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(54) **Method for making a mineral-insulated cable.**

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Description

The present invention relates to a method of making a mineral insulated cable and to a mineral insulated cable made by such a method.

Mineral insulated cable comprises an outer metal tubular sheath, usually made of copper, containing one or more conductors embedded in an insulating mineral, usually magnesium oxide. Mineral insulated cable is used in applications where the cable has to withstand high temperatures or fires, for instance in emergency lighting systems and fire alarm systems. Such cables have conventionally been made by either a batch process or a continuous process.

In a known batch process, preformed blocks of mineral insulant having through-holes are inserted into a metal tube which will form the outer sheath in the finished cable. The holes in the blocks are aligned and conductor rods are inserted through the aligned holes. This arrangement forms a blank which is then further processed, for instance by repeated drawing or rolling and annealing to reduce the cross section and provide a finished cable. In alternative batch processes, the conductors are embedded in mineral insulant in powder form, the metal tube being arranged vertically and the powder being inserted from above. A ram may be used to compact the powder within the tube.

By their very nature, such batch processes are capable of producing cables of limited maximum length. Also, these processes have a relatively low rate of production, and the finished cable made by such processes is relatively expensive.

A known continuous process is illustrated in Figure 1 of the accompanying drawings, which illustrates manufacture of a mineral insulated cable having two conductor cores.

The conductors are made from a pair of copper rods 1 which are supplied continuously through bores in a spacer block 2. Copper strip 3 for forming the cable outer sheath is likewise continuously supplied to a tube forming mill illustrated diagrammatically by a pair of rollers 4 and 5. Powdered magnesium oxide 6 is fed under gravity from a hopper 7 through a tube 8 so as to fill the outer sheath. A welding station 9 welds the tube seam in the immediate vicinity of the rollers 4 and 5 so as to form a completed blank 10. The completed blank 10 is continuously fed to a plurality of rolling stages 11 and annealing stages 12, only one of each being shown in Figure 1.

In practice, the continuous process illustrated in Figure 1 has to be performed vertically, at least up to the first rolling stage 11. This requires a considerable vertical space.

DE-A-3137956 discloses a cable comprising preformed insulation blocks of ceramic or quartz having peripheral grooves in which conductors are laid. An insulating layer is formed around the blocks and is enclosed in a metal tube.

According to a first aspect of the invention, there is provided a method of making mineral insulated cable, comprising supplying preformed blocks of mineral insulant having end faces and at least one groove, disposing the blocks such that adjacent end faces abut against each other the at least one grooves are aligned with each other, laying at least one conductor in the or each groove, forming a metal tube around the blocks, and performing at least one step of cross-section reduction.

Preferably, the preformed blocks are supplied continuously and the or each conductor is continuously laid in the or each groove. Although the method according to the first aspect of the invention can be used with advantage in various processes, such as the batch process described hereinbefore, it is particularly advantageous when used in a continuous process.

Preferably, the or each cross-section reduction step is followed by an annealing step.

The preformed blocks may be supplied as sets of blocks having opposing faces provided with corresponding grooves, the blocks of each set being brought together such that the corresponding grooves form at least one duct containing a respective conductor. For instance, the sets may comprise pairs of blocks, each of which is hemi-cylindrical and has at least one longitudinally extending groove in a flat surface.

In an alternative arrangement, the blocks may be formed as substantially cylindrical blocks with at least one longitudinally extending peripheral groove for receiving a respective conductor. After the or each conductor has been laid in the respective groove, mineral insulant in the form of blocks or powder may be introduced into the or each groove so that the or each conductor becomes embedded. Alternatively, a subsequent cross section reduction step may be sufficient to close the mineral insulant around the or each conductor.

The blocks may be held in place around the or each conductor, prior to forming the metal tube, by a plurality of rollers. Alternatively, the blocks may be held in place by winding an elongate material therearound. For instance, the elongate material may be a thread, such as a glass fibre thread, wound helically around the blocks. The elongate material may alternatively be an electrically insulating tape, preferably self-adhesive, wound so as to cover or partially cover the blocks. Electrically insulating tape may alternatively be applied longitudinally around the blocks and formed into a tube. The tape may, for instance, be a silicone rubber which can have the advantage of being self-amalgamating. However, other types of tape may be used, such as mica tape or polytetrafluoroethylene tape.

The use of electrically insulating tape to surround the blocks has advantages in addition to holding the blocks in place. The insulating properties of the finished cable between the or each conductor and earth are improved. When a continuous production process has to be interrupted, the ingress of moisture into the blocks is reduced or eliminated and this avoids possible problems caused by degrading of the insulation, expansion of the blocks, and production of steam within the cable during subsequent heat treatment, such as annealing.

According to a second aspect of the invention, there is provided a mineral insulated cable made by a method according to the first aspect of the invention.

