

## Bus Line Terminal Lugs

### Field of the Invention

**[0001]** The present invention relates to terminal lugs that are crimpable onto bus lines.

### Background

**[0002]** A spade lug is typically used to connect an end of a conductor or wire at a terminal block. When parallel connections are required, it is typical to stack two or more spade lugs at a terminal point of a terminal block. Due to a limit to the number of spade lugs (typically limited to two) that can be stacked at each terminal point, it is typical to use jumper wires/connectors to link-up a number of terminals so as to make a plurality of parallel connections possible. This requires careful planning of sufficient numbers of electrical terminal points. Further, during re-wiring, long electrical wires are required as each wire must start from a terminal block and end at another terminal block.

**[0003]** To connect a spade lug, it is necessary to strip an end of an electrical wire or conductor of its insulation, insert the exposed end of the wire/conductor into a receptacle of a spade lug and crimp the receptacle onto the exposed end of the wire. When additional parallel connections are required, the electrical layout termination has to be re-executed, often involving rearranging the existing terminal points and the laying of new wirings and providing terminal lugs at each end of the new wirings. This rearrangement would be difficult when there are insufficient numbers of spare terminal points. This inevitably results in a major re-laying of the wirings and terminal blocks.

**[0004]** It can thus be seen that there exists a need for a terminal lug that can overcome the disadvantages or limitations of the existing prior art.

## Summary

**[0005]** In one embodiment of the present invention, a terminal lug is provided. The terminal lug comprises an elongate interconnect end; a sleeve end formed in a substantially U-shaped open-tube having two ends, with one end of the open-tube having a spike projecting into a space of the open-tube sleeve; and a connecting member connecting the interconnect end and the sleeve end; wherein the sleeve is operable to fit onto the electrical wire and operable to be crimped thereon such that the spike pierces through the wire's insulation and makes electrical contact with a conductor of the electrical wire.

**[0006]** In another embodiment of the terminal lug, the terminal lug further comprises a cutting edge formed at an open edge of the open-tube sleeve. The cutting edge is selected from the following: a continuous sharp edge; a serrated edge; and a serrated edge with discrete teeth.

**[0007]** In another embodiment, the terminal lug has a longitudinal axis of the sleeve end perpendicular to the elongate interconnect end. In another embodiment, the terminal lug has a longitudinal axis of the sleeve end parallel to the elongate interconnect end.

**[0008]** In another embodiment, the sleeve end and the elongate interconnect end are at different planes.

**[0009]** In yet another embodiment of the terminal lug, the elongate interconnect end is selected from the following shape: a spade, a ring, a bar, a flat bar and a C-shaped socket complementary to the flat bar.

**[0010]** In another embodiment of the terminal lug, each end of the open-tubular sleeve has a spike. In another embodiment, the spike comprises two or more spikes.

### Brief Description of the Drawings

**[0011]** This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

**[0012]** FIG. 1A illustrates a terminal lug according to an embodiment of the present invention; FIG. 1B illustrates a cross-section of the terminal lug shown in FIG. 1A in its crimped (used) state; and FIGs. 1C-1E illustrate variations of the terminal lug shown in FIG. 1A;

**[0013]** FIGs. 2A and 2B illustrate terminal lugs according to other embodiments of a terminal lug;

**[0014]** FIGs. 3A-3D illustrate terminal lugs according to further embodiments of a terminal lug;

**[0015]** FIG. 4 illustrates another embodiment of a terminal lug;

**[0016]** FIGs. 5A-5C illustrate variations of embodiments of the terminal lug according to the present invention;

**[0017]** FIG. 6 illustrates yet another embodiment of the terminal lug according to the present invention; and

**[0018]** FIGs. 7A and 7B illustrate the use of the terminal lug of the present invention on a solid-core conductor wire.

### Detailed Description

**[0019]** FIG. 1A shows a terminal lug 10 according to an embodiment of the present invention. The terminal lug 10 is made of a conductor material and is shown in FIG. 1A without its insulation jacket. The terminal lug 10 has an elongate interconnect first end shown as a U-shaped lug 14, a sleeve 18 at a second end and a connecting member 22 connecting the first and second ends.

