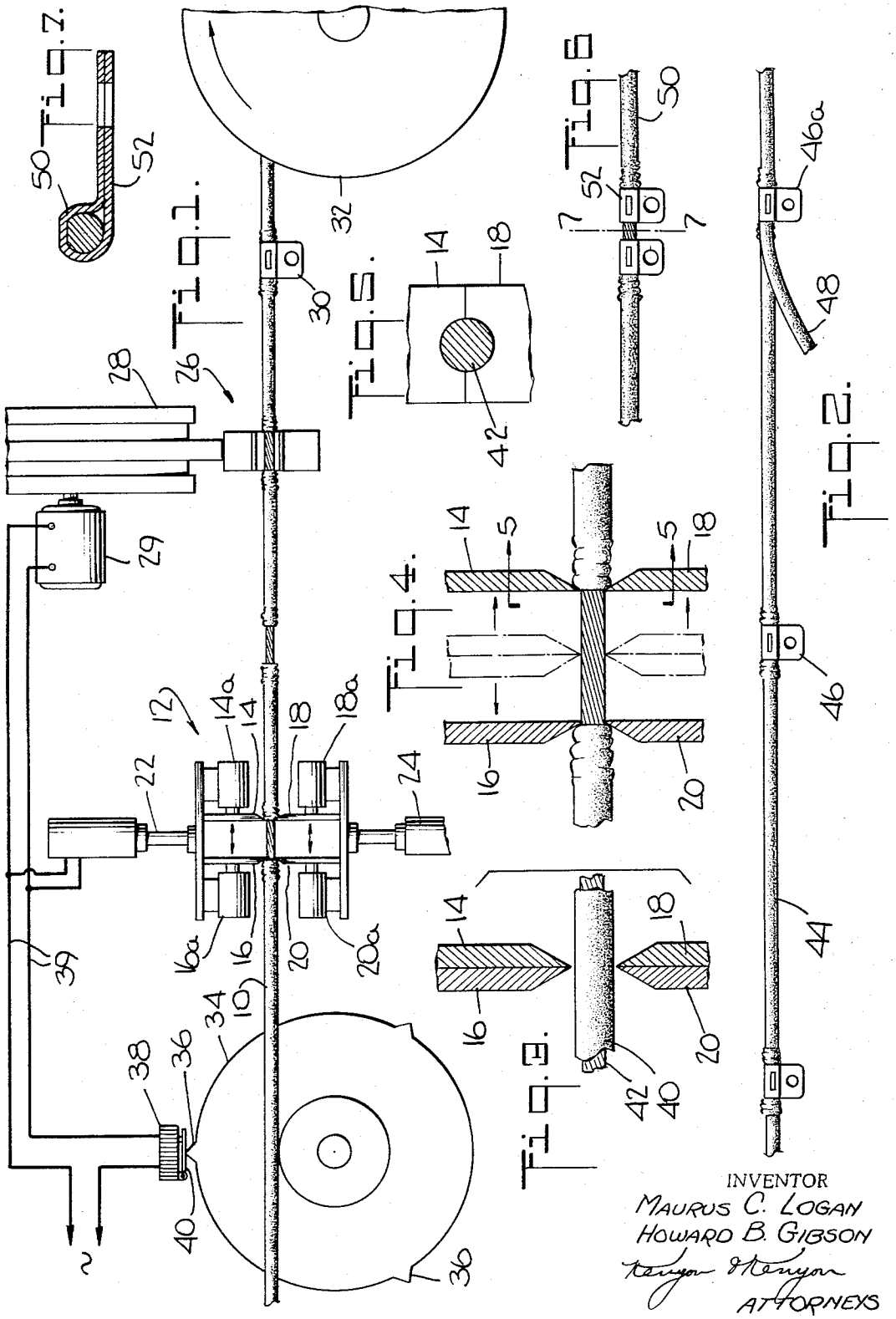
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METHOD OF ATTACHING TERMINALS TO A LENGTH OF INSULATED CONDUCTOR

