

Oct. 6, 1959

M. D. BERGAN
ELECTRICAL CONNECTOR
Filed July 25, 1957

2,907,978

FIG. 1

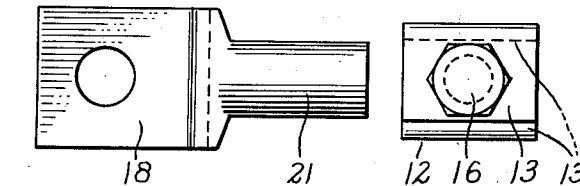


FIG. 2

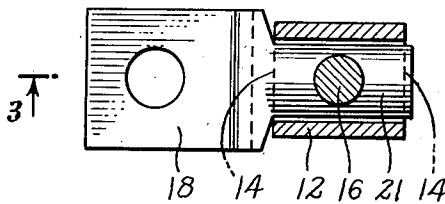


FIG. 3

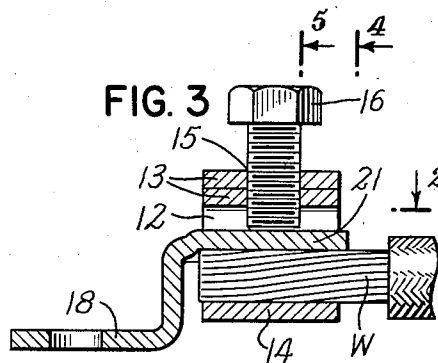


FIG. 4

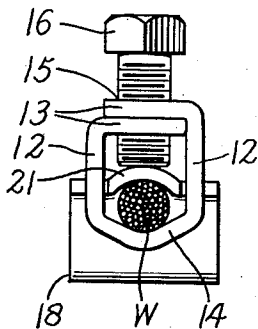


FIG. 5

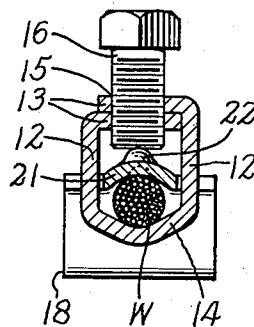


FIG. 6

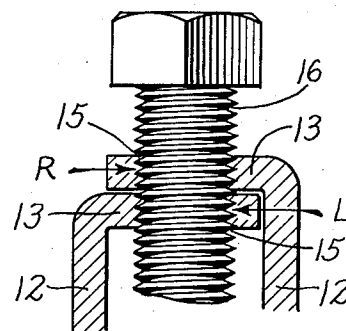


FIG. 7

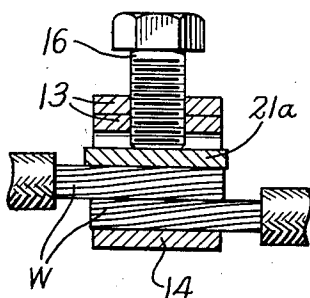
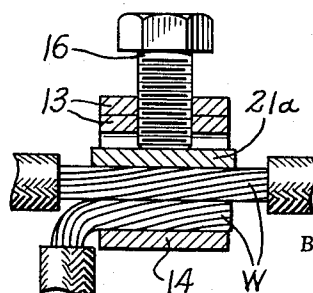


FIG. 8



INVENTOR.
Martin D. Bergan
BY
James C. Ledbetter
ATTORNEY

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2,907,978

ELECTRICAL CONNECTOR

Martin D. Bergan, Westfield, N.J., assignor to The Thomas & Betts Co., Elizabeth, N.J., a corporation of New Jersey

Application July 25, 1957, Serial No. 674,161

1 Claim. (Cl. 339—272)

This invention relates to improvements in an electrical connector of the screw-actuated pressure type, suitable for use as a terminal, or a splice, or a tap; and this application is a continuation-in-part of my earlier case, Ser. No. 345,625, filed on March 30, 1953, and abandoned on July 30, 1957 in favor hereof.

The improvement herein relates to that class of electrical connectors which employ a screw-pressure clamping means for securing or installing the connector on a wire or wires. This invention is believed to possess functional advantages in its novel means for more positively securing a connector on an electrical conductor—against loosening due to vibration or other causes—than now available in connectors of the prior art.

The invention provides a tubular body having a screw pinch-locking head, together with a new form of convex rigid-clamping or pressure plate, lying parallel with and engaging an electrical conductor, in combination with a clamping screw which coacts perpendicularly to and against the pressure plate and thus at right angles to the conductor axis—the purpose of the invention being to so relate the plate and the screw as to reduce the rotating frictional resistance of the screw, by which the force or torque applied thereto—for subjecting the plate to pressure—is greatly augmented and reacts on the head of the tubular body to pinch the threads of the screw and lock it within the tubular body (against loosening) with a greater force than in connectors of the prior art.