**[0020]** As shown in FIG. 1A, the terminal lug 10 is formed from a flat strip of conductor material. The U-shaped lug 14 at the first or front end is shaped and dimensioned to fit into a terminal post of a typical terminal block 4. The sleeve 18 is formed by bending the second end of the terminal conductor about its thickness into a U-shape sleeve 18. As shown in FIG. 1A, the U-shaped sleeve end 18 is an open tube 26 that is open when viewed from the front end. The U-shaped lug 14 and the connecting member 22 are substantially in the same horizontal plane. The sleeve 18 is also formed with a spike 30 near a center of the bend 20 at each of the two ends of the open-tube 26 and a cutting edge 34 at a free edge of the open-tube sleeve 18. The spike 30 and cutting edge 34 project into a space of the U-shaped sleeve 18.

**[0021]** The sleeve 18 with the spike 30 and sharp edge 34 are formed with dimensions so that an electric wire 8 of a suitable range of conductor thicknesses and insulation thicknesses can be inserted into the open-tube sleeve 18. In use, the electric wire 8 with its insulation is inserted into the open-tube sleeve 18 and the sleeve 18 is crimped with a crimping tool (not shown). During crimping, the crimping tool deforms the free-edge of the sleeve 18 into an arch 38, as shown in FIG. 1B. The arch 38 wraps around part of the wire's insulation such that the cutting edge 34 faces the spikes 30. By applying a further force on the crimping tool, the arch 38 is formed further and the spikes 30 and sharp edge 34 bite and pierce into the insulation of the wire 8. Once the sleeve 18 is crimped onto the wire's 8 insulation, the conductor material of the terminal lug 10

wraps around, or partially around, the wire 8 whilst the spikes 30 and sharp edge 34 contact with the conductor in the electric wire 8 as shown in FIG. 1B. With the present invention, the terminal lug 10 of the present invention allows one to tap onto an electrical wire (or bus line) to make a parallel connection, for example, to tap electric power or signal from the wire. There is no need to remove an insulation from the wire 8 before crimping a terminal lug 10 of the present invention onto the wire 8. Further, a plurality of the terminal lugs 10 can be crimped along the length of the wire 8.

**[0022]** As described earlier, the terminal lug 10 is formed from a flat strip of conductor material. In one embodiment of forming the terminal lug 10, its two-dimensional (2-D) profile, together with the spikes 30 and sharp edge 34, is developed, and the 2-D profile is stamped out from a flat strip of conductor material. The cutting or sharp edge 34 is formed, for example, by grinding or machining, preferably, before the stamping process. The cutting edge 34 is then formed, for example by bending and/or cold forming with a die. The U-shaped sleeve 18 is formed, for example, by bending. The spikes 30 are then bent to complete the production of each terminal lug 10. However, the steps of forming and bending the spikes 30, cutting edge 34 and U-shaped sleeve 18 may be varied in their sequences. For example, all the spike and cutting edge bending and forming steps can be done in a single operation and the U-shaped sleeve 18 is formed in a final step. In another variation, the U-shaped sleeve 18 is formed before the spikes 30 and cutting edge 34 are bent or formed. In yet another variation, all the forming and bending steps are performed in a progressive die.

**[0023]** Variations in the length of the open-tube sleeve 18 are envisaged. As shown in FIG. 1A, the length of the open-tube sleeve 18 is longer than the width of the connecting member 22. In another embodiment as shown in FIG. 1C, the length of the sleeve 18 is the same as a width of the connecting member 22. In another embodiment as shown in FIG. 1D, the length of the open-tube sleeve 18 is the same as the width of both the connecting member 22 and U-shaped lug 14. In yet another embodiment as

shown in FIG. 1E, the width of the connecting member 22 is reduced from both the width of the U-shaped fork 14 and the length of the sleeve 18.

**[0024]** FIG. 2A shows another variation of a terminal lug 10a. As shown in FIG. 2A, the terminal lug 10a is substantially the same as the terminal lug 10 but has a serrated edge 34a, instead of a continuous cutting edge 34 shown in FIGs. 1A-1E. In a variation, FIG. 2B shows a terminal lug 10b with a serrated edge 34b made up of discontinuous or discrete teeth. Other embodiments are also possible, for example, a serrated edge with saw-like teeth, with continuous or discontinuous teeth.