It is thus possible to provide a method which can be performed horizontally or in any convenient arrangement, thus reducing the cost of manufacturing plant. The conductors are held accurately in place without the need for any guidance, which reduces or eliminates the possibility of metal particles or slivers being produced during guidance of the conductor or conductors and entering the insulant. It is not necessary to use fused magnesium oxide, and hence damage to the conductor surface is reduced or eliminated. Thus, it is not necessary to use over-sized conductors in order to achieve a desired current rating. The density of the mineral insulant can easily be varied in order to obtain mineral insulated cable with desired properties. A much higher rate of production can be achieved compared with any known process for making mineral insulated cables. Thus, the cost of the cable can be reduced and a cable with better defined geometry and properties can be made.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagram illustrating a known continuous process for manufacturing mineral insulated cable, as hereinbefore described;

Figure 2 is a diagram illustrating a method of and apparatus for making mineral insulated cable constituting a first preferred embodiment of the present invention;

Figure 3 is a cross sectional view of a preformed block of mineral insulant for use in the method illustrated in Figure 2;

Figure 4 is a cross sectional view of parts of a mineral insulated cable before tube forming to form an outer sheath;

Figure 5 is a cross sectional view of a finished mineral insulated cable constituting a preferred embodiment of the invention;

Figures 6 to 13 are cross sectional views of different shapes of preformed blocks which may be used in preferred methods;

Figure 14 is a diagram illustrating a method of and apparatus for making mineral insulated cable constituting a second preferred embodiment of the present invention; and

Figures 15 to 19 are cross-sectional views on lines I-I to V-V, respectively, of Figure 14.

The method and apparatus illustrated diagrammatically in Figure 2 show all the steps required to make preformed blocks and finished mineral insulated cable. In the first step 21, a mineral insulating powder, such as magnesium oxide, is mixed and supplied to a powder granulating step 22. The granules of insulant are supplied to a tablet making step 23 which forms the mineral into the desired shape of the preformed blocks. These blocks are then supplied to a heat treatment step 24 which ensures that the blocks have a sufficiently stable form for the subsequent steps.

The preformed blocks 25 have the shape shown in Figure 3 i.e. substantially hemi-cylindrical with a diameter of approximately 1″ (approximately 2.5. centimetres) and a length of approximately 8″ (approximately 20 centimetres). The flat surface of the block has two longitudinally extending grooves 26 which are also hemi-cylindrical in shape with a diameter of approximately 1/5″ (approximately 5 millimetres).

The preformed blocks 25 are automatically supplied in facing pairs at 27 and 28 so as to entrain therebetween two copper conductors 29 supplied in the form of continuous rods. The opposing grooves 26 of the pairs of blocks 25 form continuous ducts containing the conductors 29.

The blocks 25 and the conductors 29, together with a continuous strip 30 of copper, are supplied to a tube-forming mill 31 in which the strip 30 is formed into a tube around the blocks. The resulting seam is welded at 32 to form a continuous blank which is then supplied to a plurality of further processing steps. Figure 3 shows, purely by way of example, three rolling steps 33 to 35, each of which is followed by a respective annealing step 36 to 38, the final annealing step 38 being followed by a coiling step 39 for the finished mineral insulated cable.

Figure 4 illustrates the partly formed blank as supplied to the forming mill 31, whereas Figure 5 illustrates the finished blank after the welding step 32. In fact, the rolling and annealing steps 33 to 38 do not alter the form, so that Figure 5 also illustrates the finished mineral insulated cable, having a weld seam at 40.

Figure 6 illustrates the pairs of blocks 25, showing the cylindrical ducts 41 provided by the opposed grooves 26. Figure 7 illustrates two blocks 42 which have grooves arranged to provide a single duct 43 for a single core cable. The step of laying the conductors in the grooves of the blocks may be performed in any suitable way. For instance, as described above, the blocks 25 are brought together around the continuously fed conductors 29. However, in an alternative configuration, the lower blocks of the pairs are supplied so as to define two continuous grooves with the conductors being laid in the grooves from above. The upper blocks may then be placed on top so as to complete the laying in of the conductors.

Figures 8 and 9 illustrate two alternative forms of blocks 44 and 45. The blocks 44 shown in Figure 8 are continuously supplied so as to define two continuous diametrically opposite grooves 46. The blocks 45 in Figure 9 differ in that the grooves 47 are side-by-side and extend downwardly. The conductors are laid into the grooves 46 from the side whereas the conductors are laid into the grooves 47 from above. In order that the conductors be embedded within the mineral insulant, it may be sufficient merely to perform the rolling operations so that the mineral insulant closes around the conductors. However, it is also possible to fill the grooves 46 or 47, after the conductors have been laid therein, with mineral insulant. Suitably shaped preformed lengths of mineral insulant may be provided for this purpose. Alternatively, mineral powder or granules may be used, particularly with the blocks 46 shown in Figure 9.

Figure 10 shows a set of four identical blocks 48, each of which is generally quarter-cylindrical in shape with grooves extending longitudinally along the two flat surfaces of each block. When placed together as shown in Figure 10, the blocks 48 define four ducts 49 for receiving conductors in order to provide a four core cable. The blocks 50 shown in Figure 11 differ in that each is generally third-cylindrical in shape, these blocks being used to provide a three core cable.

Figures 12 and 13 illustrate two possible forms of dissimilar pairs of blocks. The blocks 51 and 52 in Figure 12 differ from the blocks 25 in Figure 6 in that the block 51 has a longitudinal tongue 53 which extends between ducts 54 into a correspondingly shaped groove in the block 52. Figure 12 shows the block 51 disposed above the block 52, but the reverse arrangement is possible and may have advantages in that the tongue 53 assists in correctly locating the conductors during laying in.

The lower block 55 in Figure 13 is similar to the block 45 shown in Figure 9 but has a centre limb of reduced height for co-operating with a preformed upper block 46 to close the conductors within ducts 57.

