Abstract: A wire crimp, a crimping tool for crimping a crimp contact to an insulated wire and a method of crimping a crimp contact to an insulated wire, the wire crimp comprising: an electrical wire comprising an electrical conductor and an insulator sheath which sheaths the conductor, and a crimp contact including a cavity which receives the wire, at least one first crimp and at least one second crimp, wherein the first and second crimps have different internal lateral spacings and crimp the wire to different depths such that the crimp contact is crimped to respective ones of the conductor and the insulator sheath.
A WIRE CRIMP, A CRIMPING TOOL AND A CRIMPING METHOD

The present invention relates to a wire crimp, in particular an insulation displacement crimp, a crimping tool for crimping a crimp contact to an insulated wire and a method of crimping a crimp contact to an insulated wire.

Traditionally, a wire crimp is formed with an electrical wire by stripping the insulator sheath from the electrical conductor and crimping a crimp contact to the stripped electrical conductor. Such wire crimps exhibit a reduced mechanical strength, however, owing to the removal of the insulator sheath at the point of termination, which would otherwise act to provide mechanical support, and also as a result of damage to the electrical conductor as can be caused by stripping the insulator sheath from the electrical conductor.

Insulation displacement crimps are also known, in which a wire crimp is formed with an electrical wire by crimping a crimp contact to the sheathed electrical conductor, and the crimping action is such as to pierce or slice the insulator sheath to expose the electrical conductor. Again, such wire crimps exhibit a reduced mechanical strength owing to damage to the electrical conductor in piercing or slicing the electrical conductor.

The present inventors have devised a wire crimp, in particular an insulation displacement crimp, which provides a high-strength and low-resistance termination, especially as compared to stripped wire crimps, and in particular allows for crimping to narrower gauge wires, and also a crimping tool and crimping method for such a wire crimp.

In one aspect the present invention provides a wire crimp, comprising: an electrical wire comprising an electrical conductor and an insulator sheath which sheaths the conductor; and a crimp contact including a cavity which receives the wire, at least one first crimp and at least one second crimp, wherein the first and second crimps have different internal lateral spacings.
and crimp the wire to different depths such that the crimp contact is crimped
to respective ones of the conductor and the insulator sheath.

In one embodiment the insulator sheath comprises a toughened
fluoropolymer.

In one embodiment the insulator sheath comprises a high-strength, ductile
material.

In one embodiment the insulator sheath is tape wrapped about the
conductor.

In one embodiment the wire is of substantially circular lateral section.

Preferably, the conductor has a lateral dimension of not more than about 0.5
mm.

More preferably, the conductor has a lateral dimension of not more than
about 0.4 mm.

Still more preferably, the conductor has a lateral dimension of not more than
about 0.3 mm.

Still yet more preferably, the conductor has a lateral dimension of not more
than about 0.25 mm.

In one embodiment each crimp comprises a plurality of opposed crimp
elements.

In one embodiment the crimp elements are disposed around the longitudinal
axis of the crimp contact.
In one embodiment the at least one first crimp has a first internal lateral spacing, which is such that the at least one first crimp extends through the thickness of the insulator sheath, which is deformed laterally beyond contact faces of the at least one first crimp, and into the conductor, such as to provide electrical connection therewith, and the at least one second crimp has a second internal lateral spacing, which is greater than the first internal lateral spacing of the at least one first crimp and such that the at least one second crimp extends only into the insulator sheath, such as to provide for mechanical engagement between the crimp contact and the insulator sheath, with the insulator sheath being deformed laterally outwardly of contact faces of the at least one second crimp.

In one embodiment the first and second crimps are located at spaced longitudinal positions along a length of the wire.

In one embodiment the first crimp is located distally of the second crimp relative to the distal end of the wire.

In another embodiment the second crimp is located distally of the first crimp relative to the distal end of the wire.

In another embodiment at least ones of the first and second crimps are located substantially at the same longitudinal position along a length of the wire.

In a further embodiment the first and second crimps are located substantially at the same longitudinal position.

In one embodiment the crimp contact includes a first crimp zone which includes the at least one first crimp and a second crimp zone which includes the at least one second crimp.
In one embodiment the first crimp zone is located distally of the second crimp zone relative to the distal end of the wire.

In another embodiment the second crimp zone is located distally of the first crimp zone relative to the distal end of the wire.

In one embodiment the first crimp zone comprises first and second longitudinally-spaced crimps.

In one embodiment the second crimp zone comprises first and second longitudinally-spaced crimps.

