Feb. 1, 1966 L. G. FIALA 3,233,206

ELECTRICAL CONNECTOR

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FIG. 1

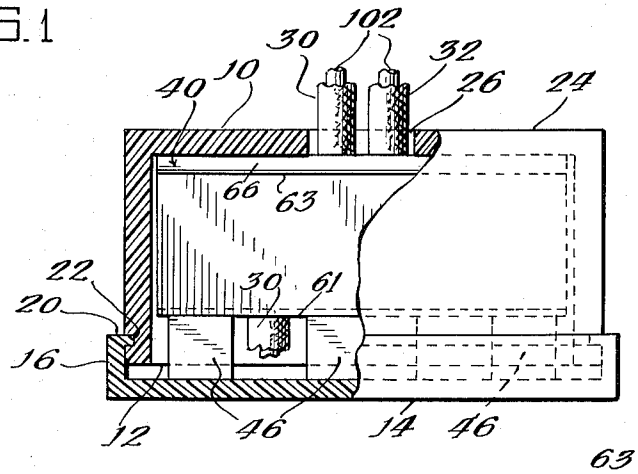
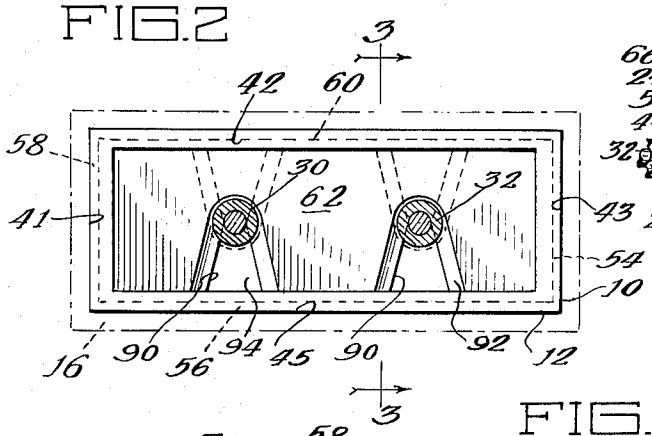


FIG. 2



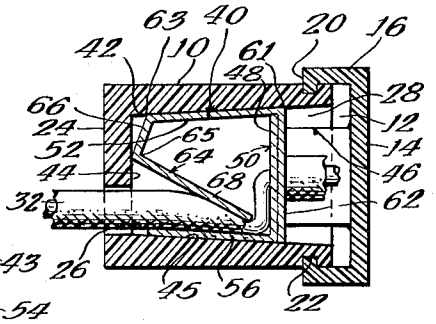


FIG. 3

FIG. 4

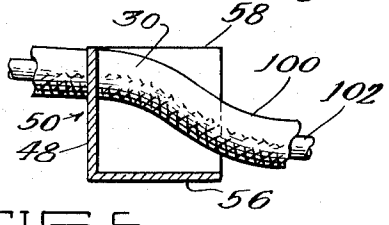


FIG. 5

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ELECTRICAL CONNECTOR

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FIG. 6

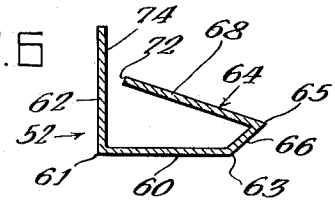


FIG. 9

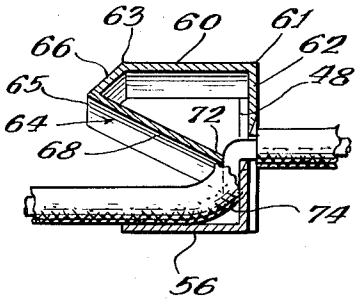
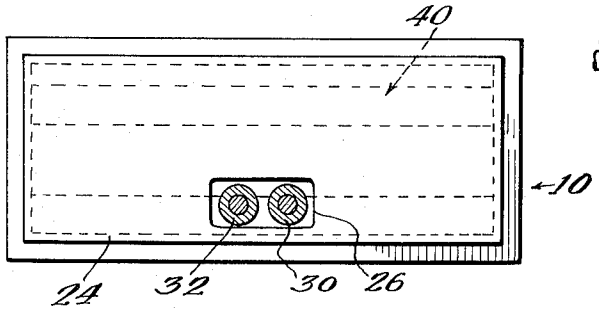


