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ELECTRICAL CONNECTOR

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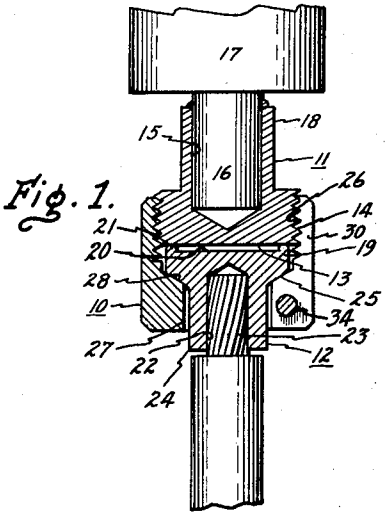

Fig. 1.

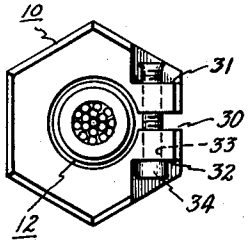

Fig. 2.

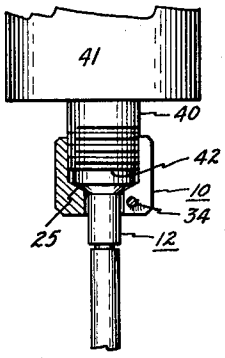

Fig. 4.

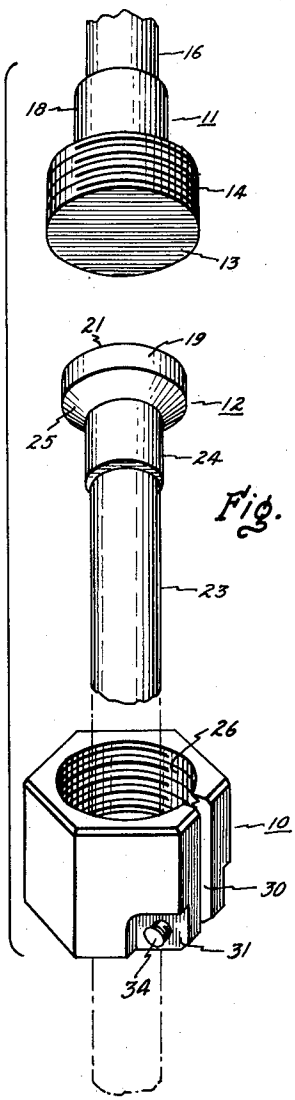

Fig. 3.

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ELECTRICAL CONNECTOR

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4 Claims. (Cl. 339—268)

This invention relates to electric connecting means, and more in particular to an improved electrical connector especially adapted for connecting stationary electrical apparatus to the central conductor of a high voltage bushing mounted on the tank of the apparatus. As will be seen from the following disclosure of our invention, however, the electrical connector may also be advantageously employed in other applications.

Electrical apparatus, such as transformers and high voltage switches that are normally housed in metallic enclosures, employ bushings to insulate the electrical conductors that carry electrical energy through the enclosing housing. As a matter of economy, transformer bushings, required to carry currents of about 600 amperes or less usually are of the type in which an insulated cable or lead from the transformer extends through the bushing and is affixed to a stud or connector at the upper end of the bushing. This arrangement has been found to have the advantages of simplicity, economy of parts, and ease of assembly. In the case of higher current rating transformer bushings, however, the through lead would be too stiff and heavy to draw through the bushing, and in many cases it would require an increase in the diameter of the components of the bushing. Therefore, in the higher current rating bushings, the bushing is provided with a central conductor that is affixed to the transformer lead internally of the transformer enclosure.

In high voltage switching apparatus, it is common practice to support the switch mechanism from the bushing conductor, and therefore the bushing conductor must be rugged enough to carry the current, and the bushing must have sufficient mechanical strength to support the switch assembly.

In the event of failure of a low current transformer bushing (i.e., one adapted to carry about 600 amperes or less) a high current bushing may be substituted therefor temporarily or permanently by cutting a portion from the transformer cable and fastening it internally to the end of the high current bushing.