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METHOD OF ATTACHING TERMINALS TO A LENGTH OF INSULATED CONDUCTOR

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ABSTRACT OF THE DISCLOSURE

The present invention contemplates a method of fixing terminals to a continuous length of insulated conductor. The preferred method comprises feeding a length of insulated conductor to an insulation stripping or displacing station, stripping or displacing insulation from selected portions of the length of the conductor at said stripping station to provide portions of said conductor bared of insulation, attaching terminals to said bared portions of said conductor and winding the continuous length of conductor having terminals attached thereto up on a reel whereby control for advancing the length of conductor through the various stations is provided by the take-up reel. In one embodiment, the conductor is intermittently advanced to the insulation stripping and terminal attaching stations with the stripping and attaching operations performed while the conductor is at rest. In another embodiment, the stripping and attaching operations are performed on the conductor while the conductor is in continuous motion.

This invention relates to a new and improved method of attaching terminals to insulated conductors and more particularly to a new and improved method for attaching terminals to a length of an insulated conductor.

Terminated conductors are well known in the art. Heretofore, a terminal was attached to an insulated conductor after an individual piece of conductor had been severed from a larger length wound up on a reel. The ends of the severed insulated conductor were then stripped of insulation and a terminal applied to at least one end of the conductor by crimping or the like. Such a process obviously involves a great number of individual steps, viz., severing individual leads from a reel of wire, gathering up the severed leads and conveying them to an insulation stripping machine, transferring the stripped leads to a terminal attaching machine, attaching terminals to the leads and bundling the terminated leads. It will be seen that the present method of terminating insulated conductors is basically a batch type operation involving a number of individual operations on a severed conductor. In many applications, it has been found desirable to sever the leads after terminals have been attached thereto.

According to a preferred method of terminating electrical conductors of the present invention, a reel of insulated conductor is fed to an insulation stripping or displacing station where insulation is stripped or displaced from a portion of the electrical conductor without severing the conductor. The bared electrical conductor is then conveyed to a terminal attaching station where a terminal is attached to the conductor, against without-

severing the conductor itself. The insulated conductor with terminals attached is then wound up on a take-up reel. The severing operation is then accomplished whenever desired.

It is thus an object of the present invention to provide a method of applying terminals to an electrical conductor that is simple and economical.

It is a further object of the present invention to provide a new and improved method of applying terminals to an electrical conductor whereby the terminals are applied to the insulated conductor without severing the electrical conductor.

Other and further objects will be apparent from the following description and drawings wherein:

FIG. 1 is a schematic view of one apparatus for carrying out a preferred method of the present invention;

FIG. 2 is a plan view of a length of electrical conductor after terminals have been attached thereto;

FIG. 3 is a partially sectional elevational view of the electrical conductor prior to the insulation stripping or displacing operation;

FIG. 4 is a partially sectional elevational view of the insulation stripping or displacing operation;

FIG. 5 is a partially sectional view taken along line 5—5 of FIG. 4;

FIG. 6 is a partial plan view of a length of electrical conductor after two terminals have been attached thereto; and

FIG. 7 is a partially sectional elevational view taken along line 7—7 of FIG. 6.

Referring now to the figures, FIG. 1 shows schematically one apparatus for carrying out a preferred method of the present invention. As shown, an electrical conductor **10** is fed from a reel (not shown) to an insulation stripping or displacing station **12**. Any well known insulation stripping or displacing device may be used at the insulation stripping or displacing station. As shown, such a device may, for example, be comprised of two pairs of cutting blades, **14**, **16** and **18**, **20**. Blades **14**, **16** and **18**, **20** are mounted such as to be movable in a horizontal direction by means of a suitable motive means such as ram mechanisms **14***a*, **16***a*, **18***a*, and **20***a*. Similarly, knives **14**, **16** and **18**, **20** are respectively movable in a vertical direction by means of ram mechanisms **22** and **24**. Ram mechanism **22** has mounted thereon horizontal ram mechanisms **14***a* and **16***a*, and is adapted to raise and lower knives **14** and **16**. In like manner, horizontal ram mechanisms **18***a* and **20***a* are mounted on vertical ram mechanism **24**, which is adapted to raise and lower knives **18**, **20**. As shown in FIG. 1, knives **14**, **16** and **18**, **20** are in the process of stripping insulation from insulated conductor **10**. Although the apparatus of FIG. 1 shows the stripping of insulation from a portion of the conductor, the insulation need not be stripped completely away from the entire circumference of the conductor. It is sufficient if the insulation is displaced enough so that a terminal may be attached to the bared conductor. For example, the insulation may be cut in such a way as to expose a portion of bared conductor for attachment of a terminal thereto and the displaced insulation then replaced about the barrel of the terminal. Also contemplated to be within the scope of this invention is the attachment of insulation-piercing terminals

to an insulated conductor. In such a case, the insulation stripping or displacing step would be eliminated.