In another aspect the present invention provides a wire crimp, comprising: an electrical wire comprising an electrical conductor and an insulator sheath which sheaths the conductor; and a crimp contact including a cavity which receives the wire and first and second crimp zones, which each include at least one crimp, wherein the crimps of the first and second crimp zones have different internal lateral spacings and are crimped to respective ones of the conductor and the insulator sheath.

In a further aspect the present invention provides a crimping tool for producing the above-described wire crimp, the crimping tool including a cavity which receives the crimp contact and first and second tool members, which each are operative to form respective ones of the first and second crimps.

In one embodiment the first tool member comprises a plurality of press elements which are displaceable such as to form the at least one first crimp.

In one embodiment the second tool member comprises a plurality of press elements which are displaceable such as to form the at least one second crimp.
In a still further aspect the present invention provides a method of producing the above-described wire crimp, the method comprising the steps of: locating the distal end of the wire in the cavity of the crimp contact; providing a crimping tool which includes a cavity which receives the crimp contact, and first and second tool members, which each are operative to form respective ones of the first and second crimps; locating the crimp contact in the crimping tool; operating the first tool member to form the at least one first crimp; and operating the second tool member to form the at least one second crimp.

In one embodiment the first and second tool members are operated simultaneously.

In another embodiment the first tool member is operated prior to the second tool member.

In a further embodiment the second tool member is operated prior to the first tool member.

In one embodiment the first tool member comprises a plurality of press elements which are displaceable such as to form the at least one first crimp.

In one embodiment the second tool member comprises a plurality of press elements which are displaceable such as to form the at least one second crimp.

A preferred embodiment of the present invention will now be described hereinbelow by way of example only with reference to the accompanying drawings, in which:

Figure 1 illustrates a part-sectional longitudinal view of a wire crimp in accordance with a preferred embodiment of the present invention;
Figure 2 illustrates a first lateral sectional view (along section I-I in Figure 1) of the wire crimp of Figure 1;

Figure 3 illustrates a second lateral sectional view (along section II-II in Figure 2) of the wire crimp of Figure 1;

Figure 4 illustrates a part-sectional longitudinal view of a crimping tool for crimping a wire crimp in accordance with a preferred embodiment of the present invention;

Figure 5 illustrates a first lateral sectional view (along section III-III in Figure 4) of the crimping tool of Figure 4; and

Figure 6 illustrates a second lateral sectional view (along section IV-IV in Figure 4) of the crimping tool of Figure 4.

The wire crimp comprises an electrical wire 3, in this embodiment of substantially circular lateral section and comprising an electrical conductor 5 and an electrical insulator sheath 7 which sheaths the conductor 5, and a crimp contact 9 which is crimped to the wire 3.

In this embodiment the conductor 5 comprises a copper alloy, here a high-strength, silver-plated copper alloy, but the conductor 5 could be formed of many other materials, including general copper alloys.

In this embodiment the conductor 5 comprises a plurality of strands, but could be formed of a single strand.

In a preferred embodiment the conductor 5 has a diameter of less than about 0.5 mm, preferably less than about 0.4 mm, more preferably less than about 0.3 mm, and still more preferably less than about 0.25 mm (30 AWG). However, whilst the present invention has particular application to
narrow gauge wires, the present invention also has application to larger gauge wires.

In this embodiment the insulator 7 comprises a high-strength, plastically-deformable material, here a plastics material, in particular a toughened fluoropolymer, such as PTFE, ETFE, PVDF, FEP and PFA, but the insulator 7 could be formed of many other materials, including PVC and polyurethane.

In this embodiment the insulator 7 is tape wrapped about the conductor 5, but could be fabricated in other ways, such as by co-extrusion.

The crimp contact 9 includes a cavity 11, in this embodiment an elongate cavity of circular lateral section, which receives the wire 3, and first and second crimp zones 15, 17 which include crimps 19, 21 to different internal lateral or radial spacings d1, d2, such as to crimp to respective ones of the conductor 5 and the insulator 7.

The crimp contact 9 comprises a deformable, electrically-conductive material, which allows for formation of the crimps 19, 21 and provides for a low-resistance electrical contact with the conductor 5.

In this embodiment the crimp contact 9 is formed of a metal, here a plated copper alloy, typically a gold-plated copper alloy.

In this embodiment the first crimp zone 15, which has an internal lateral spacing d1 smaller than the internal lateral spacing d2 of the second crimp zone 17, is located distally of the second crimp zone 17 relative to the wire 3. In an alternative embodiment the second crimp zone 17 could be located distally of the first crimp zone 17.