Figure 14 illustrates another process for continuously forming mineral insulated cable. Preformed blocks 60 of mineral insulant, such as magnesium oxide, are continuously supplied in the direction of production, indicated by arrow 61, so as to form a column. As shown in Figure 15, the blocks 60 are substantially identical to the blocks 25 shown in Figure 6 and are arranged in the column with their grooves 62 aligned and facing upwardly.

As the blocks move along the production line, copper conductors 63 are supplied from reels 64 or the like and are laid into the grooves 62 as illustrated in Figure 16. Further insulating blocks 65 are continuously supplied from above and are positioned on top of the blocks 60 so as to enclose fully the conductors 63, as shown in Figure 17.

The blocks 60 and 65 and the conductors 63 are next covered with a layer of insulation in the form of an insulating tape 66 supplied from a reel 67 or the like.

As the blocks 60 and 65 and the conductors 63 move in the direction of production, the reel 67 is rotated around the axis of the cable and supplies the tape 66 so as to form a continuous layer around the blocks 60 and 65. The tape 66 is electrically insulating and preferably self-adhesive so as to adhere to the outer curved surfaces of the blocks 60 and 65. For instance, the tape 66 may be a silicone rubber provided on one surface with an adhesive. Although Figure 18 indicates that the edges of the adjacent turns of the tape abut against each other, the pitch of the tape may be such that the edges overlap in order to ensure complete enclosure of the blocks 60 and 65. It is also possible to adopt a coarser winding pitch such that the layer of tape does not completely enclose the blocks 60 and 65. Such an arrangement ensures that the blocks are held in place for subsequent production steps, but does not provide the advantages associated with complete enclosure, such as improved insulating properties and exclusion of moisture from the blocks 60 and 65.

Various other types of tape may be used, such as polytetrafluoroethylene and mica tape. In general, the tape 66 is required to have electrical insulating properties and must withstand subsequent heat treatment of the mineral insulated cable. Also, the insulating material of the tape should not break down in an undesirable way at the high temperatures at which the cable is required to be able to operate, for instance as a fire-proof cable. It is preferable for the material of the tape not to contain carbon, as this could impair the insulating properties of the cable when subjected to elevated temperatures. It is also generally preferable that the material of the tape should not break down and produce substantial quantities of gas, which could cause the cable to rupture when subjected to elevated temperatures. Where the tape is provided with an adhesive, the adhesive should preferably have similar properties so as not to compromise the performance of the cable.

Although a winding arrangement has been shown for helically winding the tape 66 around the blocks 60 and 65, other techniques may be used. For instance, tape of width equal to or greater than the circumference of the blocks 60 and 65 may be supplied longitudinally and may be wrapped around the blocks in a manner similar to a tube forming mill.

In cases where improved insulation provided by the layer of tape 66 is not necessary, a thread may be wound helically around the blocks 60 and 65 so as to hold them in place on the conductors 63 for subsequent production steps. For instance, a fibre glass thread may be used for this purpose and will not impair the insulating properties of the cable. Alternatively, the blocks 60 and 65, or only the blocks 65, may be held in position by means of rollers.

The next step in the production process comprises the forming of a metal tube around the layer of tape 66. Figure 14 shows a copper strip 68 of sufficient width being supplied continuously from a reel 69. The strip 68 is formed into a tube by a rolling mill (not shown), for instance of the type illustrated in Figure 1, and the edges of the strip are welded together at a welding station 70 so as to form a weld seam 71 as shown in Figure 19. The cable is then supplied to a plurality of rolling or drawing steps alternating with annealing steps so as to reduce the cross section to the final desired size of the mineral insulated cable, after which the cable is stored in a coiling step or the like.

The continuous process for producing mineral insulated cable can operate at great speed and the length of cable produced is limited only by mechanical handling and inspection considerations. The preformed blocks 60 and 65 provide excellent geometrical stability which allows the insulating properties of the cable to the maximised. The absence of any abrasive steps in the process prevents the ingress of copper particles or slivers or other material into the mineral insulant so that the insulating properties are not compromised. Further, the copper conductors suffer little or no surface damage and their cross sections do not therefore have to be over-specified in order to ensure adequate electrical conductivity in the finished cable. Also, "hot-spots" causing high potential gradients are not created by the process so that the insulating properties are not compromised.

The provision of an insulating layer around the blocks further improves the insulating properties of the cable, but has additional advantages. For instance, if the production process has to be stopped and then restarted, the layer prevents the ingress of moisture into the blocks which might impair the insulation performance and might cause problems during subsequent production steps. For instance, during heat treatment such as annealing, any moisture trapped within the blocks could generate steam and, in severe cases, could rupture the outer metal tube or cause substantial distortion. The provision of the layer of insulating tape avoids this.

Because the mineral insulant is supplied in the form of preformed blocks, there is little or no loose mineral powder at any stage in the cable production. Thus, there is substantially no contamination at the welding stage of the outer tube. Also, there is little or no loss of insulant material or production of powder dust so that the process is very clean and does not waste raw materials.

Because of the geometrical stability in cables made by this method, it is possible to alter the conductor-to-conductor spacing compared with each conductor-to-sheath spacing in order to maximise the dielectric performance of the cable. For instance, the conductor-to-conductor spacing may be made greater than the conductor-to-sheath spacing and this provides a cable with better insulating properties than one in which the spacings are the same or, alternatively, allows the diameter of the cable to be reduced.

