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(54) **COIL WINDER AND COIL WINDING METHOD**

SPULENWICKELVORRICHTUNG UND SPULENWICKELVERFAHREN

BOBINEUR ET PROCEDE DE BOBINAGE

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(56) References cited:
GB-A- 1 005 481 **US-A- 5 174 013**

- **PATENT ABSTRACTS OF JAPAN vol. 016, no. 291 (E-1224), 26 June 1992 & JP 04 075303 A (MOSUTETSUKU:KK), 10 March 1992 cited in the application**

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Description

Background of the Invention

Field of the Invention

[0001] The present invention relates to a coil winder for winding wire and, in particular, for winding rectangular wire band, in a vertical manner and to a coil winding method therefor.

Description of the Related Art

[0002] In Japanese Patent Application, First Publication, No. Hei-475303, a coil winder for winding in a vertical a band-like rectangular wire having a rectangular cross-section is disclosed. This coil winder comprises a rotating axle member which makes contact with one of the narrow surfaces of the rectangular wire band; a cylindrical-shaped bushing which makes contact with one of the wide surfaces of the rectangular wire band on the edge surface (the supporting surface) thereof while being inserted through this rotating member; and a pressure roller for applying pressure to the other narrow surface of the rectangular wire band in such as way that the rectangular wire band is held between the above-mentioned bushing and this pressure roller, and by means of the controlled rotation of the above-mentioned pressure roller and bushing, the rectangular wire band is successively wound around the rotation axle member. By means of this coil winder, the rectangular wire band is wound vertically, therefore, it is possible to form a comparatively thin coil.

[0003] The coil wound by means of the above-mentioned coil winder is one in which the wider surfaces of the rectangular wire band are mutually opposing each other. However, with this type of coil, after winding, springing back of the rectangular wire band occurs, therefore, the spaces between the windings of the rectangular wire band (the spaces which are parallel to the central axis of the coil) increase, and the thickness of the coil increases. In other words, a coil wound by means of this type of conventional winder has the problem that because the coil has spaces in the axial direction between each of the windings, it is not possible to sufficiently reduce the thickness of the coil. This type of problem with the coil is an extremely important problem in the field of electronic devices where the demands for reduction in thickness and miniaturization are pressing. In addition, at the same time, with the above-mentioned conventional coil, there is also the problem that after being wound, the diameter of the winding increases due to spring back.

[0004] Furthermore, with the conventional coil winder, both end sections of the coil are left unwound in a straight condition, therefore, in accordance with need, it may be necessary to cut these straight sections during post-processing. In other words, when using a conventional coil winder, since a separate process is necessary in which the first section of the coil and the last section of the coil are cut, there is the problem of cost increases due to the fact that their are many processes required in the manufacture of the coil.

[0005] A further example of a coil winder can be found in US-A-5174013

Summary of the Invention

[0006] A first object of the present invention is the provision of a coil winder according to claim 1 and a coil winding method according to claim 6 with which it is possible to realize miniaturization and reductions in the thickness of the coil.***[deletion(s)]***

[0007] By employing the type of method according to claim 6, since the wire is plastically deformed during the winding, it is possible to suppress the spring back which occurs after winding the wire and, consequently, it is possible to suppress to the utmost changes in the shape of the coil.

[0008] For example, using a rectangular wire band as the wire, when winding this rectangular wire band vertically, since spring back in the coil can be suppressed, it is possible to reduce the thickness of the shape of the coil. In addition, since it is possible to suppress increases in the diameter of the coil, it is possible to miniaturize the coil. Consequently, it is possible to manufacture a coil which is suitable for use in electronic devices for which there is a strong demand for miniaturization and reduction in thickness.

Brief Description of the Drawings

[0009]

Figure 1 is a perspective view showing the structure of a coil winder of an embodiment of the present invention.

Figure 2 is a perspective view showing the structure of the winding tools of the coil winder of an embodiment of the present invention.

Figure 3A is a planar view showing the detailed structure of the winding tools of the coil winder of an embodiment of the present invention.

Figure 3B is a side view showing the detailed structure of the winding tools of the coil winder of an embodiment of the present invention.

Figure 3C is a side view showing the detailed structure of the winding tools of the coil winder of an embodiment of the present invention.

Figure 4 is a perspective view showing the positional relationship of the rectangular wire band and the winding tools at the beginning of winding according to an embodiment of the present invention.

Figure 5 is a first process diagram showing the winding process according to an embodiment of the present invention.

Figure 6 is a second process diagram showing the winding process according to an embodiment of the present invention.

Figure 7 is a third process diagram showing the winding process according to an embodiment of the present invention.

Figure 8 is a fourth process diagram showing the winding process according to an embodiment of the present invention.

Figure 9 is a front on view showing the wound condition of the rectangular wire band according to an embodiment of the present invention.

Figure 10 is a perspective view of a coil wound by means of an embodiment of the present invention.

Description of the Preferred Embodiments

[0010] In the following, the preferred embodiments of the present invention are explained.

[0011] Firstly, with reference to Figure 1, the entire structure of the coil winder of an embodiment of the present invention will be explained. In this figure, reference 1 is a rectangular platform, and, for example, it is arranged lengthwise along the direction of the X-axis. On this platform 1, there are provided an L-shaped base member 2, which is flat and rectangular, which is arranged lengthwise along the X-axis, and on the end section of which a standing section 2a projects along the Z-axis; a moveable supporting body 4 which can move along the X-axis by means of a rail 3 which is positioned at a distance from the above mentioned base member 2; a cylinder 5 for moving the above-mentioned moveable supporting body 4 along the X-axis; and a wire guide 6 for supporting the rectangular wire band A in a freely slidable manner.