In this embodiment, as illustrated in Figure 1, the crimps 19 of the first crimp zone 15 comprise a pair of longitudinally-spaced crimps 19a, b.
In this embodiment, as particularly illustrated in Figure 2, the crimps 19a, b of the first crimp zone 15 have a first internal lateral spacing d1, which is such that the crimps 19a, b extend through the thickness of the insulator 7, with the insulator 7 deforming plastically and flowing laterally beyond the faces of the crimps 19a, b, and into the conductor 5, such as to provide electrical connection therewith.

In this embodiment the crimps 19a, b each comprise a plurality of, here four, crimp elements 23 which are disposed radially, here symmetrically, about the longitudinal axis of the crimp contact 9.

In this embodiment, as illustrated in Figure 1, the crimps 21 of the second crimp zone 17 comprise a pair of longitudinally-spaced crimps 21a, b.

In this embodiment, as particularly illustrated in Figure 3, the crimps 21 of the second crimp zone 17 have a second internal lateral spacing d2, which is greater than the first internal lateral spacing d1 of the crimps 19 of the first crimp zone 15 and such that the crimps 21 extend only into the thickness of the insulator 7, such as to provide for mechanical engagement between the crimp contact 9 and the insulator 7, with the insulator 7 deforming plastically laterally outwardly of the faces of the crimps 21. With this configuration, the provision of the two crimp zones 15, 17 utilizes the mechanical strength and ductility of the insulator 7 in order to achieve a low-resistance electrical termination which has increased mechanical strength as compared to existing termination methods, and enables the use of wire gauges which would not exhibit the required robustness using the conventional crimping methods.

In this embodiment the crimps 21 each comprise a plurality of, here four, crimp elements 25 which are disposed radially, here symmetrically, about the longitudinal axis of the crimp contact 9.
In this embodiment the crimps 19, 21 are formed using a crimping tool 31, as illustrated in Figures 4 to 6.

The crimping tool 31 includes a cavity 33, in this embodiment of circular lateral or radial section, which receives the crimp contact 9 and first and second tool members 35, 37, which each form respective ones of the first and second crimps 19, 21.

In this embodiment the crimping tool 31 is hand operated, but in other embodiments could be operated by an actuator, typically pneumatically or hydraulically operated.

In this embodiment, as particularly illustrated in Figure 5, the first tool member 35 comprises a plurality of, here four, press elements 39 which are radially displaceable such as to form the crimp elements 23 of the crimps 19 of the first crimp zone 15.

In this embodiment, as particularly illustrated in Figure 6, the second tool member 37 comprises a plurality of, here four, press elements 41 which are radially displaceable such as to form the crimp elements 23 of the crimps 21 of the second crimp zone 17.

In this embodiment the first and second tool members 35, 37 are operated simultaneously, but in other embodiments the first tool member 35 could be operated prior to the second tool member 37 or the second tool member 37 could be operated prior to the first tool member 35.

Finally, it will be understood that the present invention has been described in its preferred embodiments and can be modified in many different ways without departing from the scope of the invention as defined by the appended claims.
For example, in the preferred embodiment, the crimp zones 15, 17 each comprise a plurality of longitudinally-spaced crimps 19a, b, 21a, b, but could alternatively each comprise a single crimp 19, 21.

In another modification, the crimp contact 9 could comprise a single crimp zone which comprises at least one first crimp 19 and at least one second crimp 21. As in the preferred embodiment, the crimps 19, 21 in this single crimp zone could be longitudinally spaced or be located at the same longitudinal position.
CLAIMS

1. A wire crimp, comprising:
an electrical wire comprising an electrical conductor and an insulator
sheath which sheaths the conductor; and
a crimp contact including a cavity which receives the wire, at least one
first crimp and at least one second crimp, wherein the first and second
crimps have different internal lateral spacings and crimp the wire to
different depths such that the crimp contact is crimped to respective
ones of the conductor and the insulator sheath.

2. The wire crimp of claim 1, wherein the insulator sheath comprises a
toughened fluoropolymer.

3. The wire crimp of claim 1 or 2, wherein the insulator sheath comprises
a high-strength, ductile material.

4. The wire crimp of any of claims 1 to 3, wherein the insulator sheath is
tape wrapped about the conductor.

5. The wire crimp of any of claims 1 to 4, wherein the wire is of
substantially circular lateral section.

6. The wire crimp of any of claims 1 to 5, wherein the conductor has a
lateral dimension of not more than about 0.5 mm.

7. The wire crimp of claim 6, wherein the conductor has a lateral
dimension of not more than about 0.4 mm.

8. The wire crimp of claim 7, wherein the conductor has a lateral
dimension of not more than about 0.3 mm.
9. The wire crimp of claim 8, wherein the conductor has a lateral dimension of not more than about 0.25 mm.

