March 10, 1964 J. F. NISULA 3,124,409

ELECTRICAL CONNECTOR

Filed Dec. 11, 1961

Fig. 1.

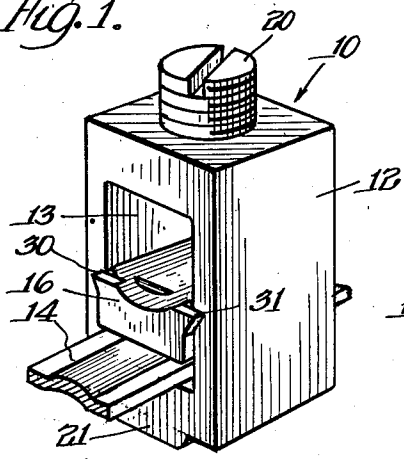


Fig. 4.

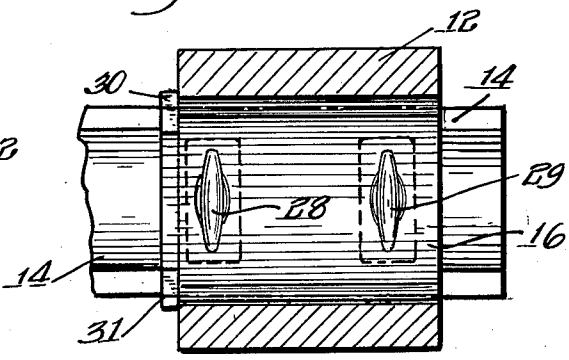


Fig. 3.

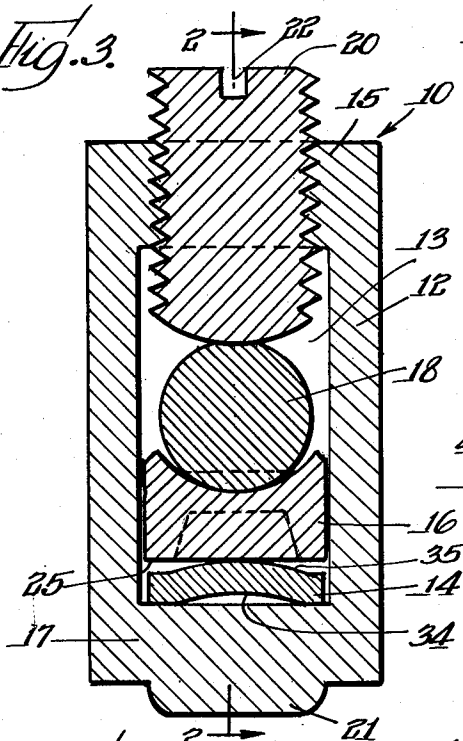


Fig. 2.

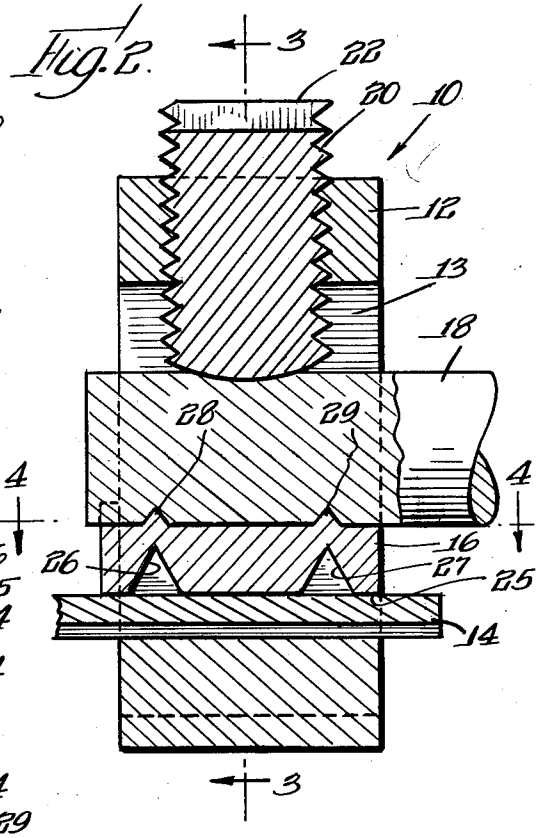
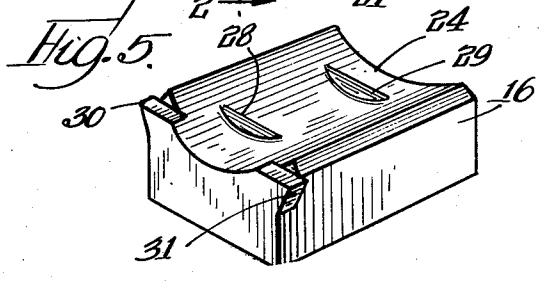


Fig. 5.



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ELECTRICAL CONNECTOR

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This invention relates generally to electrical connectors, and more particularly to an electrical connector particularly adapted to connect an electrically conductive wire composed mainly of aluminum to an electrically conductive terminal strap composed mainly of copper and forming part of an electrical device such as a switch or circuit breaker.

The different coefficient of thermal expansion between copper and aluminum and the tendency of non-conductive oxides to form rapidly on aluminum surfaces make it difficult to maintain a good electrical connection between a copper conductor and an aluminum conductor.