[0012] On the upper surface of the above-mentioned base member 2, an L-shaped auxiliary base member 8 which moves along the X-axis via rail 7 is provided; and, in addition, a cylinder 9 which moves the auxiliary base member 8 along the X-axis is provided on the standing member 2a. The above-mentioned auxiliary base member 8 is formed in the same shape as the above-mentioned base member 2 and has a standing section 8a which is fixed by means of the tip of the rod of the cylinder 9. On auxiliary base member 8, a head member 10 is provided which moves along the X-axis via rail 9A. In addition, a pressure applying cylinder 11 for moving the head member 10 along the X-axis is fixed by means of bracket 12.

[0013] In addition, a core winder longitudinal-feed cylinder 8b is provided on the auxiliary base member 8. A rod-shaped winding core member 13 is fixed via a coupling member 14 to the tip of the rod of this core winder longitudinal-feed cylinder 8b. Coupling member 14 is for the purpose of connecting the winding core member 13 to the core winder longitudinal-feed cylinder 8b in a rotatable manner. The above-mentioned winding core member 13 is at the center of the X-axis, passes through the above-mentioned head member 10, and is moved along the X-axis, in other words, along the central axis, by means of the winding core longitudinal-feed cylinder 8b.

[0014] The head member 10 has a rotation tool supporting device 15 through which the above-mentioned winding core member 13 passes and which supports the above-mentioned winding core member 13 in a rotatable manner; and a spindle motor 16 for rotating the above-mentioned rotation tool supporting device 15, a chuck opening-and-closing cylinder 17, such that a rotating tool R can be installed. More specifically, the above-mentioned winding core member 13 passes through the rotation tool R along the center of rotation of the rotation tool R. The rotation tool supporting device 15 comprises a cylindrical rotation supporting body 18 and chuck 19 which has a hollow cylindrical shape and which is provided at the end surface (the rear surface) of the above-mentioned rotation supporting body 18. The rotation supporting body 18 is for the purpose of supporting the above-mentioned rotation tool R, and is linked via belt 20 to pulley 16a which is installed on the axle of the spindle motor 16. This rotation supporting body 18 rotates rotation tool R due to the driving rotation of the spindle motor 16.

[0015] Chuck 19 is for connecting/separating winding core member 13 to the rotation supporting member 18, and, on the peripheral surface thereof, a plurality of splines are formed along the X-axis. This chuck 19 connects/separates winding core member 13 and rotation supporting body 18 by means of the movement of ring-shaped binding member 22 in the X-axis along the splines, and this binding member 22 is fitted to the tip of the rod of chuck opening-and-closing cylinder 17 via supporting tool 21 which is long in shape. In the situation shown in this figure, when the binding member 22 moves in a positive direction along the X-axis, the winding core member 13 becomes connected to the rotation supporting body 18, and when the binding member 22 moves in a negative direction along the X-axis, the winding core member 13 becomes separated from the rotation supporting body 18.

[0016] In addition, the movable supporting body 4 is for supporting a cylindrically shaped fixed tool S in such a way that the end surface (front surface) of the fixed tool S is positioned opposite the end surface (front surface) of the above-mentioned rotation tool R, and the movable supporting body 4 comprises a pressure applying cylinder 23 for applying pressure to the fixed tool S in a negative direction along the X-axis. The fixed tool S is installed on movable supporting body 4 in such a manner that it can be moved along the X-axis by means of spring 24. The tip of the rod of pressure applying cylinder 23 is installed on the end surface (the rear surface) of the fixed tool S by means of bracket 25, and by means of the operation of this pressure applying cylinder 23, the fixed tool S is pushed in a negative direction along the X-axis. In addition, a cylindrically shaped center tool

Sa passes through the center of the shaft of the fixed tool S. This center tool Sa is supported in such a way that the end surface (rear surface) of the center tool Sa is fixed to movable supporting body 4, and the other end (the front end) of the center tool is such that it is opposite the above-mentioned winding core member 13.

[0017] Here, the above-mentioned rectangular wire band A is a flat wire, and a cross-section thereof comprises a narrow surface a1 and a wide surface a2. This type of rectangular wire band A is supplied from wire supplying device 26 and supported by means of wire guide 6 such that the rectangular wire band A is inserted between the above-mentioned rotating tool R and the fixed tool S which are arranged opposite each other. Moreover, the above-mentioned rotating tool R and the fixed tool S together make up the wire winding tool.

[0018] Next, the detailed structure of the above-mentioned rotation tool R, fixed tool S and center tool Sa are explained with reference to Figure 2 to Figure 4.

[0019] The center tool Sa comprises a tube-shaped main body s1; a winding core insertion aperture s3 which is an aperture formed in the center of the front surface s2 of the above-mentioned main body s1 and into which the front end of the cylindrically shaped winding core member 13 is inserted; and a guard section s5 which is formed in the peripheral surface s4 of the main body s1 extending along the axis line L from the above-mentioned front surface s2 for a fixed length. On this guard section s5, a surface s7 (guiding surface) which runs from the front surface s2 to the edge section s6 is formed in such a way that it is slightly inclined toward the back surface s8 of the main body s1 with regard to the front surface s2. In addition, the width of this guiding surface s7 and of the above-mentioned front surface s2 is set so as to be slightly larger than the width b of the wide surface a2 of the above-mentioned rectangular wire band A.

[0020] The fixed tool S is formed in such a way that a center tool Sa having the above-described structure can be inserted into it, and, for example, the fixed tool S is formed having a cylindrically-shaped main body s9; a winding housing aperture s10 which is formed in the center of the above-mentioned main body s9 along the axis line L and into which the center tool Sa can be inserted, and a wire introduction window s13 which has a fixed depth and which is formed along the axis line L extending from the peripheral surface s12 of the main body s9 to the winding housing aperture s10 at a position corresponding to the front surface s11 of the main body s9 and the above-mentioned guard section s5.

