

# United States Patent

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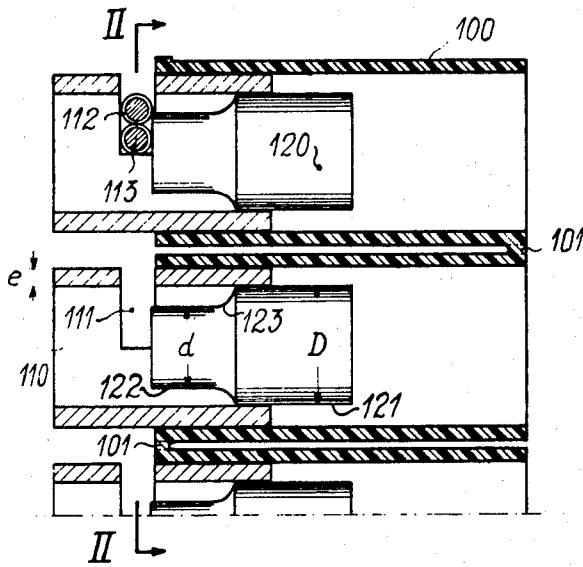
[54] **DEVICE FOR RAPIDLY INTERCONNECTING TWO INSULATED ELECTRICAL CONDUCTORS**  
2 Claims, 5 Drawing Figs.

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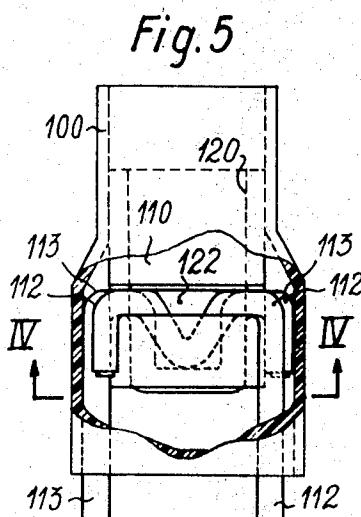
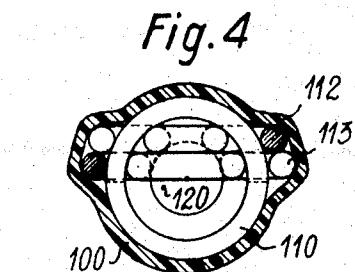
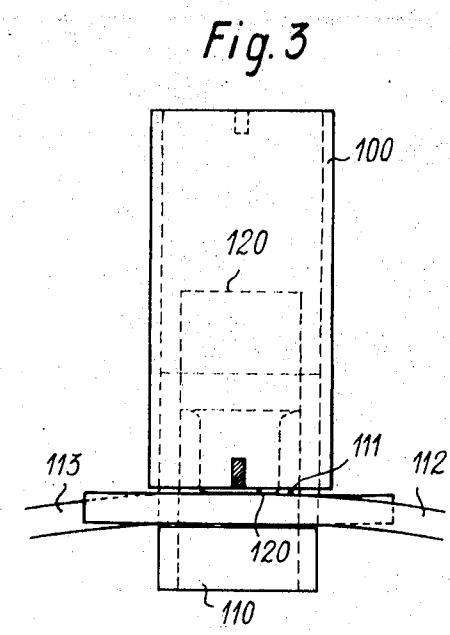
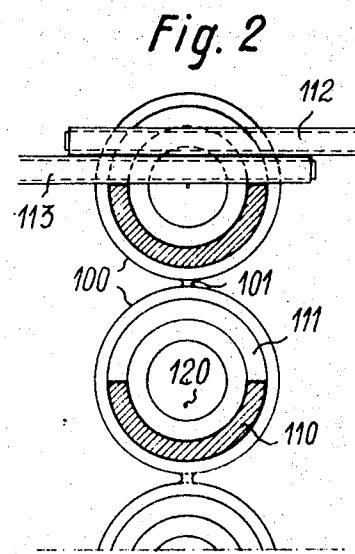
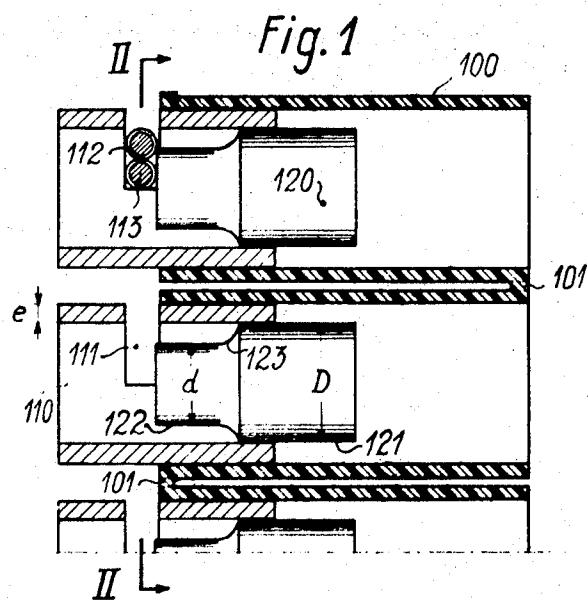
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F, 247

**ABSTRACT:** An article of manufacture for the rapid connection of insulated conductive wires without requiring previous preparation or stripping of the insulation to bare of the wires, the wires being clamped between a hollow metal cylinder and a piston slideable in the hollow metal cylinder; the hollow metal cylinder being formed with a radial slot extending substantially over half its diameter and this slot receiving the wires to be connected. The piston is moved to bend the wires and simultaneously tear the insulation thereof and thereby bring the wires into contact with one another. A hollow plastic cylinder surrounds the back portion of the cylinder and the piston and serves as insulation for the connection.



