May 24, 1960 H. H. KOBRYNER ET AL 2,938,191

ELECTRICAL PRESSURE CONNECTOR

Filed Feb. 24, 1958

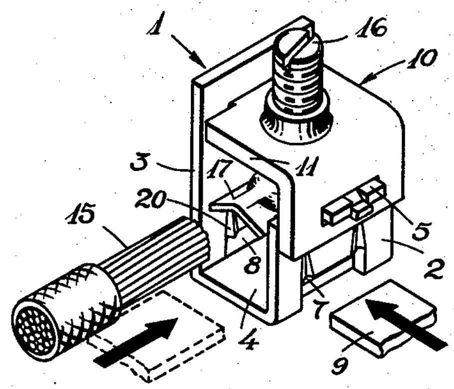

Fig. 1

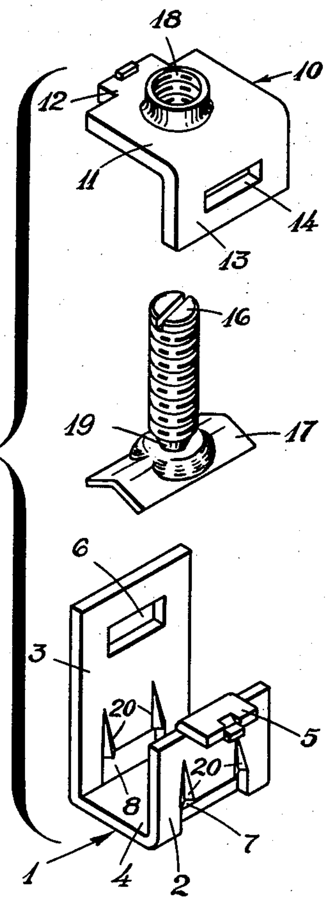

Fig 2

INVENTORS
HERMAN H. KOBRYNER
GEORGE A. OLSEN

BY John M. Calimafde
ATTORNEY

United States Patent Office 2,938,191 Patented May 24, 1960

2,938,191

ELECTRICAL PRESSURE CONNECTOR

Herman H. Kobryner, Forest Hills, and George A. Olsen, Farmingdale, N.Y., assignors to Murray Manufacturing Corporation, Brooklyn, N.Y.

Filed Feb. 24, 1958, Ser. No. 717,114

2 Claims. (Cl. 339—272)

This invention relates to pressure connectors for electrical conductors, and more particularly to such connectors suitable for a wide range of wires; for example, wires from number 4 (A.W.G. B. & S. gauge) to 250 MCM.

Electrcial pressure connectors are now well known in the industry. Generally, the connector comprises a cradle member in the shape of a U for supporting a conductor, a bridge member extending across the open end of the U, and a pressure applying means mounted to the bridge member. The cradle member is usually formed with slots in the opposite legs thereof, adjacent the base, for accommodating a fitting which, for example, may be a bus bar. The pressure applying means, in connectors of the size to which this invention relates, is usually a pressure plate swivel-mounted at an end of a screw. The purpose of the pressure applying means is to force the conductor against the fitting and to maintain such contact for a substantial period of time.

Although the connector is comparatively simple in construction, considerable effort has been expended by the industry for the development of a standardized connector which is suitable for a wide range of wires; from relatively small, e.g. No. 4, to relatively large, e.g. 250 MCM.

A standardized connector must fulfill many varied and diverse requirements. For example, the connector should be capable of retaining conductors of either aluminum or copper with equal efficacy. When it is realized that aluminum cold-flows under high pressure, the fulfillment of this requirement is not a trivial consideration. If such pressure is applied as to cause the aluminum to cold-flow, the effective holding power of the connector is decreased, and if the conductor is subjected to vibratory forces, it will become detached from the connector. Therefore, the force exerted by the pressure applying means must be sufficient to press and maintain the conductor securely against the fitting without causing the aluminum to cold-flow.

Another problem is the selection of the proper type of screw for driving the pressure plate. In most of the known type connectors, the type of screw is determined by the size of the connector, and the size of the connector is controlled by the size of wire for which it is intended. The smaller connectors generally use a screw having a slot for a screw driver, and the larger connectors use a screw having a head adapted for tightening with a wrench. Tests have shown that technicians using a screw driver exert a torque of approximately 50 pounds-inch, whereas when using a wrench, they exert approximately 250 pounds-inch. Therefore, connectors using wrench-head screws must be considerably more rugged to withstand this additional force. This "ruggedness" adds undesirably to the bulk of the connector which limits its usefulness to devices where sufficient space is available. It would seem, therefore, advantageous to use the slot type screw; however, such screw does not permit sufficient force to be exerted to hold securely

the larger size conductors. The Underwriter Standards require that a connector designed for wire up to 250 MCM be capable of withstanding a wiggle test with a 60 pound load at the end of the wire and a pullout test with a 500 pound load. Further, the connector must be able to carry 250 amperes without overheating. That is, the temperature rise of the connector may not exceed 25° C., while the connection conducts the rated current.

