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F. A. MARTA
ELECTRICAL CONNECTOR
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3,187,299

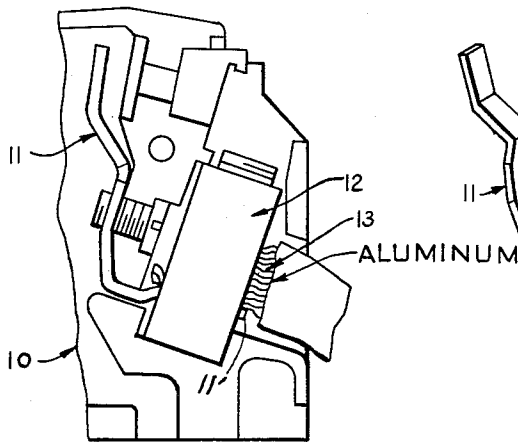


Fig. 1

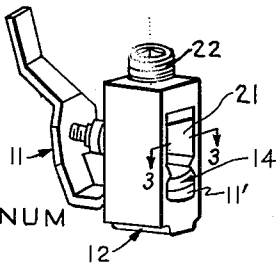


Fig. 2

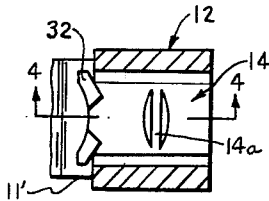


Fig. 3

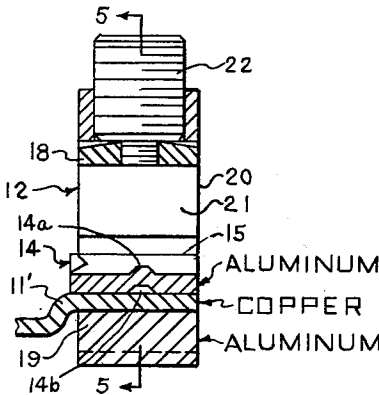


Fig. 4

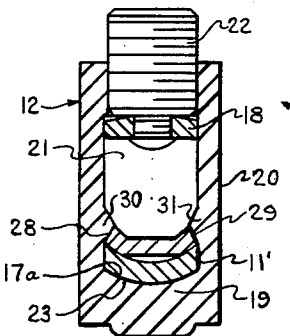


Fig. 5

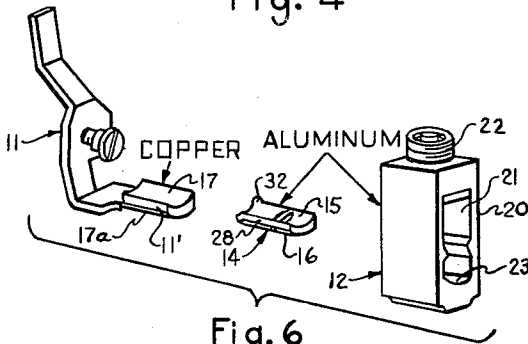


Fig. 6

INVENTOR.
FRANCIS A. MARTA

BY

Clyde H. Haynes
Attorney

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ELECTRICAL CONNECTOR

Francis A. Maria, Cleveland, Ohio, assignor to Square D Company, Park Ridge, Ill., a corporation of Michigan
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3 Claims. (Cl. 339-272)

This application is a continuation-in-part of my copending application Serial No. 821,307, filed on June 18, 1959, and now abandoned.

This invention relates generally to electrical connectors, and more particularly to a connector for electrically connecting a stranded aluminum wire to a copper terminal strap forming a part of an electrical device.

Electrical devices such as circuit breakers, safety switches, panelboards, and the like are usually provided with terminal straps made of copper and having electrical connectors of some form associated with their free outer end portions for detachably electrically connecting wire conductors thereto. The wire conductors formerly were almost always made of copper.

For compactness, weldability, and other reasons, the continued use of copper terminal straps in electrical devices is desirable, but in the electrical distribution systems of houses, commercial buildings, and factories, the use of aluminum wire has increased as aluminum has become relatively less expensive and more readily available in wire form. Much of this aluminum wire is stranded. The electrical connector of this invention enables stranded aluminum wires to be electrically connected to the copper terminal straps of electrical devices without overheating in use.

For safety and economy, an electrical connector should remain relatively cool when carrying its rated current. A connector is considered satisfactory with respect to temperature rise if its temperature does not increase more than 85 degrees centigrade above ambient temperature upon subjection of the connector to a 500 cycle current-temperature cycling test, each cycle including a period of two and one-half hours during which current flows through the connector followed by a period of one-half hour during which no current flows, the current being of a magnitude to cause an increase in the temperature of the connector of 70 degrees during the first cycle. In addition to the 85 degree temperature rise limitation, there must be no sharp temperature rise during the cycling test.