FIG. 7



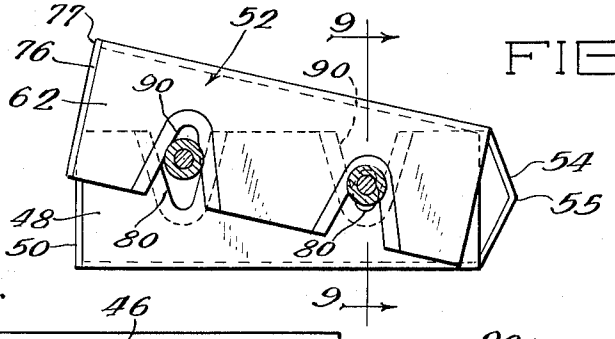


FIG. 8

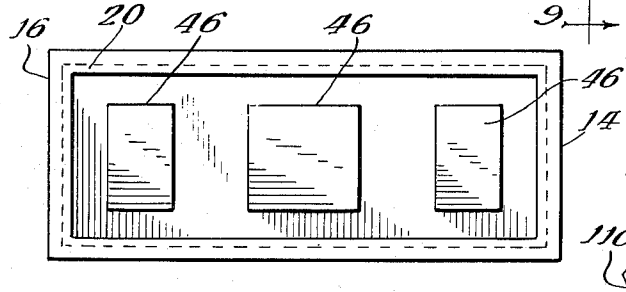


FIG. 10

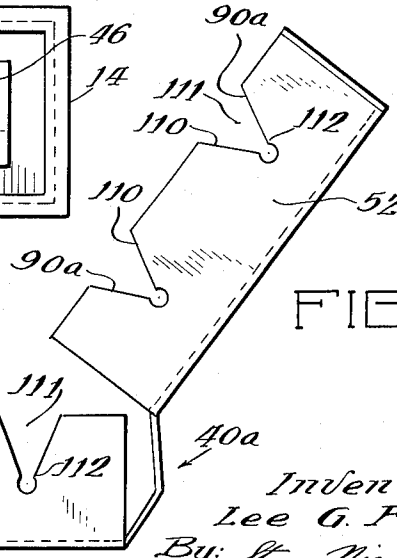
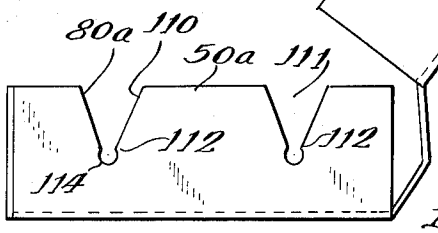


FIG. 11



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3,233,206

ELECTRICAL CONNECTOR

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Filed May 31, 1963, Ser. No. 284,466
7 Claims. (Cl. 339—98)

The present invention relates to solderless connectors for electrically interconnecting insulated wires without the necessity of manually stripping the insulation therefrom.

In the older forms of solderless connectors, it was necessary to manually strip the insulation from the wires to be joined before the wires could be connected. A large area of contact between the wires themselves or between the wires and their intermediate connector resulted, but the job of removing one or more layers of insulation proved to be a time consuming and costly job. In more recent connectors, the insulation was pierced by connector prongs in the process of assembling the wires to the connector. Another form of connector utilized mating jaws which were aligned on either side of the wires being connected resulting in line contact at diametric sides of the wire conductor. In this way, the necessity of stripping away the insulation was eliminated but the resulting area of contact was small and resulted in high resistance contact between the wires. Thus, if a large area of contact was required to insure efficient low resistance connection of the wires, the insulation had to be removed before the wires could be assembled into the connector. If the insulation was not removed prior to the placement of the wires in the connector, the user had to be content with small areas of contact and the resulting high resistance connection.

It is therefore an object of the invention to provide an improved solderless connector which does not require the removal of the insulation before assembly, yet which provides a large area of contact between the wires and the interconnecting conductor.

To provide this and other objects, the invention comprises a folded sheet metal connector which has a vertical stationary wall with channels slotted in its upper edge. These channels each extend mutually parallel, and spaced apart with tapering, converging sharp planar edges terminating in individual arcuate wire receiving edges. A second wall is hinged to close on said first wall toward a position parallel to and closely adjacent the stationary wall. The second wall has spaced channels spaced apart a distance like that of the stationary wall channels. On closure of said second wall, the arcuate edges of the channels on said walls confront one another to form bores about the wires received therein. On complete closure of said second wall, said bores completely sever the insulation on the respective wires.