After insulation has been stripped from a selected portion of the electrical conductor, the stripped portion may be carried to a terminal attaching station **26**. A ram mechanism **28** powered by motive means **29** causes terminals **30** fed to the terminal attaching station to be crimped onto the stripped portion of the electrical conductor. Terminal attaching ram mechanism **28** may be any terminal attaching device well known to those skilled in the art. Similarly, any suitable terminal feeding mechanism may be used to feed terminals to attaching station **26**, and any well known type of terminal may be attached, although the method of the present invention described herein is particularly adapted to the attachment of flag-type terminals.

After a terminal **30** has been attached to the electrical conductor, the electrical conductor is wound up on a take-up reel **32**. Thereafter, individual terminated leads may be severed from the length of electrical conductor as future needs may dictate.

Advancement of electrical conductor **10** past the insulation stripping and terminal attaching stations may be controlled by any suitable control mechanism such as the cam operated mechanism represented schematically in FIG. 1. As illustrated, a drum cam **34** with raised portions **36** is rotated by a suitable power means (not shown). Raised portions **36** are spaced around the periphery of drum **34** to control the operating cycles of insulation stripping and terminal attaching machines **22** and **28**. During the operating cycle, take-up reel **32** is controlled to advance electrical conductor **10** a distance corresponding to the selected length of lead to be severed from the length of conductor. Take-up reel **32** is then stopped for a period corresponding to the operating time of the insulation stripping and terminal attaching machines. Take-up reel **32** is then rotated to advance conductor **10** the selected distance, and the operating cycle is repeated. Cam **34** is operated in synchronism with drum **30** and functions to trip a control switch or relay **38** which is inserted in power lines **30** to stripping machine **22** and terminal attaching machine **28**. Thus, switch **38** is only closed during the time that raised portion **36** bears against lever **40** of switch **38**. Lever **40** may, for example, be spring loaded such that it is normally open and only closed when raised portion **36** bears against it. The speed of rotation and diameter of drum **34** and length of lever **40** govern the period of time that switch **38** is closed, this time depending upon the operating cycles of stripping machine **22** and terminal attaching machine **28**. It will be understood that any other suitable control mechanism that is adapted to accomplish the same result may be substituted for the control mechanism schematically represented in FIG. 1.

Although the control mechanism described hereinabove is adapted to an operating cycle in which the insulation stripping and terminal attaching operations are performed when the length of conductor is stopped in its advance, it is apparent that such operations could also be performed when the conductor is slowed down sufficiently in its advance to allow such operations to be performed. For example, the insulation stripping operation could be performed by a knife that makes a vertical cut into the insulation but which causes insulation to be stripped away from the conductor by means of the forward advance of the conductor. In such a case, the knife would first cut into the insulation to the depth of the insulation. The knife would then be maintained in this position as the conductor is advanced forward a predetermined distance. Advancement of the conductor causes the knife to strip back the insulation from the conductor. The knife may then be withdrawn. Similarly, the terminal attaching operation could also be performed as the conductor is slowly advanced forward.

Referring now to FIGS. 3, 4, and 5, there is shown in greater detail the insulation stripping operation. In FIG. 3, knives **14**, **16** and **18**, **20** are shown just prior to penetration of insulation **40** of conductor **42** during vertical advancement of the knives towards each other. The knives are further advanced vertically, until they penetrate the thickness of insulation **40**. Vertical advancement of knives **14**, **16** and **18**, **20** is then stopped so that the surface of conductor **42** is not penetrated. As shown in FIG. 5, the cutting edges of knives **14** and **18** are complementary such as to completely encircle conductor **42**. Although not shown, the cutting edges of knives **16** and **20** are likewise complementary such as to completely encircle conductor **42** after penetration of insulation **40**. Thus, the entire circumference of insulation **40** is cut by the knives in order that the insulation may be stripped cleanly from the conductor.