**[0025]** FIG. 3A shows another embodiment of a terminal lug 10c. As shown in FIG. 3A, the terminal lug 10c is also formed from a flat strip of conductor as that for terminal lug 10, 10a, 10b except that the terminal lug 10c has three spikes 30 at each end of the open-tube sleeve 18. In a variation, a terminal lug 10c may have one spike 30 as shown in FIG 3B or two spikes 30 as shown in FIG. 3C at each of the two ends of the open-tube sleeve 18. In yet another variation of the terminal lug 10c as shown in FIG. 3B or 3C, the free edge of the open-tube sleeve 18 has an extended portion 42, as shown in FIG. 3D. In use, the sleeve extension 42 is formed during crimping to partially wrap around the wire's 8 insulation, for example as shown in FIG. 3D.

**[0026]** FIG. 4 shows another embodiment of a terminal lug 10d. As shown in FIG. 4, the terminal lug 10d has the connecting member 22 and lug 14 laying on a plane (as in the previous embodiments 10, 10a, 10b, 10c), with the plane joining radially with a substantial center 21 of the bent portion 20 of the U-shaped sleeve 18. Other variations of terminal lug 10d are possible. In a variation, the plane of the connecting member 22 and lug 14 may be offset from the center 21 of the bent portion 20.

**[0027]** FIGs. 5A-5C show variations of the terminal lugs 10, 10a, 10b, 10c, 10d. As shown in FIG. 1A, the connecting member 22 is flat and lies in the same plane as the U-shaped lug 14. In FIGs. 5A-5C, the connecting member 22 is at an angle to the lug 14 and sleeve 18, and the sleeve 18 and the lug 14 are provided at different planar levels. These variations are useful for stacking of three or more of the terminal lugs 10, 10a, 10b, 10c, 10d of the present invention at each terminal post at a terminal block. In another variation (not shown), the connecting member 22 is non-planar, for example, like a twisted ribbon so that the longitudinal axis of the open-tube sleeve 18 is not in a plane through the planar lug 14.

**[0028]** FIG. 6 shows another embodiment of a terminal lug 100. The terminal lug 100 has a U-shaped lug 114 at a first end, a U-shaped sleeve 118 at a second end and a connecting member 122 connecting the first and second ends. The connecting member 122 is at an angle with the lug 114 and sleeve 118 and connects the sleeve 118 and the lug 114 at different planar planes. In FIG. 1A, the longitudinal axis of the sleeve 18 is perpendicular to a longitudinal axis of the elongate U-shaped lug 14. However, as shown in FIG. 6, the longitudinal axis of the sleeve 118 is parallel with a longitudinal axis of the lug 114. This embodiment is useful when a newly added wire is to run parallel to the existing wire 8. Each end of the sleeve 118 in FIG. 6 is shown with one spike 130 and two cutting edges 134 projecting into the space of the sleeve 118. Other variations and combinations of the spike 30 and cutting/serrated edge 34 according to the variations described above can also be provided on the terminal lug 100.

**[0029]** In a further variation of the terminal lugs 10, 10a, 10b, 10c, 10d, 100 the first or front end of the terminal lug need not be U-shaped. The elongate interconnect front end may be formed in the shape of a bar or a ring, for example. The bar may be round, polygonal or flat, such that it is dimensioned for securing by a screw post at a terminal

block. Similarly, the front end may be formed in the shape of a ring. In addition, the front end of the terminal lug can also be secured by a spring clamp instead of a screw post. In yet a further variation, the elongate interconnect first or front end is a C-shaped socket complementary to the flat bar shape of the above variation. The C-shaped socket and flat bar combination is suitable for in-line connection from the terminal lug, that is, without the use of a terminal block.

**[0030]** In use, the spike 30, 130 and cutting edge 34, 134 need not be directed radially into the wire 8. With the tubular sleeve 18, 118 formed around, or partially around, to support the wire 8 during crimping, the terminal lug of the present invention would work equally well as long as the spike 30, 130 and/or cutting edge 34, 134 is/are directed into the wire for contact with the wire's conductor. This means that a particular size of the terminal lug is suitable for use with a range of wire sizes and/or wire insulation thicknesses.

