

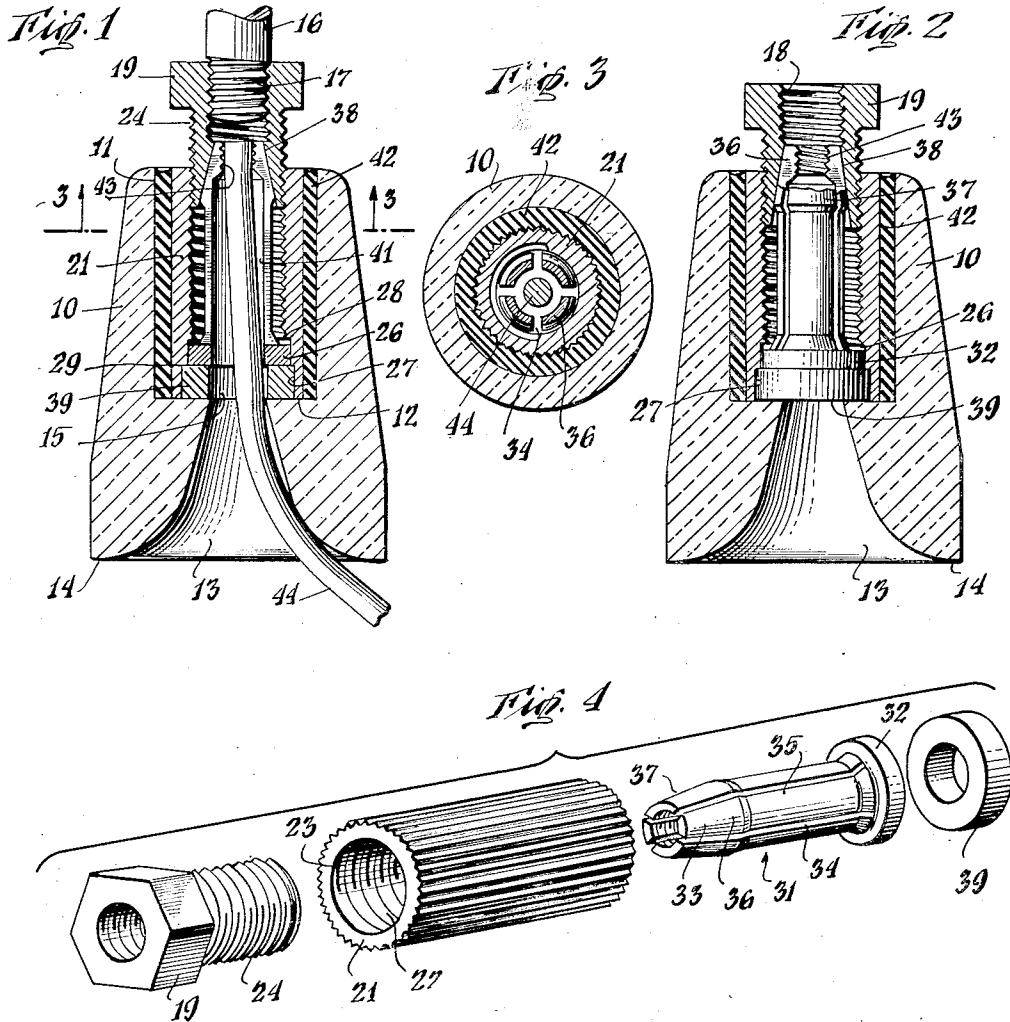
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R. B. SCHOONMAKER

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TRANSFORMER TERMINAL CONNECTOR

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INVENTOR.  
Raymond B. Schoonmaker  
BY

Duell and Kane  
ATTORNEYS

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## TRANSFORMER TERMINAL CONNECTOR

Raymond B. Schoonmaker, Poughkeepsie, N. Y.,  
 assignor to Fargo Mfg. Company, Inc., Pough-  
 keepsie, N. Y., a corporation of New York

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1

This invention relates to clamps in electrical connections and more particularly to connecting or clamping and supporting ends of cables or wires.

It is an object of this invention to provide an electrical connector which will receive and grip the ends of cables and wires.

Another object of this invention is to provide and electrical connector which will cooperate with, clamp, and connect the end of a cable or wire to a terminal.

A more specific object of this invention is to provide an electrical connector which cooperates with, grips, supports and connects cables and wires to a terminal in such a way that the wires will be securely gripped and supported without strain or stress.

It is still another object of this invention to design a connector in which the gripping elements are applied to the cables or wires clamped and supported therein by tightening one part of said connector upon another part of the same connector.

A further object is that of providing a unit which will embody relatively few parts, each of simple, rugged construction, such parts being capable of economical manufacture and assembly by relatively unskilled labor to furnish a unitary article operating over long periods of time with freedom from all difficulties.