[0021] In addition, the front surface s11 of this fixed tool S (the surface which is opposite the rotation tool R) is not a simple flat surface and it has the following form. Specifically, in the ring-shaped front surface s11, a segment section s14 having a fixed angle is formed from the wire introduction window s13 with the axis line L shown in the Figures as the center, and this segment section s 14 is formed in such a way that it is orthogonal with regard to the axis line L. The other surface section s15 of front surface s11 which is not part of segment section s14 is formed such that it recedes smoothly and successively with regard to the segment section s14 in the direction indicated by the arrow k1 In other words, there is a step s17 of a fixed depth at the edge section s16 of the segment surface section s14.

[0022] With respect to the fixed tool S having the above-mentioned form, rotation tool R has the following form. Specifically, the rotation tool R comprises, for example, a cylindrically shaped main body r1; an insertion aperture r2 formed in the center of the above-mentioned main body r1 along the axis line L and through which the above-mentioned winding core member 13 passes; and a guiding groove r4 which is formed in the front surface r3 (the surface which is opposite the fixed tool S) of the main body r1. The leading end of the rectangular wire band A enters this guiding groove r4 in such a way that the narrow surface a1 of the rectangular wire band A comes into contact with the peripheral surface of the winding core member 13 (i.e. in a vertical condition). In addition, as shown in Figure 3A, this guiding groove r4 is formed in the front surface r3 and is inclined such that the depth increases at a constant grade from the top of the above-mentioned insertion aperture r2 to the external peripheral surface r5 of the main body r1. In addition, the depth of the guiding groove r4 at the external peripheral surface r5 is formed slightly greater than the width of the narrow surface a1 of the rectangular wire band A.

[0023] The front surface r3 of the above-mentioned rotation tool R is also not a simple flat surface. A segment section r6 is formed with a fixed angle from the guiding groove r4 with the axis line L at the center, and this segment section r6 is formed in such a way that it is orthogonal with respect to the axis line L. The other surface r7 of the front surface r3 which is not part of the segment section r6 is formed such that it recedes smoothly and successively with regard to the segment section r6 in the direction indicated by the arrow k2. In other words, there is a step r9 having a depth which is equal to that of the above mentioned step s17 in the edge section r8 of the segment section r6. In other words, the front surface r3 of the rotation tool R can be put in contact with the surface of front surface s11 of the above-mentioned fixed tool S with the rectangular wire band A in a sandwiched condition therebetween.

[0024] As shown in Figure 4, by means of putting the front faces s11 and r3 into a condition in which they are in mutual contact with each other such that the rectangular wire band A is held between them and guided from the wire introduction window s13 along the guiding groove r4, the rotation tool R and the fixed tool S, formed in the above-mentioned way, hold the rectangular wire band A in a vertical manner on the peripheral surface of the winding core member 13. In this condition, the front surface s2 of the center tool Sa and the guiding surface s7 are in contact with one of the wide surfaces a2 of the rectangular wire band A.

[0025] In the above, the structure of the coil winder of the present embodiment is explained: however. the cylinders 5 and 9 which are the driving means, the winding longitudinal-feed cylinder 8b, the pressure applying cylinders 11 and 23, the chuck opening-and-closing cylinder 17, and the spindle motor 16 are controlled and driven by means of a controlling device which is not shown in the Figures. In addition, supply of the rectangular wire band A is adjusted by the wire supplying device 26.

[0026] Next, a coil winding method which uses the above-mentioned coil winder is explained with reference to Figure 1 through to Figure 10.

[0027] Firstly, in the present coil winder, the rectangular wire band A is maintained at a fixed position, as shown in Figure 1, along the X-axis by means of the wire guide 6 which supports the rectangular wire band A in such a way that the wire can slide freely in the direction of the Y-axis. In this condition, the rotation tool R and the fixed tool S are moved by means of the operation of the cylinders 5 and 9 so as to hold the rectangular wire band A from both sides.

[0028] More specifically, the movable supporting body 4 is moved along the rail 3 in a negative direction along the X-axis by means of the operation of cylinder 5, thereby, a portion (the portion which is opposite the guiding groove r4) of the front surface s11 of the fixed tool S and the guiding surface s7 of the center tool Sa make contact with one of wide surfaces a2 of the rectangular wire band A. In addition, by means of the operation of the cylinder 9, the auxiliary base member 8 is moved along the rail 7 in a positive direction along the X-axis, and together with the operation of the winding core longitudinal-feed cylinder 8b, the front end of the winding core member 13 is inserted into the winding core insertion aperture s3 and the leading end of the rectangular wire band A fits into the guiding groove r4, and the bottom surface of this guiding groove r4 and a portion (the portion which is opposite the guiding surface s7 of the center tool Sa) of the front surface r3 of the rotation tool R make contact with the other one of the wide surfaces a2 of the rectangular wire band A.

[0029] In this condition, with the rectangular wire band A held by the fixed tool S, the center tool Sa and the rotating tool R, because of the presence of the incline in the above-mentioned guiding surface s7 and the incline having a constant grade in the guiding groove r4, the leading end of the rectangular wire band A becomes slightly inclined toward the rotation tool R with regard to the axis line L. In addition, in this condition, the rectangular wire band A is in a condition in which it can slide freely with regard to the above-mentioned various surfaces (contact surfaces) with which it is in contact.

[0030] In this condition, next, by operation of the pressure applying cylinders 11 and 23, each of the wide surface a2 of the rectangular wire band A are pressed at constant contact pressure by the above-mentioned contact surfaces. The above-mentioned contact pressure is a force in a direction which is orthogonal to the longitudinal direction (the direction of winding) of the rectangular wire band A, and acts as lateral pressure with regard to the rectangular wire band A. This lateral pressure (contact pressure) is set in accordance with the type of rectangular wire band A, and is set at a pressure which slightly exceeds the elastic limit of the rectangular wire band A, in other words, at a pressure which can plastically deform the rectangular wire band A.