An insulating housing is fitted over the connector and the wires are grasped and tugged once firmly to strip the wires bare for a section adjacent the bores. The housing cavity has a tapered wall which forces locking arm of the connector against the stripped section to depress the stripped section against the adjacent connector wall. The housing is then covered by a cap which exerts further pressure on the locking arm to maintain the stripped section firmly in contact with the adjacent connector wall in permanent fashion. Thus, a large area of contact between the wires and the connector is effected in an assembly process which eliminates the necessity of manually stripping the wires prior to assembly in the connector.

These and other objects and features will be apparent from the following detailed description viewed with the accompanying drawings in which:

FIGURE 1 is a plan view in elevation of a complete connector assembly embodying the present invention, the exterior housing of which is partially broken away to expose the conducting connector;

FIGURE 2 is a front elevational view of the connector assembly of FIGURE 1 with the front insulating cap removed;

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2;

FIGURE 4 is a front elevational view of a conducting connector removed from its housing and opened to its wire receiving position for the start of the assembly process;

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 4;

FIGURE 6 is a sectional view taken along line 6—6 of FIGURE 4;

FIGURE 7 is a rear view in elevation of the assembly of FIGURE 1;

FIGURE 8 is a front elevational view of the connector of FIGURE 4 in its partially closed position during the assembly process;

FIGURE 9 is a sectional view taken along line 9—9 of FIGURE 8;

FIGURE 10 is an elevational view of the insulating cap of FIGURE 1 removed from the housing and viewed from the rear or interior side; and

FIGURE 11 is an elevational view of a modified form of connector.

Turning now to the figures in detail, in FIGURE 1 there is shown a completely enclosed connector assembly including an outer housing **10**, generally rectangular in cross-section, which is fabricated of insulating material which may be of any suitable plastic, such as polyethylene. This housing **10** has an open front end **12** which is covered by an insulating cap **14**, also of polyethylene, which is in the form of a rectangular plate. The cap **14** has a rearwardly extending flange **16** about its perimeter, the flange terminating in an inwardly directed ridge **20** extending continuously about the flange. This ridge is adapted to snap fit into a groove **22** cut into the side, top and bottom walls of housing **10** parallel to the front opening **12**. The ridge **20**, by virtue of the inherent resilience of the cap material, yields sufficiently to slide into the groove **22** and resiliently locks the cap **14** onto the housing.

The housing rear wall **24** has a rectangular passage **26** leading from its inner cavity **28** to the exterior. Passage **26** is sufficiently large to accommodate the two insulated single conductor wires **30** and **32** which are joined or connected in the connector assembly. The wires **30** and **32** extend through the passage **26** in side-by-side arrangement into the housing cavity **28** for connection in the conducting connector **460**. The cavity **28** has five flat surfaces or walls within the housing **10**, designated **41**, **42**, **43**, **44** and **45**. The rear surface **44** is disposed normal to the opposed parallel side surfaces **41** and **43**. The top interior housing surface **42** is inclined downwardly at a slightly obtuse angle towards a line of joinder to rear surface **44** of the cavity. The cavity bottom wall **45** also is inclined slightly upwardly toward the rear wall, thus forming a cavity with a smaller cross section remote from the opening **12** than adjacent the opening **12**. It should be noted that the front cap **14** has three spaced, inwardly directed projections or embosses **46** which abut against and push on the front wall **48** of the base **50** of connector **40**, as will be more fully explained hereafter.

The connector **40** is constructed of suitable conducting sheet metal of light gauge to provide a degree of inherent resilience in the connector. The connector **40** is a unitary structure comprising a base **50** and a cover **52** both hinged together by a sidewall **54** as will be explained. In FIG-

URES 1, through 3 and 7, the connector is shown in its closed or final assembled condition. In FIGURES 4, 5, and 6 the connector is shown in its open condition and its construction can be understood from an explanation of the connector as shown in these last mentioned figures.