With these and other objects in mind, reference is had to the attached sheet of drawings illustrating a practical embodiment of the invention and in which:

Fig. 1 is a sectional side view of a connector coupling the end of a wire or cable to a terminal;

Fig. 2 is a sectional side view of the connector of Fig. 1 minus the wire or cable and the terminal and showing the clamping element partly in elevation;

Fig. 3 is a sectional end view taken along lines 3-3 and in the direction of the arrows as shown in Fig. 1; and

Fig. 4 is an exploded view of the terminal stud sleeve, gripping element and retaining ring of the connector shown in Fig. 1.

In general the electrical connector of this invention connects a wire or cable to a terminal by a simple operation capable of being performed under adverse conditions and clamps and supports the wire in such a manner as to provide a permanent and secure electrical connection without stress or strain.

As shown in the figures, the connector of this invention has a clamping element which grips the connected wire or cable when the insulator is screwed on to the terminal stud. Referring to Fig. 1, an insulator 10 has centrally disposed in its upper portion a cylindrical recess 11 terminating in a bottom surface 12. A funnel-shaped

2

passage 13 extends upward from the lower rim 14 of the insulator 10 to a central aperture 15 in the bottom surface 12, thus providing a continuous passage from top to bottom through the insulator 10. A terminal 16 positioned above the insulator 10 is suitably connected to an electrical line. An external thread 17 on the end of terminal 16 receives an internal thread 18 in a bored stud 19 which is thereby fastened to the terminal 16. As shown in Fig. 4, a sleeve 21 contains a cylindrical chamber 22 which has threaded on its wall an internal thread 23. As shown in Figs. 1 and 2, this internal thread 23 receives an external thread 24 of the stud 19 so that the stud 19 may be screwed downward into the sleeve 21 which in turn is centrally positioned in the recess 11 of the insulator 10. The sleeve 21 seats with its lower end 25 on the bottom surface 12 of the recess 11. Counterbored into the sleeve 21 from the lower end 25 are two recesses 26 and 27. The upper recess 26 forms a shoulder with the lower end of the chamber 22 and the lower recess forms a shoulder 29 with the recess 26.

Referring to Fig. 4, clamping element 31 has an annular base 32 from which extend four separate fingers 33, separated from each other by longitudinal slots 34 extending along the length of the fingers from the base 32. Each finger 33 has a thin arcuate shaft section 35 and a relatively short thick arcuate head section 36. The arcs of the juxtapositioned finger sections make up a circular element. The arcuate outer surfaces of the head sections 36 are tapered outwardly to make up a frusto-conical surface 37. As shown in Figs. 1 and 2, the lower end of the central bore of stud 19 is formed into an inverted tapered bore diminishing in diameter upward from the bottom of the stud 19.

The clamping element 31 as shown in Figs. 1 and 2 fits into the sleeve 21 with the base 32 slipping into the recess 26, the shaft sections 35 extending upward through the threaded chamber 22 and the head sections 36 protruding out of the upper end. The frusto-conical surface 37 is thus brought into contact with the inverted taper of the bore 38 as the sleeve 21 and stud 19 are threaded together. A retaining ring 39 fits into the lower recess 27 at the lower end of sleeve 21 and fitting snugly in the recess 27 seats against the shoulder 29 to hold the clamping element 31 in position within the sleeve 21. It is noted, as shown in Figs. 1 and 2, that the height of base 32 is not as great as the depth of recess 26 which contains it, and therefore while held securely in place by retaining ring 39 the clamping element 31 is free to rotate on its axis within the sleeve 21.

In the assembly of the connector the clamping element 31 is inserted in the sleeve 21 and the

3

ring 39 press-fitted into the recess 27. The sleeve and clamping element assembly is then positioned in the recess 11 with the lower end 25 of sleeve 21 seated on the bottom surface 12 so that the center hole of ring 39 and the open center of element 31 form a passage 41 which is aligned with the passage 13 in the lower portion of insulator 10 to form a continuous passage from the lower rim 14 through the head sections 36. The assembly is then secured in the insulator 10 by means of a suitable sealing substance 42 introduced into the recess 11 around the outside of the sleeve 21 as shown in Figs. 1, 2 and 3.