[0031] Figure 5 is a process diagram showing the condition (the initial position of the winding process) in which lateral pressure is applied to the rectangular wire band A in the above-mentioned way. In this condition, the rotation tool R is rotated in a clockwise direction by means of the operation of the spindle motor 16. At this time, the supply of the rectangular wire band A is prevented by means of the wire supplying device 26, thereby, as shown in Figure 6, the leading end of the rectangular wire band A, in other words, the portion which is held in the guiding groove r4, is wound around the peripheral surface of the winding core member 13 in accordance with the rotation of the rotation tool R. In this way, since the leading end of the rectangular wire band A is in the guiding groove r4 and since the segment section r6 protrudes in the positive direction ofthe X-axis further than the guiding groove r4, rotation is reliable and the leading end of the rectangular wire band A is wound around the peripheral surface of the winding core member 13. Here, while the rectangular wire band A is being wound around the peripheral surface of the winding core member 13, the rectangular wire band A is also plastically deformed by means of the lateral pressure which is applied by the above-mentioned contact surfaces and which exceeds the elastic limit of the rectangular wire band A.

[0032] Next, as shown in Figure 7, when the rotation tool R has been rotated one half turn, all of the leading end of the rectangular wire band A has been wound around the peripheral surface of the winding core member 13. In other words. in this embodiment, the length of the leading end of the above-mentioned rectangular wire band A is set so as to correspond to the length of one half turn of the winding core member 13. In this condition, the chuck 19 is closed by means of the operation of the chuck opening-and-closing cylinder 17. As a result, the rotation tool R and the winding core member 13 are put into a joined condition, and from this time on, the winding core member 13 rotates simultaneously with the rotation tool R.

[0033] Next, together with the simultaneous rotation of the rotation tool R and the core winding member 13, the rectangular wire band A is fed out synchronously with the rotation of the rotation tool R from the wire supplying device 26 and, thereby, from this time on, the rectangular wire band A is held between the front surface r3 of the rotation tool R, and the front surface s2 of the center tool Sa. In the same way as the lateral pressure which is applied to the rectangular wire band A by means of the above mentioned rotation tool R and the fixed tool S, the force of pressure (the lateral pressure)

applied to the rectangular wire band A by the front surface r3 of the rotation tool and the front surface s2 of the center tool Sa is also set at a pressure which plastically deforms the rectangular wire band A, and from this time on, the rectangular wire band A is wound around the winding core member 13 while being plastically deformed.

[0034] Here, the position of the wire guide 6 along the X-axis, in other words, the supply position for the rectangular wire band A, is fixed, and the position of the movable supporting body 4 and the position of the center tool Sa along the X-axis can be fixed at a set position by means of cylinder 5. However, because the wound rectangular wire band A is successively taken into the inside of the wire housing aperture s10 in response to the rotation of the rotation tool R, the position of the rotation tool R along the X-axis changes successively in a negative direction along the X-axis as shown in Figure 9, and simultaneously with this, the position of the fixed tool S also changes successively in a negative direction along the X-axis.

[0035] When the rectangular wire band A has been wound for a predetermined number of times in the above-mentioned way, the rectangular wire band A is cut at the supply side, for example, at the wire introduction window s13, by means of a cutting device not shown in the figures. Then, by means of additional rotation of the rotation tool R, the remaining rectangular wire band A is completely wound. Then, when all of the rectangular wire band A has been wound, the pressure applied by means cf the pressure applying cylinders 11 and 23 is released, and the winding core member 13 is withdrawn from the fixed tool S by the operation of the core longitudinal-feed cylinder 8b. In addition, the coil housed in the wire housing aperture s10 can be removed by separating the fixed tool S and the rotation tool R by means of the operation of cylinders 5 and 9.

[0036] Figure 10 is a perspective view of a coil C which was manufactured by means of the above-described winding process. According to this type of coil manufacturing method, since the rectangular wire band A is wound while being plastically deformed by lateral pressure applied to the wide surface a2 of the above-mentioned rectangular wire band A, it is possible to suppress spring back which occurs after the winding is completed. Consequently, it is possible to manufacture a thin coil having a coil thickness d because the space between the windings of the rectangular wire band A which has been wound can be made smaller.

[0037] Moreover, the present invention is not limited to the above-mentioned Embodiment and, for example, Embodiment Variations like the following are also included in the scope of the present invention.

(1) The above mentioned Embodiment is structured in such a way that the center tool Sa is fixed to the movable supporting body 4, and the fixed tool S can move along the X-axis with respect to the center tool Sa, but a structure is possible in which the fixed tool S is fixed with respect to the movable supporting body 4 and the center tool Sa is attached to the movable supporting body 4 via an elastic member such as a spring. In this situation, the rectangular wire band A which is wound around the winding core member 13 is wound and plastically deformed while receiving lateral pressure due to the rotating tool R and the elastic member.

(2) In the winding process of the above-mentioned coil, as shown in Figure 10, the initially wound section c1 and the finally wound section c2 of the coil are completely wound into a ring shape. However, by means of simultaneously rotating the rotation tool R and the winding core member 13 in a joined manner when the rotation of the rotation tool R begins, and by relaxing the maintaining force of the rectangular wire band A of wire guide 6, the leading end of the rectangular wire band which is inserted in the guiding groove r4 is not wound and its straight form is maintained. In addition, by means of removing the coil after it has been cut at the supply side of rectangular wire band A by means of a cutting device, the last section of the rectangular wire band A also remains in a straight form. By means of this type of winding process, it is possible to form lead wires having a straight form on both ends of the coil.