This specification with its claimed subject matter and accompanying drawings disclose the invention as preferred and embodied at this time for an understanding of the problems discovered and sought to be solved. Since these teachings may suggest structural changes to others, it will be appreciated that subsequent modifications hereof may well be equivalent in form and hence the same in spirit as this disclosure.

The drawings:

Fig. 1 shows a top plan disassembled view of the electrical connector parts before inserting the new convex rigid-pressure plate within the tubular body in its novel relation with the clamping screw mounted in the pinch-locking head of said body.

Fig. 2 shows the assembled connector, being a lengthwise section, looking down on the pressure plate which is engaged by the clamping screw and which is shown in transverse section, the plane of line 2 (in Fig. 3) indicating this view but omitting the electrical conductor.

Fig. 3 shows a lengthwise sectional view (along the plane of line 3) of the connector, adopted as a terminal, and thus anchored upon the end of a conductor.

Fig. 4 shows an outer end elevation of the connector (as taken along the plane of line 4) installed on the conductor. This view emphasizes the convex pressure plate devised to reduce the friction against the clamping screw when rotating and tightening it.

Fig. 5 shows a transverse section through the connector further illustrating the relation between the parts which are in finally clamped position on the conductor. This

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view may be regarded as a sectional view taken on the plane 5, except for its modification.

As to the modified form, Fig. 5 shows a further improvement in the pressure plate having means for reducing the rotating friction to an amount even less than accomplished in the previous views.

Fig. 6 is a fragmentary view, being a diagrammatic action illustration, for demonstrating the pinch-locking action of the tubular body on the clamping screw, thus emphasizing the functional advantages arising from the new combination.

Figs. 7 and 8 show a second modified form of the invention and emphasize the versatility of the connector.

Fig. 7 shows the connector adapted as a splice, i.e., joining two wires end to end.

Fig. 8 shows the connector adapted as a tap, i.e., connecting a branch wire to a main line conductor.

The three connector functions

In the foregoing views, Fig. 3 shows the electrical connector as a terminal, Fig. 7 as a splice, and Fig. 8 as a tap—thus serving all three wiring installation functions.

The splice and tap are functions of one and the same connector which is characterized by a new pressure plate 21a, whereas the terminal (Fig. 3) requires a bolting tongue 18 integral with a pressure plate 21 or its modified counterpart 21a. The three installation functions, therefore, merely require the two structural parts 21a and 18, 21.

The other five views (Figs. 1, 2, 4, 5 and 6) are illustrative of the two structural variations performing the three functions and, therefore, pertinent in general to this disclosure of the terminal, splice, and tap.

General description

As shown in the drawings, a tubular body 12 is fashioned from metallic strip stock, say of nominally hard copper. Thus the two parallel side portions (also 12) of the body are resilient and hence susceptible to a limited movement or flexure toward and from each other. The tubular body is preferably made in the proportion as shown, and it is adapted to receive the end of a single electrical conductor or wire W when the connector is adopted as a terminal. However, when adopted as an electrical splice or tap, the body receives two conductors (Figs. 7 and 8).

The tubular body 12 is open at both ends and comprises a rectangular-looped member as shown, with over-lapping and contiguous ends of the body strip deformed at right angles with the sides 12 to provide a double-thickness or two-ply head 13. A V-shaped conductor seat 14 is formed opposite the head 13. This provides an open body to receive the conductor W which is adapted to rest within the seat 14. The two-ply head 13 is provided with a screw-threaded hole 15, and a clamping screw 16 (of standard straight-end form) is operatively mounted therein for in and out movement in back and forth relation to the conductor-receiving seat 14 and hence perpendicular to the axis of the conductor W.

The two overlapping bar-stock ends 13, forming the two-ply head (also 13), are parallel and capable of slight relative motion in their parallel planes. The screw-threaded holes 15 (one through each head portion 13) are normally coaxial when the connector is not under compression in service position. Accordingly, the clamping screw 16 initially turns freely in the coaxially-aligned threaded holes 15, that is, the screw rotates with normal thread friction only when not under clamping pressure.

When adopted for terminating an electrical wire W, as shown herein, a conventional bolting tongue 18 is made integral with one end of my new clamping or pressure plate 21 (next described) of a form and function which

provides an improved mode of operation in connectors of the class here concerned. The bolting tongue performs the usual function of making a bolted or screw-fastened electrical connection with another electrical connector, such as a binding post or seat joint on a bus bar, or with a switch or other apparatus.

