*a* does not extend beyond the ferrule part 26*a* of the terminal. In this respect the terminal resembles the composite laminated ferrule shown in Figure 9 of Buchanan Patent 2,379,567 rather than the one shown in Figure 13 of the Buchanan patent where the sleeve extends to form an insulation support in the fashion exemplified herein by the embodiment of Figures 6 and 7.

Figure 13 illustrates the connector of Figures 11 and 12 after it has been permanently crimped onto the end of an electrical conductor. As in the case illustrated in Figure 9, the overall transverse width of the ferrule in the region of the contact-forming crimp is seen to be the portion of maximum transverse width. This portion resists longitudinal slipping of an insulating tubing corresponding to the tubing 36 described in connection with the embodiment of Figure 9.

It will be understood with respect to each of the various embodiments of the invention that the contact-forming crimped portions of the ferrules will serve to hold a piece of insulating tubing in position enveloping the interconnection and that so long as the tubing is held in place the interconnected terminals cannot be disconnected. And in each instance the shoulder portions 6, 24, 24*a*, etc., prevent appreciable lengthwise movement of one terminal with respect to its counterpart so that relative longitudinal movement of the interconnected terminals cannot work an enveloping insulating tubing off of locking position on the connection.

In each of the foregoing specifically described embodiments of the invention the terminal has included some form of ferrule. Figures 14 and 15 illustrate another type of terminal generally indicated at 40. In the embodiment herein described, terminal 40 is formed from sheet metal by metal stamping and bending operations and embodies a channel-like connecting end indicated at 42 and a ring tongue end indicated at 44. Tongue 44 is intended to be positioned over a threaded binding post in conventional fashion and there locked in place by a nut. Connecting end 42 includes a blade-like portion 46 provided toward its outer end with an integral clip 48 bent over through approximately 180° from the upper outer longitudinal edge of the blade. Between blade portion 46 and tongue 44 the terminal is provided with a shoulder portion 50 spaced from the nearest edge of clip 48 as measured longitudinally along blade portion 46 by an amount only slightly greater than the longitudinal width of the clip. Thus a connector of the type described in relation to Figure 8 may be interconnected with terminal 40 in the same manner that the two connectors described in relation to Figure 8 were interconnected.

When terminals of the type illustrated in Figures 14 and 15 are available, an electrical connector of the preceding types illustrated and described herein may be brought into electrical engagement with an ordinary binding post so that electrical systems embodying my invention may readily be assembled as parts of larger systems embodying more conventional connectors. It will be appreciated, of course, that the clip, blade portion, and shoulder portion of the terminal illustrated in Figures 14 and 15 perform the same equivalent functions as are performed by the corresponding parts of the connectors previously described herein.

Figures 16, 17 and 18 illustrate the present in-

vention embodied in a multiple connector block such as is disclosed in Figures 17–21 of my application Serial No. 631,031 filed November 27, 1945, now Patent No. 2,545,429, issued March 13, 1951; for a more complete disclosure of this type of multiple connector block reference may be had to said application. The conducting element of the connector block is indicated generally in Figure 16 at **52**. Element **52** in the illustrative form is formed from sheet metal by stamping and bending operations and incorporates a central conducting portion **54**, a pair of shoulder portions **56** and **58** located at each end of the conducting portion, a pair of blade portions **60** and **62**, and at each end of the element an integral clip **64**, **66**. The clip and shoulder and blade portions of element **52** are shaped to perform the same functions as the clip and shoulder and blade portions of terminal **40** and of the preceding connectors described hereinabove. Thus a connector of the type illustrated in Figure 8 may be interconnected at either end of element **52** with the clip of the connector in face-to-face contact with the blade portion of element **52** and constrained against longitudinal movement in either direction along the blade portion by the abutting faces presented by the clip and the shoulder portion.

Figures 17 and 18 illustrate the use of a plurality of elements **52** locked in parallel disposition within a connector block fashioned from insulating material. The connector block comprises a central disk **68** provided with radial slots, each slot being fitted to receive the intermediate portion **54** of an element **52**. As shown in Figure 18 a pair of insulating cores **70** and **72** are clamped in back-to-back relationship upon the center of disk **68** by an axially disposed rivet **74**. Each of these cores is provided with radially extending clearances aligned with the radially extending slots of disk **68** fitted so as to afford access to the end portions of the elements **52** and so as to form insulating barriers between adjacent end portions. As pointed out in greater detail in my copending application, the intermediate portion **54** of each element **52** is molded or otherwise permanently secured within its individual radially extending slot so that its end portions are maintained in fixed position within the respective fitted clearances provided in cores **70** and **72**. Thus, as shown for example in Figure 17, the portion **54** of element **52** there illustrated is fixedly secured in disk **68** with shoulders **56** and **58** in abutment against the opposing flat surfaces of the disk so as to reinforce element **52** against longitudinal movement within the radial slot in which it is held. The end portions of elements **52** function in the same manner as the end portions of any of the above-described interconnectors embodying my invention.

The opposing ends of each of the elements **52** may be made accessible, so that connectors of the type illustrated in Figure 8 for example may be interconnected with them, by removing the spring clips **76**, **78**, **80** and **82** and disassembling the insulating surrounding semi-cylindrical shells indicated at **84** and **86**. After the connections have been made they may be locked against accidental disconnection or protected against short circuits by restoring the insulating shells **84** and **86**.

From the foregoing it is apparent that the connectors, terminals and connecting elements described above are well suited to attain the ends and objects herein directly and indirectly set forth, and that they can be manufactured easily by conventional fabrication techniques, and that the various features and arrangements of parts can be modified readily so as best to suit a particular use. Certain features of the disclosure may be used to advantage in particular applications without a corresponding use of other features, and the elimination or modification of such features is to be construed as within the scope of this invention unless specifically excluded by the following claims or required by the scope of the prior art.

I claim:

1. A connector comprising a ferrule for connection to a circuit element, a strip-like blade of substantially uniform thickness extending freely therefrom, a clip on a portion of the blade remote from the ferrule, one face of said blade toward the free end portion thereof being planar for a distance back from the free end at least about twice the corresponding dimension of said clip, said clip extending integrally from a lateral edge of said end portion and across said planar face with spacing therefrom which, when the connector is unconnected, is slightly less than the thickness of the blade, and a bend on a straight line across the strip-like blade between the ferrule and the end portion forming a guide for engaging the end of a counterpart connector during connection to hold its clip portion within the region surrounding said planar face.

2. A connector comprising a ferrule having a blade extending from one end thereof, said blade being bent adjacent the ferrule to offset the remainder of the blade so that one face thereof is substantially on an extension of the axis of the ferrule, a clip on a portion of said blade remote from the bend, said clip extending from one lateral edge beyond said axial face and back across said face with spacing therefrom which, when the connector is free, is slightly less than the thickness of the blade, said clip being formed from an ear extending integral with the blade, extending laterally therefrom and folded back upon the blade through at least 180 degrees, and the length of the blade portion between the clip and the bend in the blade adjacent the ferrule being at least as great as the corresponding dimension of the clip.

JAMES C. MACY.

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