A large number of different connectors each adapted to electrically connect a stranded aluminum wire to a copper terminal strap were constructed and subjected to the aforementioned current-temperature cycling test before a connector constructed in accordance with this invention was conceived, constructed, tested, and proved satisfactory. All of the unsatisfactory connectors failed after a few current-temperature cycles. For example, one connector in which the stranded aluminum wire directly engaged the copper terminal strap was tested far beyond the failure point of 85 degrees temperature rise and had a temperature rise of 537 degrees after only 144 current-temperature cycles.

Failure was finally turned into success by a connector constructed in accordance with the invention, which gave a new and unexpected result of only 79 degrees temperature rise after 503 current-temperature cycles, the maximum temperature increase of 83 degrees occurring after 243 current-temperature cycles.

An object of this invention is to provide an improved connector for electrically connecting a stranded aluminum wire to a copper terminal strap forming a part of an electrical device.

Another object is to provide an improved electrical connector in which a stranded aluminum wire is adapted to

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be clamped in direct surface-to-surface engagement with one side of a unitary and homogeneous aluminum plate and a copper terminal strap of an electrical device is adapted to be clamped in direct surface-to-surface engagement with the other side of the aluminum plate.

Still another object is to provide an electrical device with an improved electrical connector and terminal strap assembly in which an end portion of a copper terminal strap is received in an opening in an aluminum body of the connector in direct contact with the aluminum body and a homogeneous aluminum plate is provided in the opening in direct contact with the copper terminal strap, the opening being adapted to receive an end portion of an aluminum wire on the other side of the aluminum plate from the end portion of the copper terminal strap, and in which clamping means are provided to clamp the aluminum plate between the end portions of the copper terminal strap and the aluminum wire.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is an elevational view of a portion of an electrical device such as a circuit breaker having a connector constructed in accordance with this invention mounted on a copper terminal strap of the device;

FIGURE 2 is a perspective view of the connector and terminal strap assembly of FIGURE 1;

FIGURE 3 is a sectional view taken as indicated by line 3-3 of FIGURE 2;

FIGURE 4 is a sectional view taken as indicated by line 4-4 of FIGURE 3;

FIGURE 5 is a sectional view taken as indicated by line 5-5 of FIGURE 4; and

FIGURE 6 is an exploded perspective view of the assembly of FIGURE 2.

As illustrated in FIGURE 1, a circuit breaker including a body portion 10 supports a copper terminal strap 11 having an end portion 11', and also supports a connector 12 constructed in accordance with this invention and adapted to electrically connect a stranded aluminum wire 13 to the end portion 11' of the copper terminal strap.

The connector 12 includes an aluminum body 20 having an opening 21 extending therethrough from one side to another side thereof and partially defined by a pair of opposed wall portions, one of which is identified by the numeral 19. The end portion 11' of the copper terminal strap 11 extends into the opening 21 and has a curved lower surface 17a in direct engagement with a curved linear surface 23 of the wall portion 19.

A unitary and homogeneous aluminum plate 14 is provided in the opening 21 of the aluminum body 20 and is formed with a curved lower surface 16 in complementary direct engagement with a curved upper surface 17 of the end portion 11' of the copper terminal strap, except at a recess 14b formed in the homogeneous aluminum plate 14 during the forming of a ridge 14a in a curved upper surface 15 of the plate 14. The ridge 14a aids in gripping an end portion of the stranded aluminum wire 13, which is adapted to be received in the opening 21 in direct engagement with the curved upper surface 15. If desired, the ridge 14a and recess 14b may be omitted.

The wall portion of the aluminum body 20 opposite the wall portion 19 threadably receives a clamping screw 22 extending therethrough into the opening 21 and cooperating with the wall portion 19 to urge the end portion of the stranded aluminum wire 13 and the end portion 11' of the copper terminal strap toward each other to clamp the homogeneous aluminum plate 14 therebetween. A pressure plate 18 may be rivetted to the inner end of the clamping screw 22.

A pair of tapered shoulders 30 and 31 may be provided respectively on another pair of opposed wall portions of the aluminum body 20 to extend inwardly into the opening 21 for respective engagement with a pair of opposed tapered side edges 28 and 29 of the homogeneous aluminum plate 14. When the end portion 11' of the copper terminal strap 11 and the homogeneous aluminum plate 14 are assembled in the aluminum body 20 by a press fit, a pair of ears 32, 32 is formed on the aluminum plate 14 during the assembly.