Claims

1. A method of making mineral insulated cable, comprising supplying preformed blocks (25, 60, 65) of mineral insulant having end faces and at least one groove (26, 62), disposing the blocks (25, 60, 65) such that adjacent end faces abut against each other and the at least one grooves (26, 62) are aligned with each other, laying at east one conductor (29, 63) in the or each groove (26, 62), forming a metal tube (30, 68) around the blocks (25, 60, 65), and performing at least one step of cross-section reduction (33, 34, 35).

2. A method as claimed in Claim 1, characterized in that the preformed blocks (25, 60, 65) are supplied continuously and the or each conductor (29, 63) is continuously laid in the or each groove (26, 62).

3. A method as claimed in Claim 2, characterized in that the metal tube (30, 68) is continuously formed around the blocks (25, 60, 65).

4. A method as claimed in any one of the preceding claims, characterized in that the or each cross-section reduction step alternates with at least one annealing step (36, 37, 38).

5. A method as claimed in any one of the preceding claims, characterized in that the preformed blocks are supplied as sets of blocks (25, 42, 48, 50, 60, 65) having opposing faces provided with corresponding grooves, the blocks of each set being brought together such that the corresponding grooves form at least one duct (41, 43, 49) for receiving a respective conductor (29, 63).

6. A method as claimed in any one of claims 1 to 4, characterized in that the preformed blocks are supplied as substantially cylindrical blocks with at least one longitudinally extending peripheral groove for receiving a respective conductor.

7. A method as claimed in any one of the proceeding claims, in which an elongate material is wound around the preformed blocks after the or each conductor has been laid therein.

8. A method as claimed in Claim 7, characterised in that the elongate material is an electrically insulating material.

9. A method as claimed in Claim 8, characterised in that the elongate material is a thread.

10. A method as claimed in Claim 9, characterised in that the thread is a glass fibre thread.

11. A method as claimed in Claim 8, characterised in that the elongate material is a tape.

12. A method as claimed in Claim 11, characterised in that the tape is wound so as to enclose the preformed blocks.

13. A method as claimed in any one of Claims 1 to 6, characterised in that a tape is applied longitudinally of the preformed blocks and is wrapped around the preformed blocks.

14. A method as claimed in Claim 13, characterised in that the tape made of an electrically insulating material.

15. A method as claimed in any one of claims 11 to 14, characterised in that the tape is a silicone tape.

16. A method as claimed in any one of Claims 11 to 15, characterised in that the tape carries an adhesive.

17. Mineral insulated cable made by a method as claimed in any one of the preceding claims.

Patentansprüche

1. Verfahren zur Herstellung eines mineralisolierten Kabels, umfassend das Zuführen vorgeformter Blöcke (25, 60, 65) aus mineralischem Isolierstoff mit Endflächen und mindestens einer Rille (26, 62), das Anordnen der Blöcke (25, 60, 65) so, daß benachbarte Endflächen gegeneinanderstoßen und die mindestens einen Rillen (26, 62) miteinander ausgerichtet sind, das Einlegen mindestens eines Leiters (29, 63) in die oder jede Rille (26, 62), das Bilden einer Metallröhre (30, 68) um die Blöcke (25, 60, 65) und das Ausführen mindestens eines Schrittes einer Querschnittsverringerung (33, 34, 35).

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die vorgeformten Blöcke (25, 60, 65) kontinuierlich zugeführt werden und daß der oder jeder Leiter (29, 63) kontinuierlich in die oder jede Rille (26, 62) eingelegt wird.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß die Metallröhre (30, 68) kontinuierlich um die Blöcke (25, 60, 65) gebildet wird.

4. Verfahren nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß der oder jeder Querschnittsverringerungsschritt sich mit mindestens einem Temperschritt (36, 37, 38) abwechselt.

5. Verfahren nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die vorgeformten Blöcke als Gruppen von Blöcken (25, 42, 48, 50, 60, 65) zugeführt werden, die einander gegenüberliegende Flächen mit korrespondierenden Rillen haben, wobei die Blöcke jeder Gruppe sö zusammengebracht werden, daß die korrespondierenden Rillen mindestens einen Kanal (41,43, 49) zur Aufnahme eines entsprechenden Leiters (29, 63) bilden.

6. Verfahren nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die vorgeformten Blöcke als im wesentlichen zylindrische Blöcke mit mindestens einer sich längs erstreckenden äußeren Rille zur Aufnahme eines entsprechenden Leiters zugeführt werden.

7. Verfahren nach einem der vorangehenden Ansprüche, wobei ein langgestrecktes Material um die vorgeformten Blöcke gewunden wird, nachdem der oder jeder Leiter darin eingelegt wurde.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß das langgestreckte Material ein elektrisch isolierendes Material ist.

9. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß das langgestreckte Material ein Faden ist.

10. Verfahren nach Anspruch 9, dadurch gekennzeichnet, daß der Faden ein Glasfaserfaden ist.

11. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß das langgestreckte Material ein Band ist.

12. Verfahren nach Anspruch 11, dadurch gekennzeichnet, daß das Band so gewickelt wird, daß es die vorgeformten Blöcke einschließt.