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## DEVICE FOR RAPIDLY INTERCONNECTING TWO INSULATED ELECTRICAL CONDUCTORS

This invention relates to an article of manufacture for rapidly interconnecting two insulated electrical conductors, the article of manufacture using simple means enabling the connection to be made without the wires having to be previously bared and without any other form of preparation beforehand. Also, the connections thus made are free from welds.

The form of connection described is of use in all cases in which it is required to join two conductors, more particularly for telephone lines having a large number of pairs where it is useful to be able to make connections automatically and rapidly.

Various connectors based on a clamping principle are known and these use a metal gripper in the form of a divided slat or strip. The slot or aperture is generally Y-shaped to guide the wire when the device is used and to clamp the cable core at the end of its travel after the insulation of the wire has been cut as the wire passes through the aperture; since the aperture is narrower than diameter of the wire and since the metal of the connection where the aperture is disposed is resilient, an electrical contact is made. As a safeguard and to reduce contact resistances, various means can be used to apply various pressure contacts to a single wire.

In another known embodiment of a connector, a single sheet-metal plate or sheet is pierced at a number of places by punching so that the material displaced from the apertures forms projections which pierce the insulation of the wires to be connected and provide the required contact by pressing on the system formed by the plate and the wires wound therearound.

In a third known embodiment, wires are connected by a small sheet-metal connector having a sinusously extending socket whose sides provide sharp edges formed by sheet-metal parts bent towards the inside. In use, the member is deformed so that the wires are immobilized therein and the projecting parts of the member penetrate into the insulation to make contact.

The method according to the invention comprises clamping the wires to be connected between a cylinderlike member and a pistonlike member slidable therein to pierce and remove the insulation when the members are positioned. Clamping is effected by jamming of the wires between the cylinder and piston and is maintained by the resilience of the metals used, any relative movement being prevented by static friction on the familiar principles of force fits.

A feature of the invention is therefore that electrical contact is made not by contacts bearing on sharp edges but by rubbing contacts, so that electrical resistance is reduced yet there is no appreciable reduction in the ability of the wires to withstand mechanical pulling.

Also, since it is unnecessary to provide a large number of contacts in order to achieve a low electrical resistance, the connector according to the invention is smaller than the known connectors. Its ease of use and the fact that it can be positioned by means of a pair of flat-nosed pliers mean that the connector according to the invention can be used in a simple automatic machine, an advantage more particularly for joining up two telephone cables having a large number of pairs, where the conventional procedure is first to mark the wires, then bare an appropriate length and then join them by stranding them together in twos, the final part of the operation being to insulate the joined-together conductors by means of oiled paper "cigarettes," then finish with a general wrapping up. When the connector according to the invention is used, the only manual steps are the marking of the wires and the placing thereof in a machine, which can place connectors on the wires at a rate of approximately 50/minute.

For improved reliability, protection can be given in the form of silicone greases, as recommended to insulate electrical contacts from external agents, more particularly dampness.

There is a minimum cylinder diameter for any wire diameter, determined by the formula:

$$D=2(2d+e)$$

in which  $D$  denotes cylinder diameter,  $d$  denotes the diameter of the conductor together with its insulation, and  $e$  denotes cylinder thickness.

Unlike some prior art connectors, the connector according to the invention can also be used with multistrand wires, although the large number of types of multistrand wires available makes it necessary to test before determining optimum connector dimensions.

The invention will be more clearly understood from the following description, reference being made to the accompanying drawings wherein:

FIG. 1 is a sectioned plan view of a loading strip or tape or the like on which a number of connectors are disposed;

FIG. 2 is a view in side elevation of a loading strip, the wires 15 which it is required to connect having been placed in a connector;

FIG. 3 is a plan view of a connector with the wires which it is required to connect in position, and

FIGS. 4 and 5 are views, in section and in plan respectively, 20 of a connector in use.

FIGS. 1 and 2 are views, in sectioned plan and side elevation respectively, of part of a loading facility. Connectors awaiting assembly are disposed in a thin flexible plastic strip formed by a number of hollow insulating plastic cylinders 100 which are interconnected by way of bridging sections as 101. A strip 100 resembles a hunter's cartridge belt. Each hollow insulating plastic cylinder 100 contains a connector comprising two rigid members 110, 120, member 110 being a hollow cylindrical tube formed with a radial aperture or slot 111 over half its diameter, while member 120 is a piston whose large-diameter part 121 slides with considerable friction within the walls of cylindrical member 110. The larger diameter part 121 of piston 120 is tapered by the circular fillet 123 to form a 30 reduced-diameter part 122 of the piston and the face of the reduced part serves as the tool for manipulating the connecting device.