Base **50** includes a substantially vertical stationary front wall **48** having a length selected to fit loosely between the side surfaces **41** and **43** of the cavity **28**. The base front wall **48** meets a rearwardly extending floor **56** disposed at an angle to the front wall **48** equal to the supplement of the angle between the surafecs **44** and **45** of the cavity **28**. Extending from the edge of the floor **56** is double-acting sidewall hinge **54** which connects the cover **52** to the base **50**. This hinge has a bend **55** centrally thereof along a line parallel to the floor **56** to hinge the cover to the base in a manner allowing sideway movement of cover **52** for alignment with the base **50**. At the side of floor **56** opposite hinge **54**, the base has a sidewall **58** extending normally from the floor **56** to about the height of the front wall **48** and its rearward dimension matches that of the floor **56** to form the generally rectangular configuration of the connector. The connector is dimensionally designed for a slight interference fit within the housing cavity **28** to firmly position and lock the connector therein.

Cover **52** has a flat top wall **60** which extends from the end of the hinge **54**. This top wall **60** has a bend **61** slightly greater than a right angle and a section integrally forming a front wall **62** disposed parallel to the base front wall **48**. Top wall **60** has a rearward bend **63** parallel to the bend **61** forming an elbow-shaped locking brace **64**. The brace **64** has a bend **65** parallel to the bends **61** and **63** which forms section **66** extending rearwardly of the end of top wall **60**, and a second section **68** which terminates in a transversely extending edge **72** adjacent the rear surface **74** of cover front wall **62** and parallel to the bends **61**, **63** and **65**. Edge **72** has a length about equal to the transverse dimension of front wall **48**. A side wall **76** is formed by a bend **77** normal to the bend **61** at the end remote from the front hinge **54** to complete the generally rectangular structure of the cover **52**.

In the base front wall **48**, as viewed in FIGURE 4, there are two spaced-apart, parallel U-shaped channels **80** slotted into the top surface **82** of the front wall. These channels are each formed by sloping edges **83** which converge uniformly from their top opening **84** in surface **82** to terminate in an arcuate edge **86** slightly below the mid level of the front wall. The arcuate edges **86** of the front wall **48** and the straight edges **83** of these channels **80** are beveled or otherwise sharpened to produce channel edges which will cut through wire insulation.

Similar channels **90** are slotted into front wall **62** of the cover **52** with inwardly sloped edges **92** convergingly extending from top opening **94** in the front wall **62** to termination at an arcuate edge **96**. These channels **90** are spaced apart a distance equal to the distance between the base channels **80**, are alignable therewith on closure of the cover **52** on bending of hinge sidewall **54**, and have their straight edges **92** and arcuate edges **96** beveled or sharpened as previously mentioned for channels **80**.

The channels **80** are configured so that when wires **30** and **32** are placed individually in the channels, the insulation **100** of the wires rests near the top open end **84**, and when the wires are depressed into channels **80**, the straight edges **83** cut into the insulation. The converging shape of the straight edges **83** tends to cut the insulation more as the wires are depressed toward arcuate edges **86**. The across-the-channel dimension adjacent the arcuate edge **86** in each channel **80** is slightly smaller than the diameter of the circular cross section of the wire conductor **102** with the insulation **100** slit through. This dimensioning insures that the insulation layer will be fully cut through when the conductor rests on arcuate edge **86**. In this position, the outer surface of the wire

conductor **102** may be slightly scored but not sufficiently to impair the wire strength.

Channels **90** as shown are similar in shape, size and positioning to channels **80** for reasons which will become apparent as the assembly of wires into the connector assembly is explained. Further, it will be seen that each connector has channels dimensioned for a particular gauge wire for optimum ease of assembly.

To assemble wires **30** and **32** in a connector assembly, the first step includes threading the wire through wire passage **26** in the housing rear wall and thereafter passing these wires through the open front end **12** of the housing **10**. The housing may be held in any suitable way on the wires away from the wire ends to facilitate the connector assembly process.

A connector **40** is then held securely and individual wires **30** and **32** are positioned into individual channels **80** with at least an inch of wire projecting forward of base front wall **48**. These wires at this time rest within the channels closely adjacent the channel top openings **84** as shown in FIGURES 4 and 5. The hinged sidewall **54** is then bent so that cover front wall **62** pivots in a plane parallel to base front wall **48** and closely adjacent thereto. The cover front wall **62** is in front of the base front wall **48**, and as the channels **90** are aligned to confront channels **80** at their respective open ends, these channels **90** each cover the top half of the wires **30** and **32** resting in the base channels **80**.