Difficulty has been encountered in the making of such connections, however, since the limited space available in the apparatus enclosure frequently prohibits the use of standard wrenches or other tools to satisfactorily tighten said connectors. A further difficulty arises in the precautions that must be taken to prevent the accidental dropping of connector components or tools in the enclosure of the apparatus, since serious damage may result to the apparatus if any metallic parts thus dropped are not removed. In addition, it is also required that any connector thus employed must not have metallic projections, such as lugs, that reduce the strike distance from the internal end of the bushing to surrounding metallic parts of the apparatus.

The problem of connecting the transformer lead to the bushing becomes increasingly difficult when it is desired to restore a low current bushing in a transformer on

which the cables have been cut for temporary use with a high current bushing.

It is therefore an object of this invention to provide an improved electrical connector.

Another object is to provide a threaded electrical connector especially adaptable for internal connection of a high voltage bushing to the leads of electrical apparatus.

Still another object of this invention is to provide an improved threaded electrical connector in which a positive electrical connection is obtainable without the use of large wrenches or other large tools.

A further object of this invention is to provide a threaded electrical connector having means for obtaining a positive electrical contact in a limited working space, and characterized by a minimum of projections that tend to reduce electrical strike distance between the connector and conductive members in the proximity of the connector.

A still further object is to provide connector means in electrical apparatus to facilitate the substitution of high current electrically insulating bushings having fixed central conductors for low current bushings of the hollow central conductor type, the connector means also facilitating the restoring of low current bushings on said apparatus.

Briefly stated, in accordance with the preferred embodiment of our invention, we provide an electrical connector comprised of a split nut having internal threads in one end portion joined to an unthreaded aperture in the other end portion by a tapered central portion, the unthreaded portion having an internal diameter less than that of the threaded portion. A first connector member is provided having a first cylindrical portion extending through the unthreaded portion of the split nut, a second cylindrical end portion having a contact face, and a tapered central portion extending outwardly from the first cylindrical portion of the first connector to join the second cylindrical end portion and having the same taper as the tapered central portion of the nut. A second connector member is provided having a generally cylindrical end portion externally threaded to engage the threads of the threaded end of the nut. The second connector has a contact face on the end adjacent the external threads adapted to contact the contact face of the first connector member inside of the nut. Releasable locking means, such as a screw, provide a force tending to close the split edges of the nut, thereby imparting an axial force on the first connector member to establish positive electrical contact between the contact faces of the connector members.

Our invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing:

Fig. 1 is a cross sectional view of the connector of this invention employed to connect the central removable conductor of a type of high voltage bushing commonly used on transformers to an electrical apparatus cable;

Fig. 2 is an end view of the connector of Fig. 1;

Fig. 3 is an exploded perspective view of the connector of Fig. 1; and

Fig. 4 is a cross sectional view of a modified form of the connector of this invention showing the connector attached to a solid conductor bushing commonly used in switchgears or transformers.

Referring now to the drawing, and more in particular to Figs. 1, 2 and 3, therein is shown an electrical connector comprised of a nut **10**, a threaded connector **11**, and a beveled connector **12**.

The threaded connector **11** is generally cylindrical in shape and has a substantially flat face **13** on one end, and

an externally threaded portion 14 adjacent the flat face. The threads on the portion 14 are preferably standard threads. The other end of the connector 11 is provided with a hole 15 to receive the central removable conductor 16 (which may be a flexible cable or a rod) of a high voltage bushing 17 (the upper portions of the bushing being omitted in the drawing for the sake of clarity) and the conductor is rigidly held in the hole 15 by brazing or any other convenient method. The portion 18 of the connector 11 adjacent the hole 15 may have a diameter less than that of the threaded portion 14.

The beveled connector 12 has a cylindrical end portion 19 having a substantially flat face 20 on one end thereof, and an annular ridge 21 extending from the face 20 thereof. The other end of the connector 12 is provided with a hole 22 to receive an electrical cable 23, the cable being brazed or otherwise rigidly held in the hole 22. The diameter of the cylindrical portion 24 of the connector adjacent the hole 22 is less than the diameter of the cylindrical portion 19 of the connector adjacent the face 20, and a tapered portion 25 joins the portions 24 and 19.