13. Verfahren nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß ein Band längs auf die vorgeformten Blöcke aufgebracht und um die vorgeformten Blöcke gewickelt wird.

14. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß das Band aus elektrisch isolierendem Material besteht.

15. Verfahren nach einem der Ansprüche 11 bis 14, dadurch gekennzeichnet, daß das Band ein Silikonband ist.

16. Verfahren nach einem der Ansprüche 11 bis 15, dadurch gekennzeichnet, daß das Band einen Klebstoff trägt.

17. Mineralisoliertes Kabel, hergestellt durch ein Verfahren nach einem der vorangehenden Ansprüche.

Revendications

1. Procédé de fabrication d'un câble à isolation minérale, comprenant le fait d'acheminer des blocs préformés (25, 60, 65) de matière isolante minérale, munis de faces terminales et dans lesquels est pratiquée au moins une rainure (26, 62), le fait de disposer les blocs (25, 60, 65) de telle sorte que les faces terminales adjacentes viennent buter l'une contre l'autre et que la ou les rainures (26, 62) viennent s'aligner l'une avec l'autre, le fait de déposer au moins un conducteur (29, 63) dans la rainure (26, 62) ou dans chacune de ces dernières, le fait de former un tube métallique (30, 68) autour des blocs (25, 60, 65) et le fait de réaliser au moins une étape de réduction de la section transversale (33, 34, 35).

2. Procédé selon la revendication 1, caractérisé en ce que les blocs préformés (25, 60, 65) sont acheminés en continu et le conducteur (29, 63) ou chacun de ces derniers est déposé en continu dans la rainure (26, 62) ou dans chacune de ces dernières.

3. Procédé selon la revendication 2, caractérisé en ce que le tube métallique (30, 68) est formé en continu autour des blocs (25, 60, 65).

4. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce que l'étape de réduction de la section transversale ou chacune d'elles alterne avec au moins une étape de recuit (36, 37, 38).

5. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce qu'on achemine les blocs préformés en séries de blocs (25, 42, 48, 50, 60, 65) dans les faces opposées desquels on a pratiqué des rainures correspondantes, les blocs de chaque série étant amenés de façon conjointe de telle sorte que les rainures correspondantes forment au moins un conduit (41, 43, 49) dans lequel vient se loger un conducteur respectif (29, 63).

6. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé en ce qu'on achemine les blocs préformés en blocs essentiellement cylindriques dans lesquels on a pratiqué au moins une rainure périphérique s'étendant en direction longitudinale pour que vienne s'y loger un conducteur respectif.

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel on enroule une matière allongée autour des blocs préformés après y avoir déposé le conducteur ou chacun de ces derniers.

8. Procédé selon la revendication 7, caractérisé en ce que la matière allongée est une matière qui procure une isolation électrique.

9. Procédé selon la revendication 8, caractérisé en ce que la matière allongée est un fil.

10. Procédé selon la revendication 9, caractérisé en ce que le fil est un fil en fibre de verre.

11. Procédé selon la revendication 8, caractérisé en ce que la matière allongée est un ruban.

12. Procédé selon la revendication 11, caractérisé en ce que le ruban est enroulé de façon à enrober les blocs préformés.

13. Procédé selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'on applique un ruban en direction longitudinale des blocs préformés et on l'enroule autour des blocs préformés.

14. Procédé selon la revendication 13, caractérisé en ce que le ruban est réalisé en une matière procurant une isolation électrique.

15. Procédé selon l'une quelconque des revendications 11 à 14, caractérisé en ce que le ruban est un ruban de silicone.

16. Procédé selon l'une quelconque des revendications 11 à 15, caractérisé en ce que le ruban porte un adhésif.

17. Câble à isolation minérale réalisé à l'intervention d'un procédé selon l'une quelconque des revendications précédentes.