The temperature rise is a function of several factors, a few of these being the area of contact between the conductor and the fitting, the force of contact, and the heat produced by eddy currents and hysteresis losses in the connector body. The area and force of contact are determined largely by the design of the connector, and the hysteresis and eddy current losses are a result of the magnetic fields traversing the connector body.

Another problem in developing a standardized connector for a wide range of wires is the design of a cradle member which is capable of centering the wires (small and large), on the fitting.

Thus, because of these many varied problems requiring solutions which appear to conflict with each other when combined in a unitary structure, manufacturers have in the past designed connectors for the specific jobs.

Thus, it is a primary object of my invention to provide a standardized connector capable of accommodating a wide range of wires of either aluminum or copper.

It is a feature of my invention to provide a connector utilizing a screw adapted to be tightened by a screw driver rather than a wrench, whereby the connector is subjected to the smaller forces, thereby permitting the connector to be made smaller in size.

It is a further feature of my invention to provide a uniquely shaped screw, in combination with the connector, which exerts a greater force than is exerted by the conventionally designed screw.

It is a further object of my invention to provide a cradle member capable of centering the wide range of wires on the fitting.

It is another object of my invention to reduce the eddy current and hysteresis losses in the connector.

In accordance with a first aspect of my invention, the connector comprises a cradle member in the shape of a U, the opposite legs thereof having slots extending along the base and conforming to the shape of a fitting. The fitting is positioned through the slots and a conductor is mounted between the legs of the U on the fitting. A bridge member is secured to the opposite legs of the cradle member, and means are provided mounted to the bridge member for pressing the conductor against the fitting. This aspect of my invention is characterized by making the cradle member of non-magnetic material whereby the eddy current and hysteresis losses in the connector are reduced.

In accordance with another aspect of my invention, the cradle member comprises a pair of projections on the inside of each leg, the projections being of similar size and shape, and extending upwardly from the slots. The projections increase gradually in size towards the slots, whereby for a relatively small conductor the projections tend to center the conductor on the fitting, and for a relatively large conductor the projections impress themselves into the sides of the conductor when the conductor is pressed against the fitting, thereby anchoring the conductor to the connector.

In accordance with still another aspect of my invention, the pressure applying means comprises a screw of the type adapted to be tightened by a screw driver, and a pressure plate swivel-mounted to an end of the screw. This aspect of my invention is characterized in that the end of the screw bearing against the pressure plate is tapered inwardly, thereby correspondingly increasing the force resulting from the torque applied to the screw.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a perspective view of my novel connector; and

Fig. 2 is an exploded view of the connector.

Referring now to the figures, the connector comprises a cradle member **1** made of non-magnetic material, preferably a copper alloy such as bronze. The cradle member is in the shape of a U having a pair of legs **2**, **3** attached to a base **4**. The legs **2**, **3** are of unequal lengths, the leg **2** being shorter and terminating in a lug **5** extending substantially at right angles to the leg and away from the other leg. The longer leg **3** is provided with a slot **6** towards the free end thereof, a given distance above the lug **5**.

The opposite legs **2**, **3** are formed with slots **7**, **8** respectively, extending along the base **4** and conforming in shape to an electrical fitting **9**. As shown the slots **7**, **8** are aligned and located intermediate the vertical edges of the legs.

The top of the cradle member is enclosed by an angle-shaped bridge member **10** comprising a first portion **11** extending across the open end of the cradle member and terminating in a lug **12**, adapted to fit into the slot **6** in the leg **3**. A second portion **13** of the bridge member **10** is bent substantially at right-angles to the first portion **11** and overlaps a small part of the upper portion of the shorter leg **2**; the lug **5** fitting into a slot **14** in the portion **13**.

A pressure applying means for pressing a conductor **15** against the fitting **9** when the fitting and conductor are positioned in the cradle is securely mounted to the bridge member **10**. The pressure applying means comprises a screw **16** of the slot type and a pressure plate **17** swivel-mounted to an end of the screw. The screw **16** is threaded into a tapped hole **18** centrally located in the portion **11** of the bridge member. The pressure plate **17** is formed with a cup-shaped recess in the bearing surface, with a hole in the center thereof. The end of the screw **16** is narrowed into the shape of a pin and riveted over the periphery of the hole. The depth of the recess is selected to provide clearance between the end of the riveted part of the screw and the conductor, thereby preventing damage to the conductor.