Aperture 111 is adapted to receive two electrically conductive wires, as 112, 113, whose outer diameter is equal to the width of aperture 111 and which requires no barring nor any other preparation beforehand.

Effectively, plastic cylinders 100 constitute the first hollow cylinders and metal cylinders 110 constitute the second hollow cylinders, cylinders 110 having a radial slot 111. Metal piston 120 fitting in tight engagement within metal cylinder 110 provides good electrical contact between the bared and bent ends of conductors 112 and 113 shown in FIGS. 1 and 5. Thus, stripping, bending, connecting and locking are carried out simply by the movement of the piston within the metal cylinder in the plastic insulating cylindrical enclosure 100.

FIGS. 2 and 3 also show the position of the wires 112, 113 relatively to the connector before any positioning operation. The connector has been detached from the adjacent connectors to which it was stuck by parts, as 101, left by incomplete cutting of the plastic insulating material. The parts 101 are frangible to facilitate separation.

FIGS. 4 and 5 show the same connector after bringing into operation. The step of bringing the connector into operation mainly comprises applying pressure to the piston 120 to move the same in cylinder 110. As the piston moves, its part 122 engages and moves the wires 112, 113. As can be seen in the plan view in FIG. 5, the wire 113 has been bent at right angles into a rectangular shape, and the wire 112, which was moved 60 along by the piston in the same movement, has taken up a triangular shape. These various bendings are accompanied by the tearing of the insulation, which has been expelled from inside the connector; the diameters of the parts 122, 121, are calculated from the formula:

$$d=D-2e+0.2c$$

in which  $d$  denotes the diameter of part 122,  $D$  denotes the diameter of part 121 and  $c$  denotes the diameter of the conductor core. The term  $0.2c$  corresponds to a clamping of the wires sufficient for satisfactory electrical contact between the 75 same and the connector.

As the piston moves, the insulating sleeve 100 is also moved in the same direction and bends the two wires 112, 113 along the connector. The contact area is therefore insulated from the environment.

The connector described is of use with plastics and paper insulated wires. Connector diameter depends of course on wire diameters. To improve contact quality, the connector surfaces are tinned, tin also serving as an antifriction material.

Once the connector has been positioned, the contacting parts of the wires can be protected against oxidation by applications of silicone greases.

To apply a connector according to the invention, it is detached from the loading strip to which it sticks and the wires which it is required to connect are so placed in aperture 111 that their ends overlap for a length corresponding approximately to  $2 D$ . If pressure is then applied to the piston and sheath simultaneously, the facility takes on the appearance of FIG. 5.

It has been found by measurements that the electrical resistance of the resulting connections has a spread of from 0.5 to 1 milliohm for wires of 0.4 and 0.5 mm. diameter, corresponding on the average to a 1 cm. elongation of the connection wires. In the same conditions the best result given by a connector of a type not according to the invention corresponds to about five times the resistance of the connector according to the invention. Tensile breaking tests on wires connected by the connector according to the invention show that there is no impairment of the mechanical strength of the wires, breakages always occurring away from the connector.

Similarly, vibration and impact tests at different frequencies in conditions similar to the practical working conditions of an energized cable show no impairment of the contacts, and no impairment is found either in accelerated aging tests in a hot wet atmosphere.

What we claim is:

1. An article of manufacture for quick interconnection of two insulated electrical conductors comprising:
  - a. a first hollow insulating plastic cylinder;
  - b. a second metallic hollow cylinder smaller in diameter than the first cylinder and formed with a radial slot over about half of the diameter, said second cylinder being frictionally retained and lying partly within the first cylinder to expose said radial slot;
  - c. a metallic piston having a large-diameter part and a small-diameter part, said large-diameter part being frictionally retained and sliding within said second hollow cylinder with the small-diameter part projecting toward the radial slot of said second cylinder when making the connection to thereby bend and strip the conductors;
  - d. the slot of said second cylinder being adapted to receive two insulated electrical conductors next to each other so that, upon applying pressure to move said piston within said second cylinder, the top of the smaller diameter part is brought against the two wires and bends the wires at right angles relative to the remaining lengths of said two wires behind the bent portions, said bending forming a rectangular and triangular-shaped crimp in the wire while tearing the insulation.
2. An article of manufacture as claimed in claim 1, wherein a plurality of first hollow plastic cylinders are provided, each with a web interconnecting one plastic cylinder to an adjacent plastic cylinder so that each of the smaller metallic hollow cylinders with radial slot and frictionally fitting metallic piston may be used to strip, bend, connect and lock the ends of the connectors by movement of the piston within the cylinder and so that the plastic cylinder is broken at the web.

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