The nut 10 is provided with an internally threaded portion 26 on one end with threads matching those of the threaded portion 14 of the connector 11. The other end of the nut 10 is provided with a drilled portion 27 having slightly larger internal diameter than that of the end portion 24 of the connector 12 and less than the diameter of the threaded portion 26 of the nut. The central internal portion 28 of the nut 10 joining the portions 26 and 27 has a bevel of substantially the same angle as the beveled portion of the connector 12.

The nut 10 has an axially extending split 30, and a pair of faces 31 and 32 parallel to the plane of the split 30 are machined or otherwise formed on opposite sides of the split 30 adjacent the end of the nut having the drilled portion 27. A hole 33 is drilled through the nut and intersecting the split 30 normal to the plane of the split and the faces 31 and 32, thereby passing through portions of the nut on both sides of the split. The hole 33 is threaded between the face 31 and the split 30, and a locking screw 34 is provided passing freely through the portion of the hole 33 between the face 32 and the split 30 and threaded into the threaded portion of the hole 33. The head of the screw rests against the face 32, and the other end of the screw is preferably peened over to prevent its accidental removal. The nut 10 is fabricated from a material such as drawn brass that has sufficient elasticity to open the split 30 to its original width upon release of the force of the locking screw 34.

As illustrated in Fig. 4, the function of the threaded connector may be provided by externally threading the lower end of the central fixed conductor 40 of a bushing 41, such as a bushing of the previously described high current type, and providing a contact face 42 on the end of the conductor 40.

The annular ridge of the contact face of a tapered connector 12 may be omitted, as shown in Fig. 4, although it is preferred that some projection be provided in order to obtain positive contact over as great an area as possible, since there is a possibility that contact will be made on only several small areas of the contact face if machined flat contact faces are used on both of the connector members.

In order to install the connector of this invention, the threaded connector member 11 is affixed to the central conductor of a bushing, or any other conductor on which the connector is to be employed, or as an alternative as seen in Fig. 4, the conductor itself is threaded. The nut 10 is slipped over the cable of the electrical apparatus and the beveled connector 12 is then affixed to the cable. Then the nut 10 is slipped into position, as shown most clearly in Fig. 1, so that its beveled portion is in engagement with the beveled portion of the connector 12,

and the nut is then screwed manually on the connector 11 (or threaded conductor 40 of Fig. 4) until the contact faces of the two connectors 11 and 12 meet. The connector assembly is then tightened, by means of the locking screw 34 to make positive electrical contact between the connectors 11 and 12. If the connectors are affixed to their respective conductors prior to assembly of the apparatus, and if the end of the locking screw is peened over as has been previously stated, there is no danger of components of the connector falling into the apparatus.

Tightening of the locking screw 34 forces the split edges of the nut 10 closer together, and due to the beveled portions of the nut 10 and the connector 12, forces the contact face of the connector 12 into closer contact with the contact face of the connector 11. If the two contact faces are brought into contacting relationship by manually screwing the nut 10 on the threaded connector 11, only a slight amount of turning of the locking screw is required to establish a positive electrical contact between the two contact faces. A small tool such as an Allen wrench provides sufficient torque on the locking screw 34 to establish positive electrical contact.

The locking screw 34 is positioned, as seen in Figs. 1 and 4, on the end of the nut 10 adjacent the tapered connector 12, in order that positive contact pressure is established before the threads of the nut lock in the threads of the threaded connector 11. In other words, with this positioning of the locking screw the necessary axial movement of the beveled connector 12 to insure positive electrical contact occurs before further closing of the split nut is prevented by jamming of the threads of the nut and threaded connector. With this arrangement, standard threads may be employed on the connector assembly.

In order to reduce the electrical strike distance from the connector assembly to adjacent apparatus parts, the locking screw should not project beyond the radial extremities of the connector assembly. To this end, it is preferred that the axis of the locking screw pass through the split of the nut 10 at a distance from the axis of the nut closer than the internal radius of the threaded portion of the nut. The edges of the nut should also be rounded or chamfered to reduce the nonuniformity of the electrical field surrounding the connector.