10. The wire crimp of any of claims 1 to 9, wherein each crimp comprises a plurality of opposed crimp elements.

11. The wire crimp of claim 10, wherein the crimp elements are disposed around the longitudinal axis of the crimp contact.

12. The wire crimp of any of claims 1 to 11, wherein the at least one first crimp has a first internal lateral spacing, which is such that the at least one first crimp extends through the thickness of the insulator sheath, which is deformed laterally beyond contact faces of the at least one first crimp, and into the conductor, such as to provide electrical connection therewith, and the at least one second crimp has a second internal lateral spacing, which is greater than the first internal lateral spacing of the at least one first crimp and such that the at least one second crimp extends only into the insulator sheath, such as to provide for mechanical engagement between the crimp contact and the insulator sheath, with the insulator sheath being deformed laterally outwardly of contact faces of the at least one second crimp.

13. The wire crimp of any of claims 1 to 12, wherein the first and second crimps are located at spaced longitudinal positions along a length of the wire.

14. The wire crimp of claim 13, wherein the first crimp is located distally of the second crimp relative to the distal end of the wire.

15. The wire crimp of claim 13, wherein the second crimp is located distally of the first crimp relative to the distal end of the wire.
16. The wire crimp of any of claims 1 to 12, wherein at least ones of the first and second crimps are located substantially at the same longitudinal position along a length of the wire.

17. The wire crimp of claim 16, wherein the first and second crimps are located substantially at the same longitudinal position.

18. The wire crimp of any of claims 1 to 12, wherein the crimp contact includes a first crimp zone which includes the at least one first crimp and a second crimp zone which includes the at least one second crimp.

19. The wire crimp of claim 18, wherein the first crimp zone is located distally of the second crimp zone relative to the distal end of the wire.

20. The wire crimp of claim 18, wherein the second crimp zone is located distally of the first crimp zone relative to the distal end of the wire.

21. The wire crimp of any of claims 18 to 20, wherein the first crimp zone comprises first and second longitudinally-spaced crimps.

22. The wire crimp of any of claims 18 to 20, wherein the second crimp zone comprises first and second longitudinally-spaced crimps.

23. A wire crimp, comprising:
an electrical wire comprising an electrical conductor and an insulator sheath which sheaths the conductor; and
a crimp contact including a cavity which receives the wire and first and second crimp zones, which each include at least one crimp, wherein the crimps of the first and second crimp zones have different internal lateral spacings and are crimped to respective ones of the conductor and the insulator sheath.
24. A crimping tool for producing the wire crimp of any of claims 1 to 23, the crimping tool including a cavity which receives the crimp contact and first and second tool members, which each are operative to form respective ones of the first and second crimps.

25. The crimping tool of claim 24, wherein the first tool member comprises a plurality of press elements which are displaceable such as to form the at least one first crimp.

26. The crimping tool of claim 24 or 25, wherein the second tool member comprises a plurality of press elements which are displaceable such as to form the at least one second crimp.

27. A method of producing the wire crimp of any of claims 1 to 23, the method comprising the steps of:
   - locating the distal end of the wire in the cavity of the crimp contact;
   - providing a crimping tool which includes a cavity which receives the crimp contact, and first and second tool members, which each are operative to form respective ones of the first and second crimps;
   - locating the crimp contact in the crimping tool;
   - operating the first tool member to form the at least one first crimp; and
   - operating the second tool member to form the at least one second crimp.

28. The method of claim 27, wherein the first and second tool members are operated simultaneously.

29. The method of claim 27, wherein the first tool member is operated prior to the second tool member.

30. The method of claim 27, wherein the second tool member is operated prior to the first tool member.
31. The method of any of claims 27 to 30, wherein the first tool member comprises a plurality of press elements which are displaceable such as to form the at least one first crimp.

32. The method of any of claims 27 to 31, wherein the second tool member comprises a plurality of press elements which are displaceable such as to form the at least one second crimp.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R4/20 H01R4/24 H01R43/048 H01R4/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

HOIR

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

See patent family annex

Date of the actual completion of the international search

5 December 2008

Date of mailing of the international search report

15/12/2008

Name and mailing address of the ISA

European Patent Office, P B 5818 Patentlaan 2 NL- 2280 HV Rijswijk Tel (+31-70) 340-2040, Fax (+31-70) 340-3016

Authorized officer

Sal ojarvi , Kristiina

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