(3) The above-mentioned Embodiment has a structure in which the position along the X-axis of the wire guide 6. in other words, the position at which the rectangular wire band A is supplied, is fixed, and together with the winding of the rectangular wire band A, the rotation tool R and the fixed tool S move in a negative direction along the X-axis. In addition, in the above-mentioned Embodiment Variation (1), together with the winding of rectangular wire band A, the center tool Sa moves in a positive direction along the X-axis. However, a structure is also possible in which the wire guide 6 moves along the X-axis, and the rotation tool R and the fixed tool S or the center tool Sa are fixed as much as possible. In this situation, a moving mechanism for the wire guide 6 is necessary.

(4) In the above-mentioned Embodiments, embodiments for a coil winder for a rectangular wire band A and for a winding method therefor are explained, but the essential technical concept of the present invention is the use of a means which winds a wire while plastically deforming this wire in order to suppress as much as possible spring back after winding, therefore the type of wire is not limited to rectangular wire band A. The use of round wires which are commonly used in coil manufacture is also possible. However, in this situation, it is necessary to vary the shape of each of the surfaces of the above-mentioned winding tools (the rotation tool R and the fixed tool S) so as to mach the shape of the wire.

Claims

1. A coil winder for winding a wire (A) around a surface of a winding core member (13),
characterised in that
said winder is capable of winding said wire around the surface of said winding core member by means of a pair of winding tools (R, S) which, in use, hold said wire from both sides with a contact pressure force which plastically deforms said wire, one of said winding tools being a rotary winding tool (R), capable of rotation, the other of said winding tools being a fixed winding tool (S).

2. A coil winder according to claim 1 additionally comprising a center tool (Sa) which lies within said fixed winding tool and between said winding tools in a freely moveable manner along a center of rotation of said rotary winding tool, the center tool being capable of holding said wire between itself and an opposing surface of said rotary winding tool, by a pressure which plastically deforms said wire.

3. A coil winder according to claim 1 or claim 2 wherein said rotary winding tool has a guiding groove (r4) into which a leading end of said wire is insertable.

4. A coil winder according to any one of claims 1 to 3, additionally comprising a wire supplying device (26) for, when a leading end of said wire has been would around said surface of said winding coil member, feeding out said wire simultaneously with rotation of said rotary winding tool.

5. A coil winder according to any one of claims 1 to 4 wherein said wire is a rectangular wire band, and said coil winder is capable if winding said rectangular wire band vertically.

6. A coil winding method wherein a wire (A) is put in a condition in which it is in contact with a winding core member (13), and said wire is wound around the surface of said winding core member by means of a pair of winding tools (R, S) which hold said wire from both sides with a contact pressure force which plastically deforms said wire, and by rotating either one of said winding tools.

7. A coil winding method according to claim 6 wherein, when supply of said wire is stopped at the start of winding, a leading end of said wire is wound around a surface of said winding core member; and a last end of said wire is wound around said surface of said winding core member at the completion of said winding.

8. A coil winding method according to claim 6 or claim 7, wherein said wire is a rectangular wire band, and said wire is wound vertically.

Patentansprüche

1. Spulenwickelvorrichtung zum Wickeln eines Drahtes (A) um eine Oberfläche eines Wicklungskernelements (13),
dadurch gekennzeichnet, dass
die Wickelvorrichtung den Draht mittels eines Paars an Wickelwerkzeugen (R, S), die im Gebrauch den Draht von beiden Seiten mit einer den Draht plastisch verformenden Kontaktdruckkraft halten, um die Oberfläche des Wicklungskernelements wikkeln kann, wobei das eine Wickelwerkzeug ein Rotationswickelwerkzeug (R), das rotierbar ist, und das andere Wickelwerkzeug ein feststehendes Wickelwerkzeug (S) ist.

2. Spulenwicketvorrichtung nach Anspruch 1 weiters umfassend ein mittiges Werkzeug (Sa), das innerhalb des feststehenden Wickelwerkzeugs liegt und zwischen den Wickelwerkzeugen frei entlang einem Drehmittelpunkt des Rotationswickelwerkzeugs bewegt werden kann, wobei das mittige Werkzeug den Draht zwischen sich und einer gegenüberliegenden Oberfläche des Rotationswikkelwerkzeugs halten kann, und zwar durch einen Druck, der den Draht plastisch verformt.

3. Spulenwickelvorrichtung nach Anspruch 1 oder 2, worin das Rotationswickelwerkzeug eine Führungsnut (r4) aufweist, in die ein vorderes Ende des Drahts eingeführt werden kann.

4. Spulenwickelvorrichtung nach einem der Ansprüche 1 bis 3, weiters umfassend eine Drahtzuführvorrichtung (26), um, wenn ein vorderes Ende des Drahts um die Oberfläche des Wicklungsspulenelements gewickelt worden ist, den Draht simultan zur Drehung des Rotationswickelwerkzeugs auszugeben.

5. Spulenwickelvorrichtung nach einem der Ansprüche 1 bis 4, worin der Draht ein rechteckiger Banddraht ist und die Spulenwickelvorrichtung den rechteckigen Banddraht vertikal wickeln kann.

6. Spulenwickelverfahren, worin ein Draht (A) in einen Zustand gebracht wird, in dem er sich in Kontakt mit einem Wicklungskemelement (13) befindet, und der Draht durch ein Paar an Wickelwerkzeugen (R, S), die den Draht von beiden Seiten mit einer Kontaktdruckkraft halten, die den Draht plastisch verformt, und durch Rotieren beider Wickelwerkzeuge um die Oberfläche des Wicklungskemelements gewickelt wird.

7. Spulenwickelverfahren nach Anspruch 6, worin, wenn die Drahtzufuhr zu Beginn des Wickelns gestoppt wird, ein vorderes Ende des Drahts um eine Oberfläche des Wicklungskemelements gewickelt wird und ein hinteres Ende des Drahts beim Abschluss des Wickelns um die Oberfläche des Wicklungskernelements gewickelt wird.

8. Spulenwickelverfahren nach Anspruch 6 oder 7, worin der Draht ein rechteckiger Banddraht ist und der Draht vertikal gewickelt wird.