**[0031]** In a further variation of the use of the terminal lug of the present invention, the terminal lug can also be used with a single- or solid-core conductor wire 8a. In use, as shown in FIGs. 7A and 7B, the tip or part of the spike/cutting edge bends when the spike/cutting edge contacts with the solid-core conductor during crimping.

**[0032]** To ensure safe use of the terminal lug 10, 10a, ...etc, for example, to prevent inadvertent short electrical shock or short-circuiting, an insulation sleeve 50 is provided. The insulation sleeve 50 is cut from a typical insulation tube but the insulation sleeve 50 is opened by a longitudinal cut along its length. The insulation sleeve 50 is then opened and slotted over a crimped sleeve 18 so that the open cut edges of the insulation sleeve 50 sandwiches the connecting member 22. In another embodiment, the open insulation sleeve 50 is opened and slotted over a sleeve 18 and wire 8 and the insulation sleeve 50 is crimped together with the sleeve 18 onto the wire 8. In a further

embodiment, part of the terminal lug, for example, other than the spike or cutting edge is coated with an electrical insulation material.

**[0033]** While specific embodiments of the present invention have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the invention. Further, it is understood that there are no limits on the number of terminal lugs of the present invention for connection along the length of an electrical wire or bus line.

CLAIMS:

1. A terminal lug for parallel connection to an electrical wire having an insulation, the terminal lug comprising:
  - an elongate interconnect end;
  - a sleeve end formed in a substantially U-shaped open-tube having two ends, with one end of the open-tube having a spike projecting into a space of the open-tube sleeve; and
  - a connecting member connecting the interconnect end and the sleeve end;wherein the sleeve is operable to fit onto the electrical wire and operable to be crimped thereon such that the spike pierces through the wire's insulation and makes electrical contact with a conductor of the electrical wire.
2. A terminal lug according to claim 1, further comprising a cutting edge formed at an open edge of the open-tube sleeve.
3. A terminal lug according to claim 2, wherein the cutting edge is selected from the following: a continuous sharp edge; a serrated edge; and a serrated edge with discreet teeth.
4. A terminal lug according to any one of the preceding claims, wherein a longitudinal axis of the sleeve end is perpendicular to the elongate interconnect end.
5. A terminal lug according to any one of claims 1-3, wherein a longitudinal axis of the sleeve is parallel to the elongate interconnect end.
6. A terminal lug according to any one of the preceding claims, wherein the open-tube sleeve is operable to bend and wrap around part of the electrical wire.

7. A terminal lug according to any one of the preceding claims, wherein the sleeve end and the elongate interconnect end are at different planes.
8. A terminal lug according to any one of the preceding claims, wherein the elongate interconnect end is selected from the following shape: a spade, a ring, a bar, a flat bar and a C-shaped socket complementary to the flat bar.
9. A terminal lug according to any one of the preceding claims, wherein each end of the open-tubular sleeve has a spike.
10. A terminal lug according to any one of the preceding claims, wherein the spike comprises two or more spikes.
11. A terminal lug according to any one of the preceding claims, wherein the electrical wire comprises a multi-strand conductor core.
12. A terminal lug according to any one of the preceding claims, wherein the electrical wire comprises a single-strand conductor core.
13. A terminal lug according to any one of the preceding claims, wherein the terminal lug is operable to fit a predetermined range of wire sizes.
14. A terminal lug according to any one of the preceding claims, wherein the terminal lug is operable to fit a predetermined range of insulation thicknesses.
15. A method for connecting a parallel connection to an electrical wire having an insulation, the method comprising:
  - a) fitting a terminal lug according to any one of claims 1-14 over the electrical wire; wherein the terminal lug comprises an elongate interconnect end; a sleeve end formed in

a substantially U-shaped open-tube having two ends, with one or each end of the open-tube having a spike or more projecting into a space of the open-tubular sleeve; and a connecting member connecting the interconnect end and the sleeve end; and

b) deforming the open-tubular sleeve of the terminal lug with a crimping tool so that the sleeve wraps around part of the wire and each spike pierces through the wire's insulation and makes electrical contact with a conductor of the electrical wire.

16. A method according to claim 15, further comprising a cutting edge formed at an open edge of the open-tubular sleeve; wherein the cutting edge pierces through the wire's insulation and makes electrical contact with the conductor of the electrical wire when the terminal lug is crimped onto the wire.