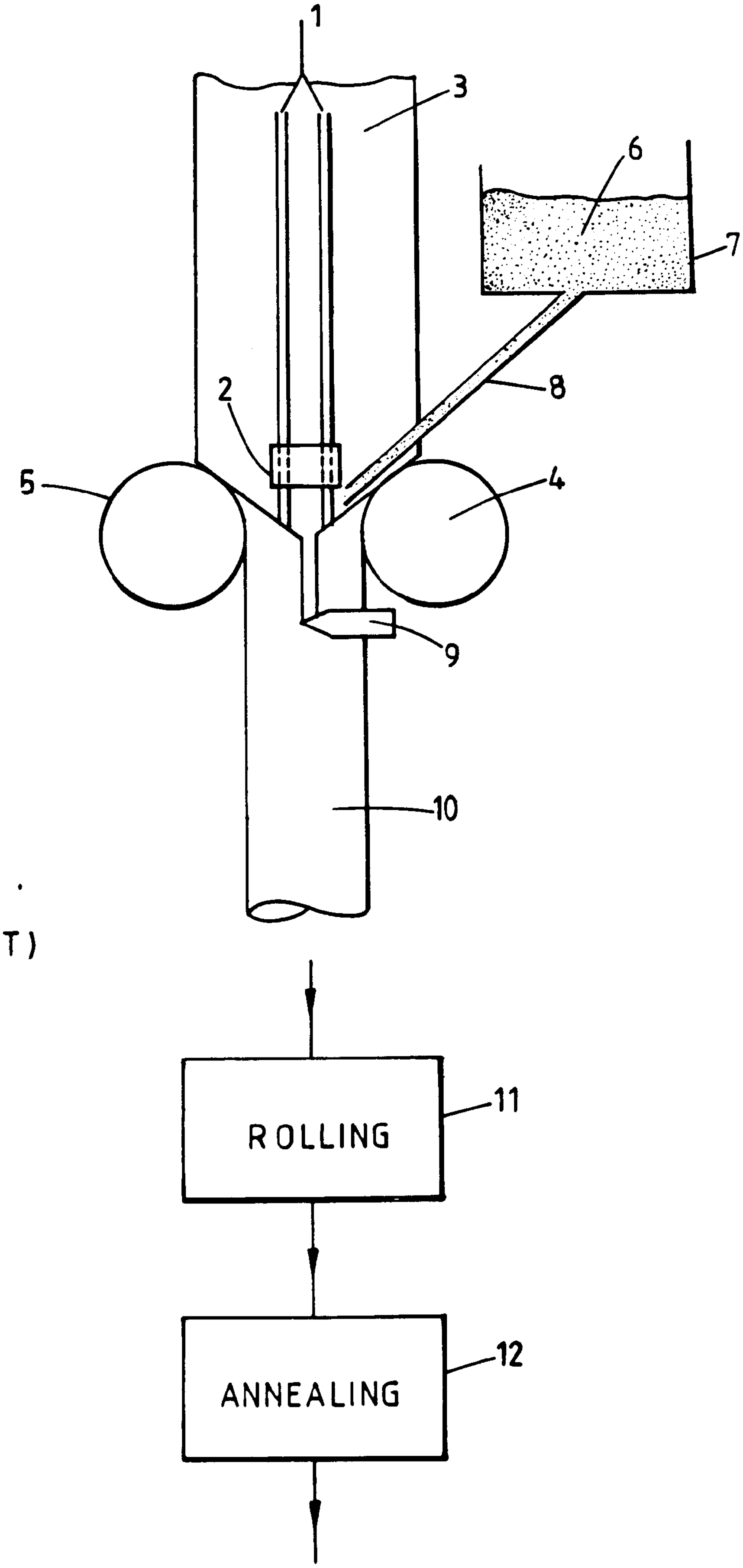

FIG. 1.
(PRIOR ART)

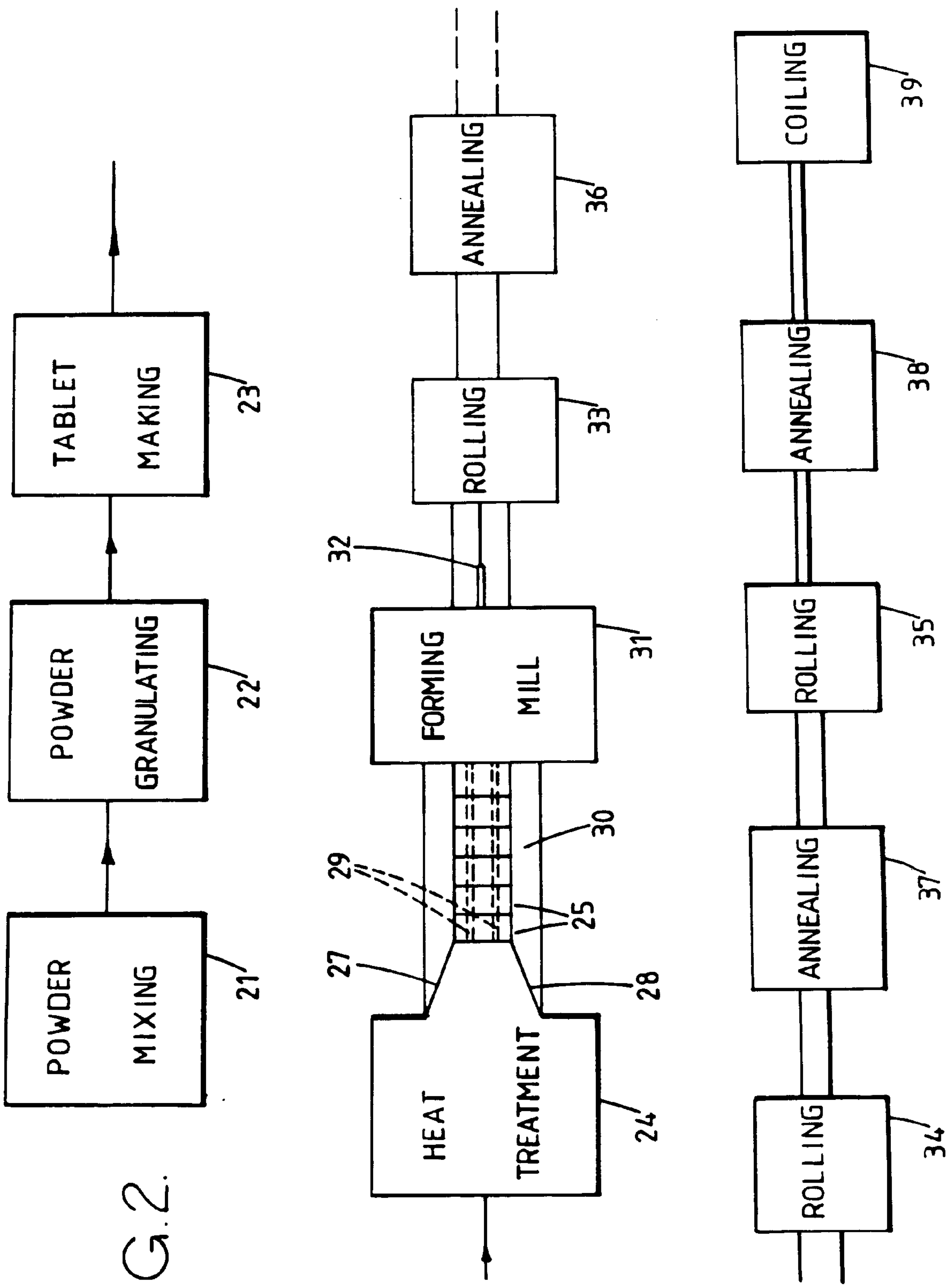
POWDER MIXING
21
POWDER GRANULATING
22
TABLET MAKING
23
HEAT TREATMENT
24
25
27
28
29
30
FORMING MILL
31
32
ROLLING
33
ANNEALING
36
ROLLING
34
ANNEALING
37
ROLLING
35
ANNEALING
38
COILING
39