Revendications

1. Bobineur pour enrouler un fil (A) autour d'une surface d'un élément formant noyau d'enroulement (13),
caractérisé en ce que
ledit bobineur est apte à enrouler ledit fil autour de la surface dudit élément formant noyau d'enroulement au moyen d'une paire d'outils d'enroulement (R, S) qui, en cours d'utilisation, tiennent ledit fil des deux côtés avec une force de pression de contact qui déforme plastiquement ledit fil, l'un desdits outils d'enroulement étant un outil d'enroulement rotatif (R), apte à tourner, l'autre desdits outils d'enroulement étant un outil d'enroulement fixe (S).

2. Bobineur selon la revendication 1, comprenant de plus un outil central (Sa) qui se situe dans ledit outil d'enroulement fixe et entre lesdits outils d'enroulement d'une manière librement déplaçable le long d'un centre de rotation dudit outil d'enroulement rotatif, l'outil central étant apte à tenir ledit fil entre lui -même et une surface opposée dudit outil d'enroulement rotatif, par une pression qui déforme plastiquement ledit fil.

3. Bobineur selon la revendication 1 ou la revendication 2, dans lequel ledit outil d'enroulement rotatif présente une rainure de guidage (r4) dans laquelle une extrémité avant dudit fil peut être insérée.

4. Bobineur selon l'une des revendications 1 à 3, comprenant de plus un dispositif d'amenée de fil (26) pour, lorsqu'une extrémité avant dudit fil a été enroulée autour de ladite surface dudit élément formant noyau d'enroulement, dérouler ledit fil simultanément avec la rotation dudit outil d'enroulement rotatif.

5. Bobineur selon l'une des revendications 1 à 4, où ledit fil est une bande de fil rectangulaire, et ledit bobineur est apte à enrouler ladite bande de fil rectangulaire verticalement.

6. Procédé de bobinage, dans lequel un fil (A) est mis dans un état où il est en contact avec un élément formant noyau d'enroulement (13), et ledit fil est enroulé autour de la surface dudit élément formant noyau d'enroulement au moyen d'une paire d'outils d'enroulement (R, S) qui tiennent ledit fil des deux côtés avec une force de pression de contact qui déforme plastiquement ledit fil, et en faisant tourner l'un quelconque des deux outils d'enroulement.

7. Procédé de bobinage selon la revendication 6, dans lequel, lorsque l'amenée dudit fil est arrêtée au début de l'enroulement, une extrémité avant dudit fil est enroulée autour d'une surface dudit élément formant noyau d'enroulement ; et une extrémité finale dudit fil est enroulée autour de ladite surface dudit élément formant noyau d'enroulement à la fin dudit bobinage.

8. Procédé de bobinage selon la revendication 6 ou la revendication 7, où ledit fil est une bande de fil rectangulaire, et ledit fil est enroulé verticalement.

FIG.1

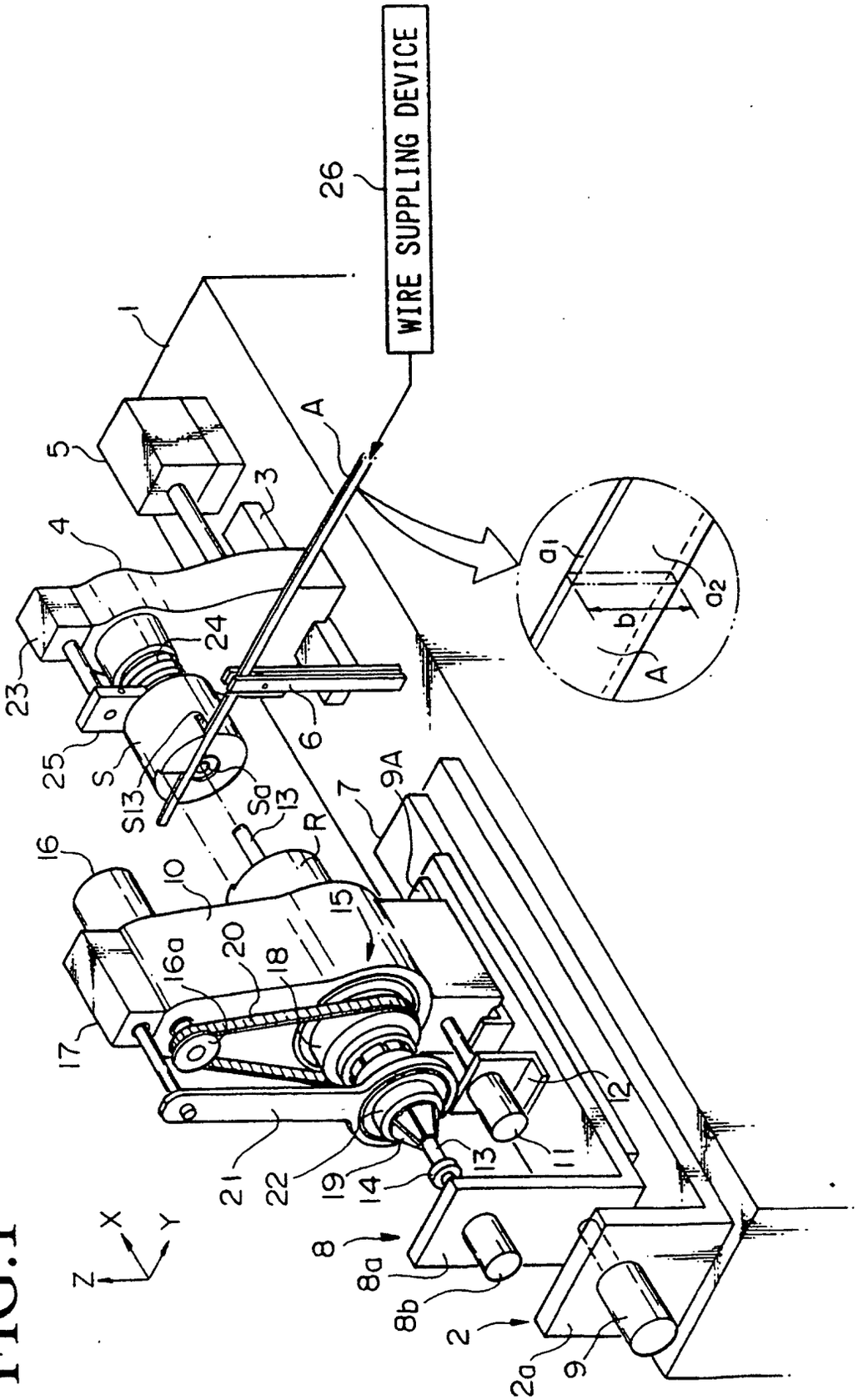
WIRE SUPPLING DEVICE
26
1
5
3
4
A
24
23
25
6
S
S13
Sa
13
R
7
9A
16
10
15
16a
20
18
17
21
22
19
14
13
11
12
8
8a
8b
2
2a
9
X
Y
Z
a1
a2
b
A