The pressure plate **17** is formed in the shape of an inverted V which shape tends to center the conductor therein and centrally on the fitting. The bearing surface of the pressure plate is knurled so that when the pressure plate forces the conductor against the fitting, the knurled surface is impressed into the conductor, thereby increasing the holding power of the connector. Further, as a result of the V-shaped pressure plate the contacting area between the plate and the conductor is increased in that two surfaces of the plate act against the conductor tending to center it on the fitting.

One of the attributes of my invention is that it is relatively small for the wide range of wires which it is capable of accommodating. Its relatively small size is possible because I use a screw of the type adapted to be tightened by a screw driver rather than by a wrench. As previously mentioned, a technician using a screw driver exerts a torque of approximately 50 pounds-inch whereas a technician using a wrench exerts a torque of about 250 pounds-inch. Thus, by using a slot-type screw a structure only ⅕ as strong is required which is far less bulky, and capable of use in devices where space is a controlling factor.

However, in order to obtain the necessary force for holding securely the larger size wires, it isn't enough merely to attach the pressure plate to an end of the screw. It is important that the screw be shaped to increase the force applied to the pressure plate.

The force exerted by the screw is proportional to the torque applied and inversely proportional to the diameter of the screw. That is: $F=T/R$. The force F is that force applied by the pressure plate on the conductor. This force is equal to the sum of the torques required to overcome the frictional force where the screw threads engage the bridge member divided by the radius of the screw, and the frictional force between the end of the screw and the pressure plate divided by the radius of the bearing end of the screw. Therefore, with given materials, and applied torque, the force applied by the pressure plate varies inversely with the sum of the above mentioned radii. Thus, in order to obtain the desired force the end of the screw bearing against the pressure plate is tapered as shown at **19**.

To improve further the holding power of the connector for large size wires, or alternatively to guide the smaller size wires centrally between the legs of the cradle, projections **20** are provided on each of the legs **2**, **3**. The projections are of similar shape and size and are located at the opposite ends of the respective slots.

The projections **20** are pyramidal in shape; the base of the pyramids coinciding with the upper edge of the slots and gradually decreasing in size as they extend upwardly. The connector parts are dimensioned so that the pressure plate fits with slight clearance between the projections, whereby when the larger size wires are forced against the fitting the projections impress themselves into the sides of the conductor, thereby anchoring the conductor to the connector. The smaller size wires are guided centrally between the legs by the projections and in a position to be guided further by the V-shaped pressure plate into the angle of the V and against the fitting.

The dimensions of the projections are selected so that the distance between the apices at the base of the pyramids is less than the width of the fitting. Thus, as shown in dashed lines in Fig. 1, the fitting may alternatively be inserted between the legs of the cradle member.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. A pressure connector for connecting an electrical conductor to a fitting, comprising a cradle member in the shape of a U, one leg of the U being longer than the other leg, the shorter leg being terminated in a lug extending substantially at right-angles to the leg in a direction away from the other leg, the opposite legs having slots extending along the base and conforming to the shape of the fitting, whereby the fitting may be securely mounted to said connector through said slots, an angle shaped bridge member having a first portion extending across the open end of the U and terminating in a lug fitting into a slot in said longer leg of the U, a second portion of said angle shaped bridge member overlapping said shorter leg and having a slot for accommodating the lug extending from said shorter leg, whereby the bridge member is secured to said cradle member, a screw adapted to be tightened by a screw driver mounted in said first portion of said bridge member, a swivel-mounted pressure plate connected to an end of said screw, the end of said screw bearing against said pressure plate being tapered radially inwardly whereby the force resulting from the torque applied to the screw is correspondingly increased, said pressure plate being shaped to center the conductor centrally on the fitting, said cradle member including a pair of projections on the inside of each of said legs, the projections being of similar size

and shape, each pair being located directly above the respective slots and extending a given distance towards the corresponding projections of the other pair, the projections being shaped to gradually increase in size towards the respective slots, whereby for a relatively small conductor the projections tend to center the conductor on the fitting and for a relatively large conductor the projections impress themselves into the opposite sides of the conductor when the conductor is pressed thereagainst, thereby anchoring the conductor to the connector.

2. The connector according to claim 1, wherein said cradle member is made of non-magnetic material, and the

bearing surface of said pressure plate comprises serrations for gripping the conductor.

References Cited in the file of this patent

UNITED STATES PATENTS

2,117,112	Buchanan	May 10, 1938
2,132,967	Pennell	Oct. 11, 1938
2,198,262	Bergan	Apr. 23, 1940
2,539,628	Kingdon	Jan. 30, 1951
2,746,025	Radack	May 15, 1956
2,780,793	Gambale	Feb. 5, 1957