FIG.2

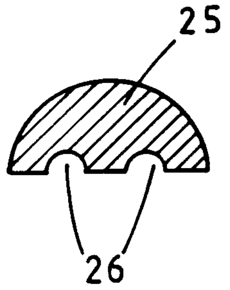

FIG.3.

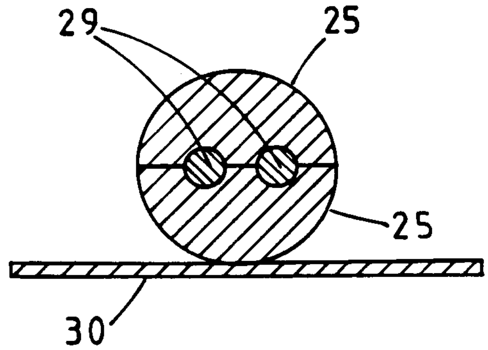

FIG. 4.

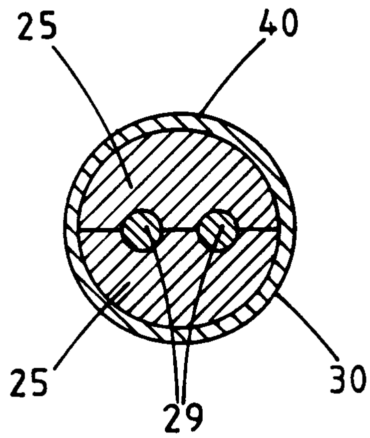

FIG. 5.

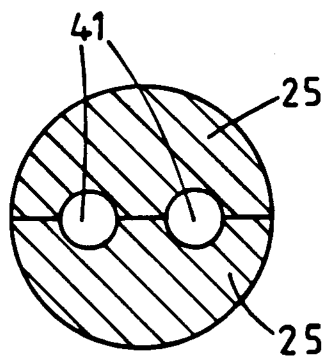

FIG.6.

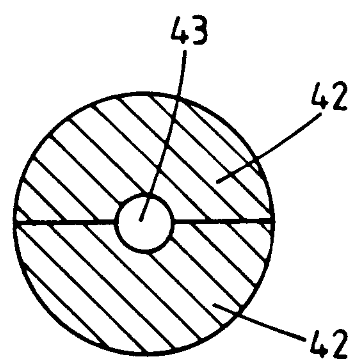

FIG.7.

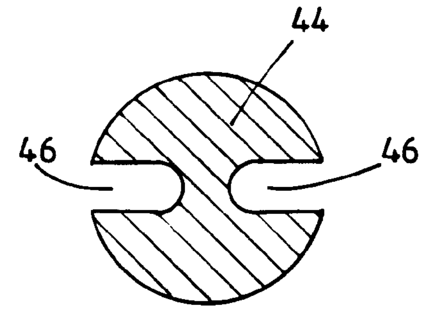

FIG.8.

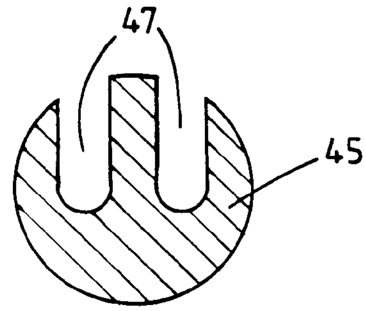

FIG.9.

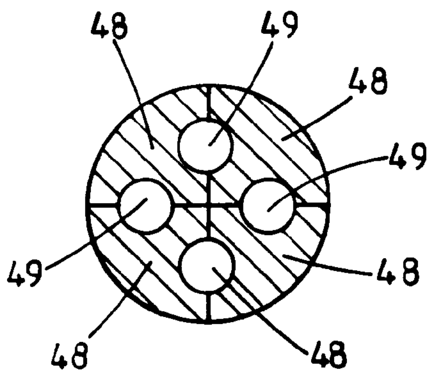

FIG.10.