The cover **52** is then further depressed onto base **50** and the sharpened straight edges **92** and arcuate edges **96** cut into the wire insulation **100** and force the wires downwardly onto sharpened straight edges **83** and sharpened arcuate edges **86**, as best illustrated in FIGURE 8. As the cover is further depressed downwardly, the channel edges cut through the insulation until the insulation is completely cut through by the cooperative cutting action of the base channel edges and cover channel edges. When the insulation **100** is completely cut through, each conductor **102** is abutting arcuate edges **86** and **96** and at that time, the top wall **60** is parallel and closely adjacent to top surface **82** of the front wall **48** of the base **50**. The upper and lower arcuate edges **86** and **96** combinedly form circular bores in abutment with the wire conductors with the insulation cut through circularly.

During this closure of the cover **52** onto the base **50** and consequent cutting through of the insulation, free edge **72** of the cantilevered section **68** of lock brace **64** is in abutment with the insulation layer of the wires **30** and **32** closely adjacent the rear surface of base front wall **48**. The wires **30** and **32**, however, are free to slide relative to the connector at this stage of assembly.

Thereafter, the connector **40** is inserted into the housing **10** with the front wall **62** facing the opening **12**. The wires **30** and **32** are then grasped in one hand and the connector held in the other and the wires are jerked sharply to bare or strip a section of the wires at the rear of the channel bores including scraping all nonconductive material from the entire area of the bared wire. As the housing **10** is forcibly advanced onto the connector, the cut in the insulation is lengthened, and the sloped interior top wall **42** and bottom wall **45** of the cavity successively depress the cover **52** to its full closed position over base **50**. Also, the bend line **65** is forced into abutment with the rear surface **44** of the rear wall **24** of the housing, and pressure is generated by the brace free edge **72** on the wires adjacent the cut in insulation. As the housing **10** is further drawn on the connector **40**, the free edge **72** is wedged against the stripped portions of both wires **30** and **32** being forced into contact with the edge **72** of the electrically conducting connector **40** and the floor **56** thereof.

This assembly is completed by placing the cap **14** on the housing open front end and compressing the cap onto the front edge of the housing perimeter until ridge **20** reaches and mates with the cooperating grooves **22** about

the housing perimeter adjacent to the front opening **12**. The connector **40** is secured in position by the three spaced bosses **46** which protrude rearwardly from the cap **14** into a compressive abutment with the front wall **62** of the cover **52** on either side of the wires **30** and **32**. The compressive force generated by these bosses holds the connector **40** tightly against the cavity rear wall **44** and maintains the tight electrical connection of the wires **30** and **32** to the connector **40**. The spaces between these projections **46** serve to contain the exposed portions of the wires **30** and **32** forward of the connector **40** and the wires must be cut to fit within this volume before mounting the cap **14** on the housing **10**.

As a result of this construction, a large area of contact between the wires **30** and **32** and the connector **40** is provided, in that three separate regions of contact to each wire are provided, namely: first, line contact between the wire conductors **30** and **32** and the channel edges **86** and **96**; second, surface contact between the edge **72** of the brace **64** and the conductors; and third, surface contact between the stripped conductors and the floor **56** and front wall **48** of the base. The insulation is cut through by the assembly process and the entire assembly is fully insulated by the protective outer housing **10**.

In the embodiment of the invention shown in FIGURE 10, the modified connector **40*a*** is identical to connector **40** except that the shape of the channels **80*a*** in the front wall of base **50*a*** and channels **90*a*** in the front wall of cover **52*a*** have been modified to what may be termed the key hole shape shown. The positioning, relative size and number of the channels have not been changed in this modification.

In describing the key hole shape, one of the channels **80*a*** will be described with the understanding that the remaining channels are shaped accordingly. In channel **80a**, the channel walls **110** angle sharply in a converging direction from the open edge **111** of the channel. These converging walls are edged by beveling or other similar means and reach aligned shoulders **112** on either side of the channel opening. From the shoulders, the edged walls **110** extend into a circular section **114**, the diameter of which is greater than the distance across the channel between confronting shoulders. This circular section **114** forms the bottom of the channel or arcuate edges on which the wire conductor rests at the conclusion of the assembly process.

In assembly, the wires **30** and **32** are placed individually in respective lower channels **80*a***, and will rest in the channels above the confronting shoulders **112**. The cover **52*a*** is pivoted and channels **90*a*** are aligned with channels **80*a*** and the cover is further closed. Shoulders in the upper channels **90*a*** depress the wires past shoulders **80*a*** cutting through the side insulation. The cover **52*a*** is further depressed forcing the wires onto bottom arcuate edges **114** cutting through the bottom insulation on the wires and arcuate edges of upper channels **90*a*** complete the severing of the insulation in a single annular cut on each wire. The circular section of both upper and lower channels cooperatively form a bore slightly larger in diameter than the diameter of the wire conductor but the narrowest portion of the channel **80** in the region of the shoulders **112** is slightly less than the diameter of the wire to insure that the insulation will be completely severed in the assembly process.