In this condition the insulator with the sleeve and clamping element assembly secured therein is fastened on to the stud 19 which has been previously screwed on to the terminal 16 as hereinbefore described. Thus the frusto-conical surface 37 with its outward taper is brought into engagement with the inverted taper of bore 38 as the threads 17 and 18 inter-engage. The head sections 36 are provided at the upper end of their inner surfaces with jaws 43 having teeth 45. As the frusto-conical surface 37 engages the tapered bore 38 the head sections 36 are permitted to flex inward by the spring of the flexible shaft sections 35 anchored in the rigid base 32. The jaws 43 are thus urged together into the central passage 41 so as to constrict that passage in the area of the jaws 43. The further that the sleeve 21 is threaded on to the stud 19 by rotation of the insulator 10 the greater will be this constriction. In Fig. 1 a wire 44 is shown inserted into the connector through passages 13 and 41 and clamped between the jaws 43 by the action between surface 37 and tapered bore 38. The wire 44 is or may be suitably connected to the electrical line which it is desired to electrically connect to the terminal 16. The element 31 is preferably composed of a material having an elasticity sufficient to permit the fingers to receive a range of wire sizes of at least from #10 stranded to #2 solid without permanent deformation. At the same time the material preferably provides teeth 45 with sufficient hardness to pierce the hard drawn copper of the ordinary conducting wire preferably over Rockwell B50. A metal alloy composed of 91% copper, 2% silicon and 7% aluminum, having a modulus of elasticity in the neighborhood of  $10^6 \times 16.5$  p. s. i. and a hardness of the order of Rockwell B85, is one example of such a material.

In the operation of this modification of the invention the stud 19 is fastened on the threaded terminal 16 by means of external threads 17 and internal threads 18, the terminal 16 being attached in some electrical circuit which it is desired to complete by electrical connection with the wire 44. The insulator 10 containing the sleeve 21 and the clamping element 31 secured in position therein is then screwed on to the stud 19 by engagement between threads 23 and 24. When sufficient engagement to hold the insulator in place on the stud 19 is obtained, the screwing operation is interrupted while the end of wire 44 inserted through passages 13 and 41 is positioned between the jaws 43. The screwing of the insulator and sleeve assembly on to the stud 19 is then resumed and by bringing the surfaces 37 and 38 in to further engagement causes the jaws 43 to close in on the wire 44 and the teeth 45 to clinch the wire 44. The jaws 43 thus coming into contact with the wire 44 clamp and hold it in position against removal. Thus the stud 19 is secured on the terminal 16, the sleeve 21

4

and the insulator 10 is secured on the stud 19 and the wire 44 clamped in the jaws 43 is secured in, and supported by, the clamping element 31 and the electrical connector as a whole.

In the clamping operation the jaws 43 are closed on the wire 44 as tightly as reasonably possible which is sufficient for teeth 45 to pierce surface layers of oxide or other matter on the wire 44. Consequently the insulator 10 and sleeve 21 are rotated with relation to the stud 19 after the jaws have come into contact with the wire 44 and hold it securely in position. The continued rotation of the sleeve 21 and the insulator 10 when the jaws 43 and wire 44 are in this condition is not translated to the clamping element 31 and consequently not transferred to the wire 44 because of the loose rotational fit permitted the clamping element 31 by the freedom of base 32 in recess 26 and the absence of contact between other parts of the element 31 and the sleeve 21 and the low coefficient of friction. Thus in the last stages of the tightening of the insulator 10 and sleeve 21 on the stud 19 when the jaws 43 and wire 44 are in contact, these members, the clamping element 31 and wire 44, remain stationary with the terminal 16 and the stud 19, while the insulator 10 and sleeve 21 are rotated.

The wire 44, as shown in Fig. 1, extends downward and out from the electrical connector, resting against the curved wall of the funnel-shaped passage 13. In Fig. 1 the wire 44 is lying against and following the surface of the funnel passage 13 is introduced between the jaws 43 at a very small angle to the axis of the head sections 36 and the jaws 43. As the wire 44 is held axially between the jaws 43 the introduction of the wire 44 into the clamping position at a very small angle to the clamping position provides that the flexure of the wire between the support of passage 13 and the clamping jaws 43 will be so slight as to be negligible.

Among other advantages of this invention the support of the connected wire by the funnel-shape of the insulator wall relieves strain placed upon the wire when it is seized by clamping. When a wire is deformed some of its inherent strength is lost, when to this loss of strength is added a severe flexure adjacent the weakened region, the probability of complete or partial rupture of the wire is considerably increased. This invention ameliorates the weakening of the wire by the clamping and obviates the possibility of rupture. As outlined above, this advantage is obtained by supporting the wire in the vicinity of the clamping and by reducing the angle of possible flexure of the wire in the vicinity of the clamping area.

Another advantage of this invention is seen in not deforming the connected wire by subjecting it to the rotation of the connected parts after it has been seized in the clamping grip. This advantage is obtained by mounting the clamping element rotatably in the connector parts so that as the connector parts are rotated in the tightening operation the wire may remain stationary and no torque placed thereon.