That the bolting tongue 18 is formed as an integral extension on and of the pressure plate 21 (and not integral with the tubular body 12) is believed to be important when the invention is embodied in a terminal. Free of the tongue 18, it follows that the body carries a minimum of stock and mass with the result that the resiliency and flexure of the body sides 12 is not restricted. As to this feature, it is observed that the strip or bar stock, which forms the tubular body 12, is of uniform width by reason of its parallel side edges. Consequently, when the bar stock is die-formed and wrapped-up to make the tubular body, it follows that the length of the bottom of the tubular body, which carries the V-shaped seat 14, is not greater than the length of the two-ply pinch-locking head 13 which mounts the screw 16.

The pressure plate 21 may be about the same length as the axial dimension or length of the open ended tubular body, at the V-shaped conductor seat 14. And in width, the plate 21 has a sliding or loose fit between the parallel body sides 12 which confines it in motion toward and from the V-shaped seat. Thus the pressure plate is disposed parallel to the wire-receiving seat 14 and engages that side of the wire W which is adjacent the screw-threaded holes 15, that is, next to the inner or pressure end of the clamping screw 16. The inner surface of the clamping plate may be concave (by virtue of its external convexity, as later described) and thus make an arcuate fit with the bare end of the wire W.

Of first importance, however, the pressure plate 21 has a characteristic external convex surface; as shown, by virtue of which the rotating pressure end of the clamping screw 16 engages said plate at a tangent. Thus the end of the screw has a minimum-area pressure engagement with the plate 21. This relation is emphasized in Figs. 4 and 5 applicable to the terminal, splice and tap. The structural form of Figs. 4 and 5 is to be compared to connectors in the prior art in order to more fully realize how this simplified structural relation begets a new mode of operation and provides the functional improvements next described.

The new result achieved by the outex convex surface of the novel clamping plate 21 is that a given input torque or turning force applied, by a wrench or a screw-driver, to the clamping screw 16 for rotating it home—in finally clamped position against the wire W—is not frictionally dissipated, as in the case of conventional connectors. In other words, a given input torque drives the clamping screw 16 and its combined pressure plate 21 into noticeably greater compression, hence a more effective electrical connection of reduced resistance with the wire W, than is the case of conventional connectors. The reason therefor is as described in the next above paragraph—in that the clamping screw rotates more freely under pressure because of its tangent, and hence minimum-area, engagement with the rigid-pressure plate 21 of external convex shape.

Another result of the external convexity of the clamping plate 21 is to reinforce it longitudinally against buckling under pressure. Since it is arched in cross section (externally convexed), the rigidity of the plate is greatly augmented. Accordingly, a given thickness of the plate carries a greater load under screw compression than conventional types. Suffice it to say that the external convex shape of the plate reduces wear and displacement of metal from occurring around the heavy-pressure end of the screw 16, thereby maintaining the minimum-area pressure engagement as the screw turns and advances into final-pressure position.

Not only is the foregoing true, but the arch of the plate and its resistance to buckling under pressure results in uniformity of compression (and hence grip on the wire W) from one end of the plate to the other. In a word, the new pressure plate 21 does not relax its conductor compression at its extremities. Thus the connector does not possess the fault of localized wire grip at the region of the screw, and thereby makes for larger area pressure contact.

A further functional advantage results from the increase in the locking action of the two-ply head 13 of the tubular body on the clamping screw 16. It is seen that the pressure of the clamping means 16 and 21 on the wire W in the V-shaped seat 14 exerts a spreading force on the two sides 12 of the tubular body. Such force tends to urge the free, parallel, overlapping head portions 13, to creep in outward opposite parallel directions away from each other at right angles to the clamping screw 16 and pinch-lock it in the tubular body, under final pressure, against any likelihood of loosening due to length of service, metallic fatigue, vibration, and other causes.

While the two-ply head type of tubular body—its free ends 13 overlapping—is known to the art, its function has not been utilized in a way to provide maximum pinch-locking of the clamping screw 16 against loosening. The action is more fully understood herein by reference to Fig. 6; and it is believed that this illustration and description is the first actual disclosure in the art, not only of the fundamentals of the point in question but also the more pronounced means of achieving the screw locking result, by reason of the magnitude of reaction next described.