FIG2

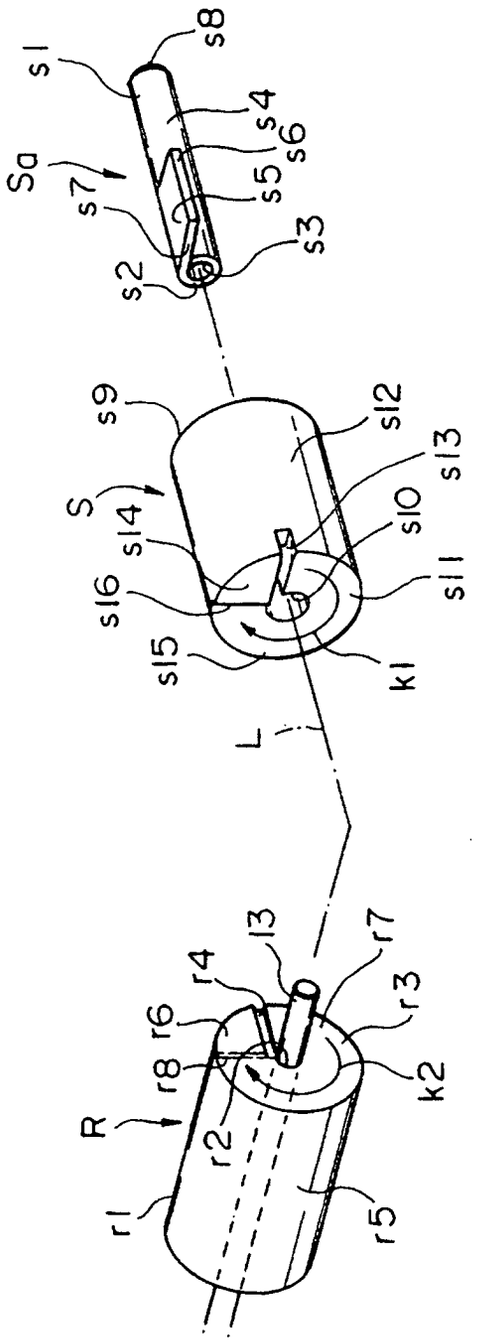
s1
s8
s4
s6
Sa
s7
s5
s3
s2
s9
s12
s13
S
s14
s10
s16
s11
s15
k1
L
13
r7
r4
r3
r6
r8
k2
R
r2
r1
r5