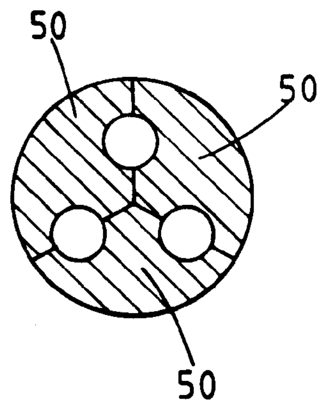

FIG.11.

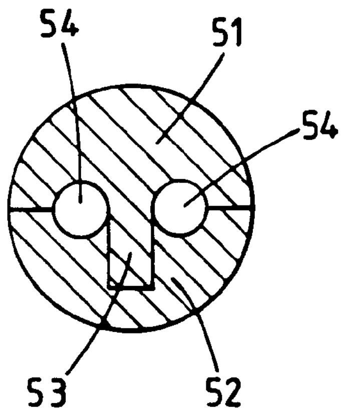

FIG.12

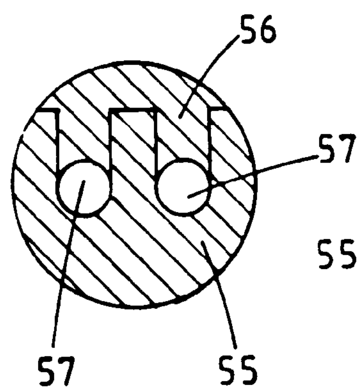

FIG.13.

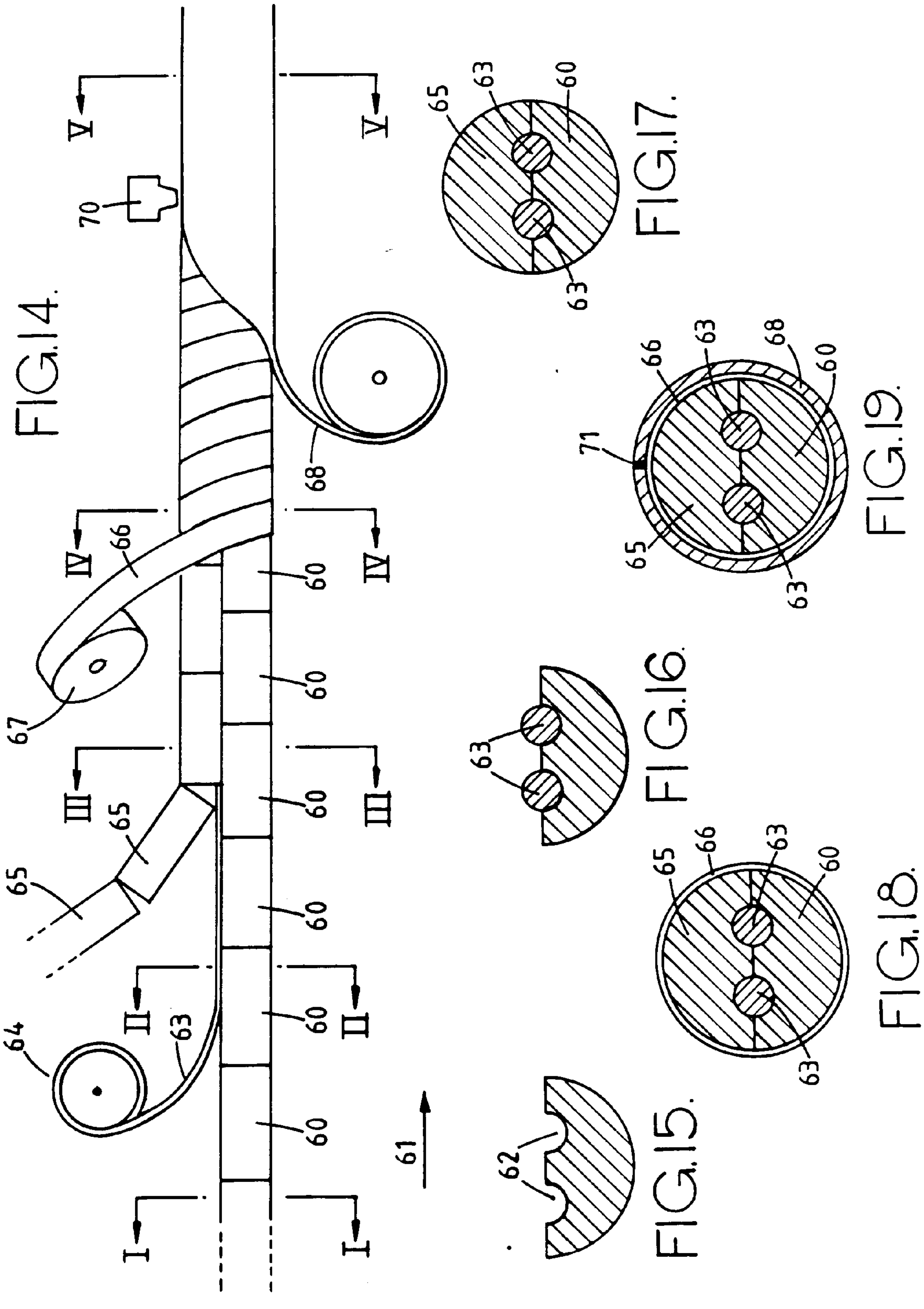
FIG.14.
FIG.15.
FIG.16.
FIG.17.
FIG.18.
FIG.19.
I
II
III
IV
V
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