From Fig. 6, and other views, it is seen that the wire W, under compression in the V-shaped seat 14, produces oppositely directed, right and left, forces R and L, as indicated by the two arrows. It is observed that the forces R and L are utilized in applying a screw-threaded locking action at diametrically opposite positions against the clamping screw 16. Further study and comparison are believed to make it clear that the means herein employed does fully develop the force in large magnitude as herein described—for it has already been explained that the outer convexity of the pressure plate 21 produces maximum compression on the wire W from a given or minimum screw torque.

Thus it follows that this new three-part combination performs the several purposes of augmenting the compression on the conductor W as well as the pinch-locking grip on the screw 16. Accordingly, the usual tool or wrench torque applied by a mechanic results in making a more effective electrical connection (one of reduced resistance) as well as a mechanical grip or joint (one of increased resistance against pull-out) between this new connector and a conductor.

Coming to Fig. 5, it shows a further improvement in the clamping plate 21, a bearing-boss 22 being formed and raised on the upper surface thereof for coaction with the clamping screw 16 which ordinarily has a concave or dished end, because it is a common or standard screw. This bearing-boss 22 has a spherical or ball-like engagement with the inner concaved end of the screw, the center of the bearing-boss being coaxial with said screw. Consequently, the center of the screw, its dished end, centers and rides on the ball-like surface, after the fashion of a ball-bearing, with a minimum of friction.

Observing Fig. 5, it is seen that the bearing-boss 22 takes the entire compression load of the screw 16, exerted against the convex pressure plate 21, without permitting the perimeter of the screw to frictionally bear and turn against the plate as in the mode of coaction of the screw in the first four views. In other words, the perimeter of the screw bears circumferentially at two opposite points against the plate in the first four views,

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whereas it bears only at its one center point and coaxially against the bearing-boss 22 in Fig. 5 as seen.

The latter feature (Fig. 5) produces a minimum of screw turning friction, hence dissipates a minimum of given wrench or screwdriver input torque applied to the screw 16 and, therefore, delivers a maximum of screw pressure on the plate 21. Accordingly, the conductor W is subjected to maximum pressure, and the reaction spread of the two sides 12 of the tubular body is at a maximum which, in turn, exerts a maximum pinch-locking force against the screw 16.

It is important to note that the structural forms described provide a take-apart connector, so that the terminal pressure plate and bolting tongue 21, 18 can be removed from the tubular body and the splice-tap pressure plate 21a substituted therefor and vice versa.

This disclosure explains the principles of the invention and the best mode contemplated in applying such principles, so as to distinguish the invention from others; and there is particularly pointed out and distinctly claimed the part, improvement or combination, which constitutes the invention or discovery, as understood by a comparison thereof with the prior art.

This invention is presented to fill a need for a new and useful electrical connector. Various modifications in construction, mode of operation, use and method, may and often do occur to others, especially so after acquaintance with an invention. Accordingly, it is to be understood that this disclosure is exemplary of the principles herein and embraces equivalent constructions.

What is claimed is:

In an electrical connector, suitable for use as a terminal or a splice or as a tap, consisting of a wholly tubular body formed of strip material, having overlapping relatively-movable ends, with their flat surfaces in engagement, and thus providing a two-ply head; and a screw-threaded hole, through each overlapping end, the two holes being in coaxial alignment but urgeable toward misalignment; with a V-shaped seat formed in said wholly tubular body, opposite said screw-threaded holes, to receive an electrical conductor; the lower por-

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tion of the wholly tubular body carrying the V-shaped seat, said seat having an axial length equal to the width of the strip material; and means for securing the conductor in said wholly tubular body, with an augmented clamping grip, and thus of reduced electrical resistance; said means consisting of a rigid-pressure plate mounted axially and loosely within the wholly tubular body, for relative movement against the conductor in the V-shaped seat, and the outer surface of said pressure plate being convex toward the screw-threaded holes; a standard straight-end form of common clamping screw mounted through the screw-threaded holes, with its inner end rotatably bearing against the convex surface of the pressure plate, and thus having tangent-pressure engagement therewith; the pressure plate, and also the screw, being free of each other and removable from the wholly tubular body; whereby the clamping screw, when tightened under a given input torque, rotates with a minimum of friction against the convex surface, thus exerting a maximum force, from said given input torque, against the conductor for clamping it in the V-shaped seat; the reaction of said maximum force resulting in a maximum spreading force exerted on the V-shaped seat, thus urging the two screw-threaded holes toward said misalignment, thereby pinch-locking the screw in the two-ply head with a maximum force; and the combined action of the two forces preventing loosening due to vibration, thereby permanently maintaining the aforesaid augmented clamping grip and the reduced electrical resistance.

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