Referring to FIG. 4, knives **14**, **16** and **18**, **20** are shown in phantom immediately after vertical penetration of insulation **42** has been completed but just before horizontal movement of the knives away from each other. Knives **14** and **16** and knives **18** and **20** respectively are then moved horizontally a predetermined distance away from each other in order to cause stripping of insulation **40** from conductor **42**. Knives **14**, **16** and **18**, **20** are then withdrawn and the bared portion of conductor **42** advanced to the terminal attaching station.

It will be seen that the insulation stripping operation described above basically comprises two steps. First, oppositely disposed, paired cutting knives are caused to converge in a vertical direction in order to effect a circumferential cut in the insulation of an electrical conductor. Second, the paired knives are caused to diverge in a horizontal direction in order to bare the conductor by stripping insulation away from it. The bared conductor is then ready for the terminal attaching operation.

In FIG. 2, there is shown a strip of electrical conductor **44** having a plurality of terminals **46** attached thereto at spaced intervals. In addition, there is shown a second conductor **48** which has been joined to conductor **44** by means of terminal **46***a* at terminal attaching station **26**.

Referring to FIG. 6, a portion of bared conductor **50** is shown as having two terminals **52** attached to the bared conductor. Terminals **52** may be attached either simultaneously or in a sequential operation at terminal attaching station **26**. If a sequential operation is used, suitable modifications in the control mechanism illustrated in FIG. 1 would have to be made. FIG. 7 shows a cross-section of electrical conductor **50** with terminal **52** attached thereto.

Variations in spacing between terminals may be accomplished by varying the speed of advance of the electrical conductor and by varying the operating cycle of the insulation stripping and terminal attaching machines.

It will be understood by those skilled in the art that although a preferred apparatus has been described hereinabove and illustrated in the drawings to carry out the method of the present invention, any other suitable apparatus to perform the same functions may be substituted therefor. It will also be understood that variations in the present method are contemplated to be within the scope of this invention, and that this invention is not to be limited by the above description and drawings, but rather by the appended claims.

What is claimed is:

1. A method of attaching terminals to a continuous length of insulated electrical conductor comprising the steps of continuously advancing a length of insulated electrical conductor to an insulation stripping station, stripping insulation from said conductor at said stripping station at selected portions along the length of said conductor, continuously advancing the conductor having stripped portions to a terminal attaching station, attaching terminals to said portions of said conductor stripped of insulation at said terminal attaching station, and winding said length of conductor having terminals attached thereto up on a reel and controlling the advance of the length of conduc-

tor to said insulation stripping and terminal attaching stations by winding up of said reel.

2. A method of attaching terminals to a continuous length of insulated electrical conductor comprising the steps of advancing a length of insulated electrical conductor to an insulation stripping station, stripping insulation from selected portions of said conductor at said insulation stripping station, advancing the conductor having stripped portions to a terminal attaching station, attaching terminals to said conductor at portions of said conductor sripped of insulation at said terminal attaching station, winding said continuous length of conductor having terminals attached thereto up on a reel, and controlling the advance of said length of conductor past said insulation stripping and terminal attaching stations by means of the winding action of said reel, such that the portions of said conductor to be worked upon at said insulation stripping and terminal attaching stations are stopped momentarily at said stations.

3. A method of attaching terminals to a continuous length of insulated electrical conductor comprising the steps of advancing a length of insulated electrical conductor to an insulation stripping station, stripping insulation from selected portions of said conductor at said insulation stripping station, advancing the conductor having stripped portions to a terminal attaching station, attaching terminals to said conductor at portions of said conductor stripped of insulation at said terminal attaching station, winding said continuous length of conductor having terminals attached thereto up on a reel, and controlling the advance of said length of conductor past said insulation stripping and terminal attaching stations by means of the winding action of said reel, such that the advance of portions of said conductor to be worked upon at said stations is substantially slowed at said stations without said advance being stopped.

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