The remaining assembly steps are identical to that previously described, except that the shoulders **112** act to hold the insulation against movement when the wires are tugged sharply to bare a section of the wire conductors to produce a large contact area in the completed assembly.

It is to be noted that the present invention may be used to interconnect stranded wires as well as solid core wires. Also, more than two wires may be interconnected in a single wire lock by providing the necessary number of separate channels **80** and **90** for each wire.

From the foregoing disclosure, those skilled in the art will devise many applications, modifications and improvements within the intended scope of this invention. It is therefore intended that the scope of this invention be not limited by the foregoing disclosure, but rather only by the appended claims.

The invention claimed is:

1. A connector for electrically connecting insulated wires, comprising an electrically conducting base, a plurality of individual wire receiving channels in said base, edged walls in said channels for cutting through the insulation of wires placed in said base channels, a cover including a plurality of channels aligned with the channels in said base, said cover channel walls being edged to score and cut through the insulation of wires in said base channels on closure of said cover on said base, said base channel walls and said cover channel walls cooperating to sever the insulation about said wires on the closure of said cover on said base, an arm extending from said connector into contact with the wires adjacent the channels on the closure of said cover, an insulating housing fitting about said connector, said housing having walls positioned to act on said arm and force said arm against the wires adjacent the severed insulation to compress said wires into contact with the electrically conducting walls of said base, and means for restraining said wires in said position.

2. An electrical connector for joining a plurality of insulated wires into electrical contact comprising, a first conducting wall with a plurality of open-topped, edged wire receiving slots, a second conducting wall parallel and closely adjacent to said first wall, said second wall including a like plurality of slots aligned with the slots in the first wall and inverted with respect thereto to form a plurality of wire receiving bores extending through both said walls, said bores each having a diameter slightly smaller than the diameter of the individual conductors of the respective wires received in each of said bores, edged walls in each of said bores adapted to cut through the insulation about wire conductors on closure of said second wall into the bore forming position and for unsheathing a section of said insulation adjacent said walls on movement of said wires normal to said bores, a further conductive wall angled from one of said walls and in electrical contact with said one wall, said further wall contacting said wires along said unsheathed section to compress said unsheathed sections against the adjacent front wall to complete a compressive electrical contact between the wire conductors and said adjacent wall, and means for further compressing said further wall against said wires and maintaining said compressive contact permanently.

3. A connector for completing permanent electrical connection between insulated wires comprising a sheet metal base including a front wall and a bottom wall substantially rectangularly disposed from said front wall, channels cut into said front wall, each channel having an open top end and edged tapering sidewalls terminating at an arcuate edged lower surface, the across-the-channel dimension adjacent the arcuate bottom of each of said channels being of slightly lesser dimension than the diameter of the conductor of the respective wires placed into each of said channels, a sheet metal cover adapted to fit over said base, said cover including a front wall and a top wall, a wall hinging said cover to said base for pivotal motion in a plane parallel to said base front wall to align said front wall of the cover adjacent the front wall of the base, channels in the front wall of the cover alignable with the channels in said base, said cover channels including edged walls shaped similarly to the channel walls of said base, said channel walls cooperatively positioned to completely sever the insulation on said wires on the closure of said cover onto said base, an arm extending from the rear end of the top wall to contact the wires adjacent the severed insulation near the front wall of said base, an insulating housing fitting over said closed cover and said base, said housing including an open front end receptive of

the closed cover and base, and a rearwardly tapering cavity in said housing depressive of said arm on said housing being drawn over said base and cover to force said arm and the wires adjacent the bottom wall of the base and into electrical contact with the front wall and the bottom wall of the base.