A further advantage is that of the range of sizes of wire that may be accommodated in any single electrical connector of this invention. For example, the same electrical connector may clamp, secure, hold and connect wires ranging in gauge from #10 stranded to #2 solid without any loss of the benefits of this invention. Further advantages of this invention are the

simplicity of construction, the economical manufacture and assemblage possible in making such parts and the fewness of the number of parts necessary. Still further advantages are found in the simplicity of attaching the connected line, the fool-proof nature of the connection made, and the reliability of its operation.

Still another advantage is found in the use of the teeth of the jaws to insure a good contact between the connector and the conductor. As the clamping element is composed of a material having hardness and elasticity to provide it with other desired advantages, such as flexibility of the fingers and hardness to reduce the friction in tightening the clamp, the sharp-edged teeth are harder than the copper of the ordinary conductor. Then when the connector is tightened reasonably tight on the conductor the teeth of the clamping element will dig into the conductor and insure a good electrical contact by piercing any insulating surface layer, and will continue to maintain a good electrical contact because of the intimate bond between the two parent metals of conductor and connector will exclude further corrosion deposits.

Thus, among others, the several objects of the invention as specifically aforementioned are achieved. Obviously numerous changes in construction and rearrangement of the parts may be resorted to without departing from the spirit of the invention as defined by the claims. For example, the internally threaded passage 13 and the tapered bore 32 through stud 19 may be divided into two parts by a solid transverse wall extending across the passage and forming an upper threaded portion for receiving the thread 17 of the terminal 16 and a lower tapered portion for receiving the head section 35 of the clamping element 31. The threaded portion and the tapered portion are thus made blind by the transverse wall. It will thus be apparent that various modifications can be made in accordance with the principle of the invention as disclosed herein and for that reason it is not intended it should be limited other than by the scope of the appended claims.

#### I claim:

1. A connector for securing an electrical conductor comprising in combination an insulator; a threaded sleeve supported in said insulator; a clamping element contained in said threaded sleeve comprising elongated fingers, conductor securing jaws mounted on said elongated fingers, and a central passage formed by said jaws and fingers extending axially through said clamping element for axially receiving an electrical conductor; a threaded member engaging said threaded sleeve; a surface actuated by said threaded member engageable with said jaws from an axial direction opposite to the axial reception of an electrical conductor into said central passage, to move said jaws to a closed position and a central bore in said insulator aligned with said axial central passage and terminating at the opposite end of said elongated fingers from said jaws, said bore admitting an electrical conductor into said passage whereby said jaws secure in said clamping element at a point removed from the entrance to said central bore, said electrical conductor being insertible in an axial direction counter to said jaws closing motion of said surface.

2. An electrical connector for securing an electrical conductor comprising in combination an insulator, a threaded cylindrical sleeve contained in said insulator, a clamping element

mounted in said cylindrical sleeve, a recess counter-sunk within said cylindrical sleeve, an annular base of said clamping element positioned in said countersunk recess and freely rotatable therein, elongated fingers in said clamping element extending from said base, conductor securing jaws mounted on the ends of said fingers, a frusto-conical outer surface on said jaws, a central passage extending axially through said clamping element from said annular base to said jaws, an insulator supporting said cylindrical sleeve, a threaded member engaging said threaded sleeve axially with relation to said central passage, a tapered bore in said threaded member engaging said frusto-conical surface on said jaws from one axial direction, and a central bore in said insulator at the opposite end of said cylindrical sleeve from said threaded member aligned with and tapering inwardly toward said central passage in the opposite axial direction from said tapered bore for admission of an electrical conductor into said central passage from said opposite axial direction whereby said jaws are securable on said insertible electrical conductor in said clamping element at a point removed from the entrance to said central bore.

3. In a connector for an electrical conductor, the combination of a threaded stud to which the conductor is connectible, a threaded sleeve threading onto said stud with a rotary motion, a clamping element carried in said threaded sleeve and rotatably independent therefrom, an annular base supported in said threaded sleeve with a low coefficient of friction between the annular base and its supporting surface, flexible elongated fingers extending axially through said threaded sleeve from said annular base, movable conductor securing jaws mounted at the end of said elongated fingers, an axially short conductor gripping inner surface on said jaws, a frusto-conical outer surface on said jaws, a tapered bore in said threaded stud engaging said frusto-conical surface to flex said elongated fingers and move said conductor securing jaws inward, a surface contact between said tapered bore and said frusto-conical surface having a low coefficient of friction to permit rotation of said clamping element within said threaded sleeve and said threaded stud after said conducting gripping surface has been brought into engagement with said conductor by the action of said tapered bore on said frusto-conical surface.

RAYMOND B. SCHOONMAKER.

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