An object of the invention is to provide an improved connector for electrically joining copper and aluminum conductors wherein the copper conductor is resilient and is so shaped that its resiliency aids in maintaining a tight connection with low resistance. Other objects will appear when the following specification is considered in conjunction with the accompanying drawings wherein:

FIGURE 1 is a perspective view of a connector constructed in accordance with the invention and including a broken off portion of a copper conductor forming a part of an electrical device;

FIGURE 2 is a sectional view of the connector of FIGURE 1 taken generally along the line 2—2 of FIGURE 3;

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

FIGURE 4 is a sectional view taken generally along the line 4—4 of FIGURE 2; and

FIGURE 5 is a perspective view of an aluminum clamping shoe forming a part of the connector.

In the drawings, the connector **10** includes a body **12** formed of an aluminum alloy and having an aperture **13** of rectangular cross section extending therethrough. An end portion **14** of an electrical conductor formed of a copper alloy and which may constitute a part of an electrical device (not shown) extends into the aperture **13** for engagement with an inner surface of a lower portion **17** of the body **12**, and a clamping shoe **16** formed of an aluminum alloy is positioned in the aperture **13** for engagement with the conductor end portion **14** on the opposite side thereof from the lower portion **17** of the body **12**. An upper portion **15** of the body **12** is provided with a threaded aperture for receiving a clamping screw **20** preferably formed of steel and adapted to clamp an end of an electrically conductive wire **18** receivable in the aperture **13** against the clamping shoe **16**.

An electrical connection of low resistance between the wire **18** and the end portion **14** of the copper alloy conductor is able to be maintained by a connector **10** constructed in accordance with the invention when the wire **18** is formed of an aluminum alloy, and also when the wire **18** is formed of a copper or other metal alloy.

The lower portion **17** of the body **12** is formed with a downwardly projecting portion or rib **21** adapted to be held by the end portion **14** in a recess (not shown) in the casing of an electrical device to secure the body **12** thereto. The clamping screw **20** is provided with a slot **22** for receiving the tip of a screw driver (not shown).

The provision of the aluminum alloy clamping shoe **16** between the wire **18** and the end portion **14** of the copper alloy conductor of the electrical device has been found to result in a better electrical connection than when a wire **18** of aluminum is clamped directly to the end portion **14**. The clamping shoe **16** is formed with a concave upper surface **24** to provide a larger area of contact with the wire **18** than if the surface **24** were flat. A bottom surface **25** of the clamping shoe **16** is generally flat, but has a pair of recesses **26** and **27** therein generally triangular in cross section and formed by forming tools in a well known manufacturing operation which also forms a pair of ribs **28** and **29** on the upper surface **24** which are spaced longitudinally of and extend transversely to the wire **18** for better gripping thereof. A pair of ears **30** and **31** are formed on one end of the clamping shoe **16** to prevent the clamping shoe from sliding out of the body portion **12** in the direction of the other end.

In accordance with the invention, the copper alloy conductor end portion **14** is preferably formed of a high tensile strength bronze having a Rockwell B hardness of 72 to 84, in order that it may have a degree of resiliency. As best shown in FIGURE 3, the end portion **14** may be formed centrally thereof with a concavo-convex portion to provide a downwardly concave lower surface **34** and an upwardly convex upper surface **35** thereon. Other shapes could also be given to the end portion **14** to render it resiliently deformable. In the clamping of the wire **18**, the screw **22** is tightened sufficiently to cause the clamping shoe **16** to resiliently deform the end portion **14** in a manner which tends to flatten the curved cross section. Then, if any looseness develops as a result of alternate thermal expansion and contraction of the parts in cycles of use, the end portion **14** tends to resume its original curved shape, thus compensating for any slack and maintaining a good electrical connection.

Various modifications may be made in the structure disclosed without departing from the spirit and scope of the invention.

I claim:

1. An electrical connector comprising:
   (*a*) a body formed of an aluminum alloy and having an aperture extending therethrough,
   (*b*) an electrical conductor formed of a resilient copper alloy and having an end portion extending into said aperture in engagement with a lower portion of said body,
   (*c*) a clamping shoe formed of an aluminum alloy and positioned in said aperture in engagement with said end portion of said electrical conductor on the opposite side thereof from said lower portion of said body, said end portion of said electrical conductor being shaped differently from the engaging surfaces of said clamping shoe and said lower portion of said body so as to be resiliently deformable thereby, and
   (*d*) clamping means associated with an upper portion of said body and adapted to clamp an end of an electrically conductive wire against said clamping shoe and to resiliently deform said end portion of said electrical conductor by compression thereof between said clamping shoe and said lower portion of said body.

2. An electrical connector as claimed in claim 1, wherein
   said end portion of said copper alloy electrical conductor is provided with a portion having a concavo-convex cross section.

3. An electrical connector as claimed in claim 1, wherein
   said clamping shoe is provided with a generally flat bottom surface for engaging said end portion.

4. An electrical connector as claimed in claim 1, wherein
   said lower portion of said body is provided with a generaly flat surface partially defining said aperture.

5. An electrical connector as claimed in claim 1, wherein
   said clamping shoe is provided with an upwardly-con-

cave curved surface for engagement with said end of said electrically conductive wire.

6. An electrical connector as claimed in claim 1, wherein

an upper surface of said clamping shoe is provided with an upstanding rib for gripping said end of said electrically conductive wire.

7. An electrical connector as claimed in claim 1, wherein

an end of said clamping shoe protrudes from one side of said body and is provided with an ear preventing displacement of said clamping shoe toward the other side of said body.

8. An electrical connector as claimed in claim 1, wherein

said clamping means includes a screw threadedly received by said upper portion of said body and adapted to extend into said aperture.

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