4. A connector providing an electrical connection between a first and a second insulated wire, said connector including an electrically conducting lower structure, a first and a second parallel spaced channels slotted in said lower structure and having sharply edged walls extending from a top opening for receiving individual wires therein to a bottom arcuate edged surface, an upper structure hinged to said lower structure for movement with respect to said lower structure, said upper structure including a first and a second channel, each of the channels of the upper structure having an open end from which edged walls converge to an arcuate bottom wall, said upper structure movable into a covering relation to said lower structure wherein said first channel in a said upper structure confronts said first channel in said lower structure to cooperatively therewith form an oval shape enclosing the wire placed in said first channel of said lower structure, said upper structure movable further onto said lower structure to place said second channels into similar confronting relation about a wire in the second channel of the lower structure, said edged walls on said further movement cutting into the insulation in the wires in said channels, the channels in a final fully closed position of said upper structure each describing a circular opening about each of said wires of slightly smaller diameter than the diameter of the insulation on said wires to thereby fully cut through the insulation in said wires, means on said connector for scraping back a length of insulation from the fully cut through insulation and means forcing said wires under said scraped back insulation into contact with the connector and locking said wires in contact with said connector.

5. A connector for electrically interconnecting a first and a second insulated wire, including a metallic structure comprising a first vertical wall, a horizontal supporting wall jointed to said vertical wall at the bottom edge thereof, a first and a second parallel spaced-apart wire receiving channel in said vertical wall, said channels each having an open top and side edges which converge from said open top to terminate in an arcuate bottom edge, said channel edges beveled to cut into the insulation of first and second wires placed respectively in said first and second channels, a second vertical wall, means hinging said second vertical wall to said horizontal wall for movement in a plane parallel to said first vertical wall, said second vertical wall including a first and a second channel similar in shape and spacing to the channels in said first vertical wall, a horizontal cover wall extending from the edge of said second vertical wall opposite the open tops of the channels in said second vertical wall, said horizontal cover wall movable with said second vertical wall on movement thereof, said second vertical wall on movement about said hinge means pivotal to a position closely adjacent said first vertical wall with the first and second channels in said second vertical wall inverted and confronting the respective first and second channels in said first wall to enclose within said confronting channels the respective first and second insulated wires, said second wall further movable with respect to said first wall whereby said channel edges cooperatively act on the insulation of said wires to cut said insulation toward a final position wherein said first and second vertical walls are in mutual alignment and said confronting channels form individual bores about the first and second wires, the bores about each of said wires of diameter slightly smaller than the diameter of the respective conductors of the wires within said bores to completely sever the insulation about said wire conductors in said circular bores, an obliquely disposed wall extending from said cover wall from the edge opposite the joinder of the cover wall to the second vertical wall, said oblique wall positioned to commonly contact the first and second wires adjacent the severed insulation, said channel bores sized to hold the insulation on the opposed side of the vertical walls on movement of the wires in the direction toward the oblique wall to thereby strip bare a section of insulation on each of said wires, an insulating housing fitting over said metallic structure, inclined walls in said housing depressive of said oblique wall on movement of said housing toward said vertical walls to a final position in which said housing encloses said structure, said oblique wall responsive to the housing reaching said final position for compressing said stripped wire sections against a vertical wall and against the horizontal supporting wall and in electrical contact therewith, and cap means engageable with said housing for increasing the compressive force on said oblique wall and on said conductors to lock said electrical contact.

6. A connector for making electrical contact with an insulated wire comprising an electrically conducting base, a wire receiving channel disposed in said base, said channel having edged walls for cutting through the insulation of a wire placed in said base channel, a cover including a channel aligned with the channel in the base, said cover channel having walls edged to score and cut through the insulation of a wire in said base channel on closure of said cover on said base, said base channel walls and said cover channel walls cooperating to sever the insulation about said wire on the closure of said cover on said base, an arm extending from said connector into contact with a wire disposed in said channels on closure of said cover, and means operatively associated with the connector to act on said arm and force said arm against the wire disposed in the channels adjacent to the severed insulation to compress said wire into contact with the electrically conducting walls of said base.

7. A connector for electrically connecting insulated wires comprising an electrically conducting base, a plurality of individual wire receiving channels in said base, said channels having edged walls for cutting through the insulation of wires placed in said base channels, a cover including a plurality of channels aligned with the channels in the base, said cover channel walls being edged to score and cut through the insulation of wires in said channels on closure of said cover on said base, said base channel walls and said cover channel walls cooperating to sever the insulation about said wires on the closure of said cover on said base, an arm extending from the cover into contact with the wires adjacent to the channels on closure of said cover, and means acting on said arm to force said arm against the wires adjacent to the severed insulation to compress and maintain said wires into contact with the electrically conducting walls of said base.

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