The interposition of a homogeneous aluminum plate between the stranded aluminum wire and the copper terminal strap would be expected to increase the electrical resistance of the assembly and result in an even more unsatisfactory connector than the one which joined the aluminum wire directly to the copper terminal strap and increased 537 degrees in temperature after 144 current-temperature cycles, since the number of electrical joints between the stranded aluminum wire and the copper terminal strap is thereby increased from one to two. Unexpectedly, however, the interposition of the homogeneous aluminum plate between the stranded aluminum wire and copper terminal strap resulted in a connector which passed the aforementioned current-temperature cycling test while all other constructions failed.

Heretofore, in the transmission of electrical power across country, aluminum wires have been electrically connected to copper wires by connectors which include aluminum body portions or separator members separating the wires sufficiently to prevent a drop of water from lodging between them and forming a bridge which will cause galvanic corrosion. To prevent high resistance, however, it is necessary to prevent direct contact between the copper wire and the aluminum forming the body portion or separator member by interposing a copper strip liner or an aluminum and copper bimetal strip liner between the copper wire and any aluminum forming the body portion or separator member of the connector. Thus, the result achieved by connectors constructed in accordance with this invention is all the more surprising when it is considered that in connectors for cross country power transmission lines direct contact between the copper wire and any aluminum portion of the connector is avoided.

It is conventional to plate aluminum parts of electrical connectors with a thin coating of a metal such as tin, and thus the aluminum body 20 and aluminum plate 14 may be plated without departing from the spirit and scope of the invention.

I claim:

1. An electrical connector and terminal strap assembly forming a part of an electrical device and comprising:
 - (a) an aluminum body having an opening extending therethrough from one side to another side thereof and partially defined by opposed first and second wall portions of said aluminum body,
 - (b) a copper terminal strap formed separately from said aluminum body as a part of an electrical device and having an end portion extending into said opening in direct engagement with an inner surface of said first wall portion of said aluminum body,
 - (c) a homogeneous aluminum plate disposed in said opening in direct engagement with said end portion of said copper terminal strap on the other side thereof from said first wall portion of said aluminum body, said opening being adapted to receive an end portion of an aluminum wire in direct engagement with said homogeneous aluminum plate, and
 - (d) a clamping screw threadedly received by said second wall portion of said aluminum body and extensible therethrough into said opening and cooperable with said first wall portion of said aluminum body in urging said end portions of said aluminum wire and said copper terminal strap toward each other to clamp said homogeneous aluminum plate therebetween.

2. An electrical connector and terminal strap assembly forming a part of an electrical control device and comprising:

- (a) an aluminum body formed in one piece and having an opening extending therethrough from one side to another side thereof and partially defined by opposed first and second wall portions of said aluminum body,
- (b) a copper terminal strap formed separately from said aluminum body as a part of an electrical control device and having an end portion extending into said opening in direct engagement with substantially the entire inner surface of said first wall portion of said aluminum body,
- (c) a homogeneous one-piece aluminum plate separable from said copper terminal strap and disposed in said opening with substantially the entire surface of one side thereof in direct contact with said end portion of said copper terminal strap on the other side thereof from said first wall portion of said aluminum body, said opening being adapted to receive an end portion of an aluminum wire in direct contact with said aluminum plate, and
- (d) a clamping screw threadedly received by said second wall portion of said aluminum body and extensible therethrough into said opening and cooperable with said first wall portion of said aluminum body in urging said end portions of said aluminum wire and said copper terminal strap toward each other to clamp said aluminum plate therebetween.

3. An electrical connector and terminal strap assembly forming a part of an electrical device and comprising:

- (a) a connector body having an opening extending therethrough from one side to another side thereof and partially defined by opposed first and second wall portions, said first wall portion being aluminum,
- (b) a copper terminal strap separate from said connector body and having an end portion extending into said opening between said first and second wall portions of said connector body, said end portion being disposed adjacent said first wall portion in spaced relationship to said second wall portion,
- (c) a homogeneous aluminum plate separate from said connector body and disposed in said opening between said first and second wall portions in direct engagement with said end portion of said copper terminal strap on the other side thereof from said first wall portion, said opening being adapted to receive an end portion of an aluminum wire in direct engagement with said homogeneous aluminum plate, and
- (d) a clamping screw threadedly received by said second wall portion of said connector body and extensible therethrough into said opening toward said first wall portion and cooperable with said first wall portion in urging said end portions of said aluminum wire and said copper terminal strap toward each other to clamp said homogeneous aluminum plate therebetween.

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JOSEPH D. SEERS, *Primary Examiner.*

75 M. HENSON WOOD, JR., *Examiner.*