While the invention has been disclosed with particular reference to use in connecting electric apparatus cables to high voltage bushings, it is obvious that the connector may be employed in the connection of electrical conductors for other applications without departing from the spirit or scope of the invention.

It will be understood, of course, that, while the forms of the invention herein shown and described constitute preferred embodiments of the invention, it is not intended herein to illustrate all of the possible equivalent forms or ramifications thereof. It will also be understood that the words used are words of description rather than of limitation, and that various changes may be made without departing from the spirit or scope of the invention, and it is aimed in the appended claims to cover all such changes as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electrical connector comprised of a nut member, a first connector member, a second connector member, said first connector member having a first contact face on one end thereof and an externally threaded portion adjacent said one end, said second connector member having a second contact face in contacting relationship with said first contact face and a tapered portion adjacent said second contact face and extending radially inwardly therefrom, said tapered portion being disposed axially beyond said second contact face in the direction

away from said first contact face, said nut member having an axially extending split, an internally threaded portion on said nut member engaging said externally threaded portion and an internal tapered shelf portion engaging the tapered portion of the second connector member, and releasable locking means located axially beyond said tapered shelf in the direction away from the tapered portion of said second connector member providing a force tending to close said split, whereby the closing of said split causes said tapered shelf to bear against the tapered portion of said second connector member and thus force said second contact face of the second connector member axially away from said shelf into positive electrical contact with said first contact face of the first connector member.

2. An electrical connector comprised of a nut member, a first connector member, a second connector member, said first connector member having a generally cylindrical end portion with a contact face at the end thereof and an etxernally threaded portion adjacent said one end, said second connector member having a first cylindrical end portion ocaxial with and in contacting relationship with the contact face of said first connector member, a second cylindrical end portion having a diameter less than said first cylindrical end portion, and a tapered central portion joining said first and second cylindrical portions, said tapered central portion being disposed axially beyond the end of second connector in the direction away from said first contact face, said nut member having an axially extending split, an internally threaded end portion of said nut member engaging said externally threaded portion of said first connector member, a tapered internal central portion of said nut adjacent said internally threaded portion and engaging said tapered central portion of said second connector member, and an apertured end portion surrounding said second cylindrical portion of said second connector member, and releasable locking means on said nut member located axially beyond the tapered internal portion of said nut in the direction away from the tapered central portion of said connector member providing a force tending to close said split, said means comprising a screw extending through said split in said apertured end portion and normal to the plane of said split, whereby the closing of said split causes the tapered internal central portion of said nut to bear against the tapered central portion of said second connector member and thus force the first end of said second connector member axially away from said tapered internal central portion into positive electrical contact with said contact face of the first connector member.

3. The connector of claim 2 in which said screw extends through said split in said apertured portion of said nut member and on an axis radially inward of the threaded portion of said nut member.

4. An electrical connector comprised of a nut member, a first connector member, and a second connector member in axial alignment, and a releasable locking means, said first connector member having a first generally cylindrical end portion with a first contact face at the end thereof and an externally threaded portion adjacent said first contact face, said second connector member having a second cylindrical end portion with a second contact face at the end thereof and a third cylindrical portion having a diameter less than that of said second cylindrical portion, and a tapered central portion joining said second and third cylindrical portions extending radially inwardly and axially away from said second cylindrical portion in the direction away from said first contact face, said contact faces being in contacting relationship and extending in a plane perpendicular to the axis of said member, said nut member having an internally threaded one end portion in engagement with the threaded portion of said first connector member, an internally tapered central portion in engagement with the tapered portion of said second connector member, an apertured other end portion surrounding at least a part of said third cylindrical portion of said second connector member, and an axially extending split, said locking means being comprised of a screw extending through said split in said apertured end portion of said nut normal to the plane of said split on an axis radially inward of the threaded portion of said nut, said screw being threaded in said nut member on one side of said split and being confined within the radial extremities of said nut member, and said screw being located axially beyond the internally tapered central portion of said nut in the direction away from the tapered portion of said second connector member, whereby the closing of said split causes the tapered central portion of said nut to bear against the tapered portion of said second connector member and thus force said second contact face of the second connector member axially away from said tapered central portion into positive electrical contact with said first contact face of the first connector member.

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