FIG.3A

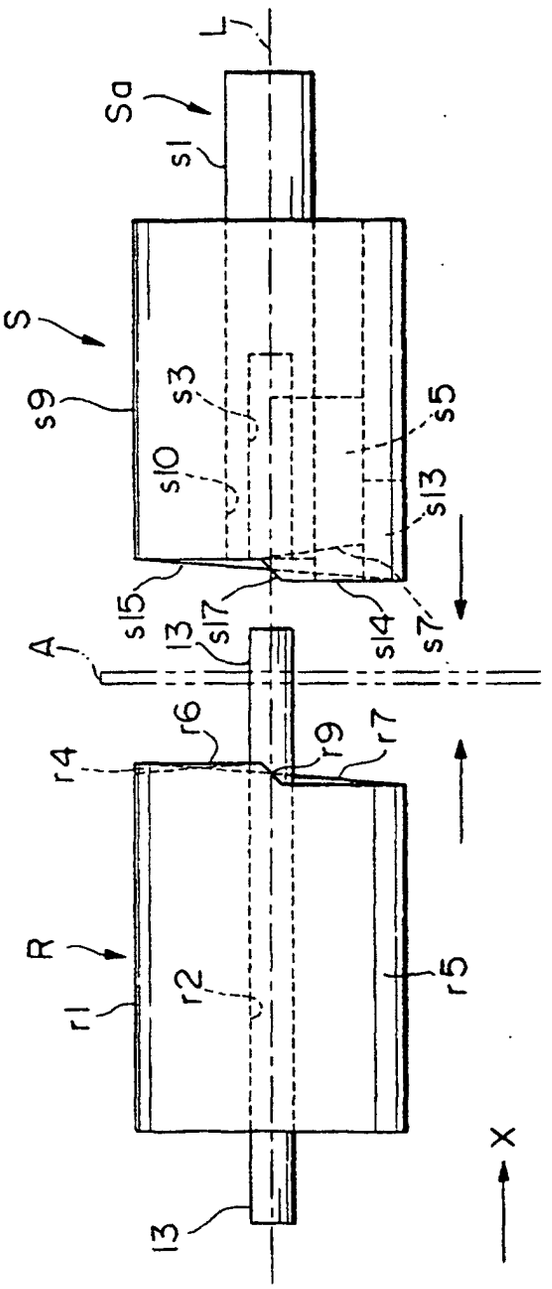

FIG.3B

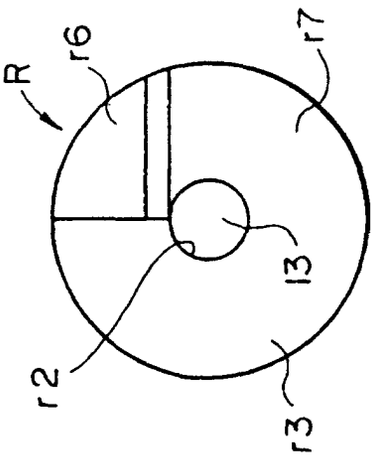

FIG.3C

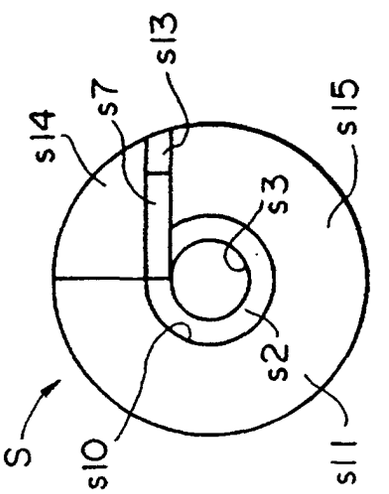

FIG.4

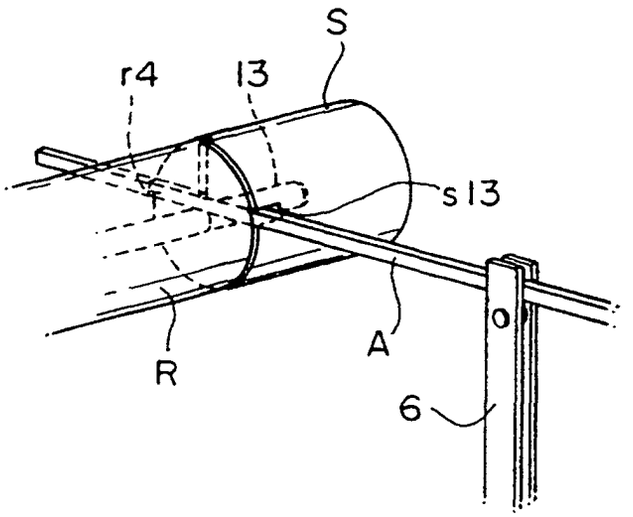

FIG.5

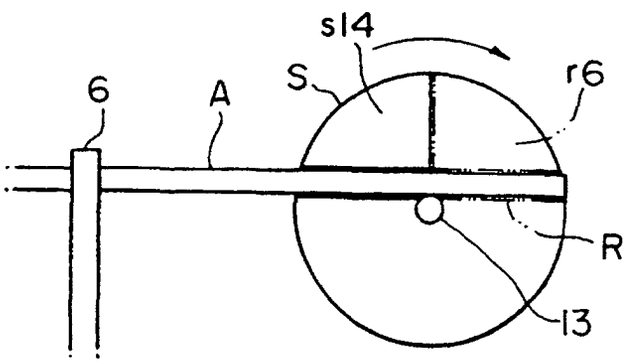

FIG.6

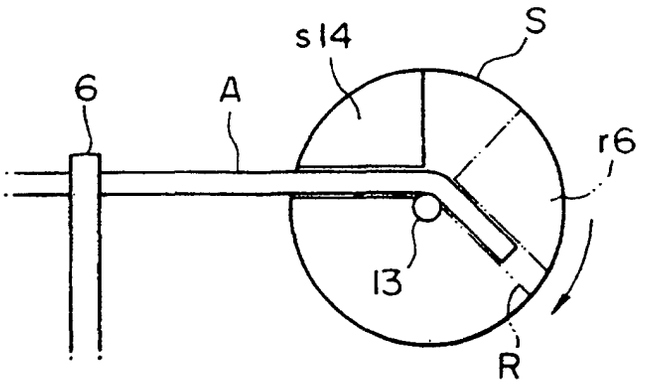

FIG.7

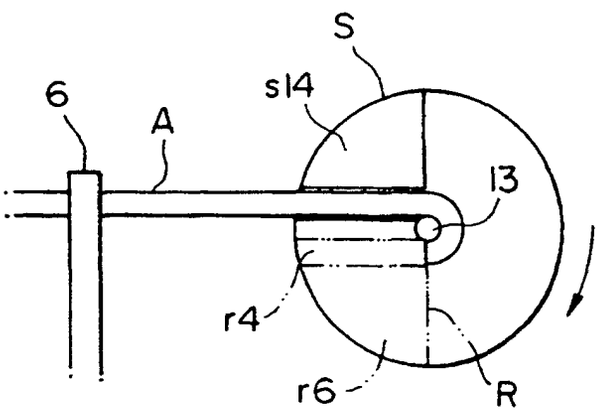

FIG.8

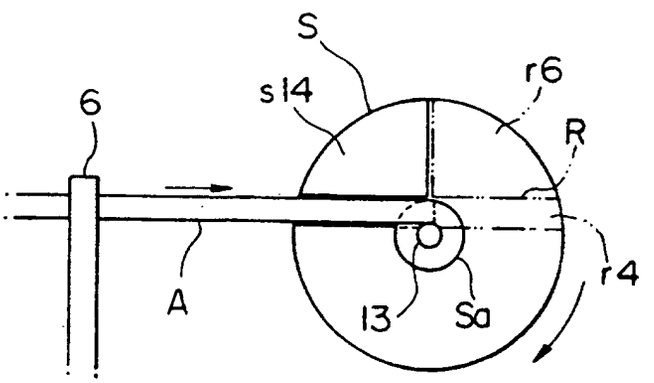

FIG.9

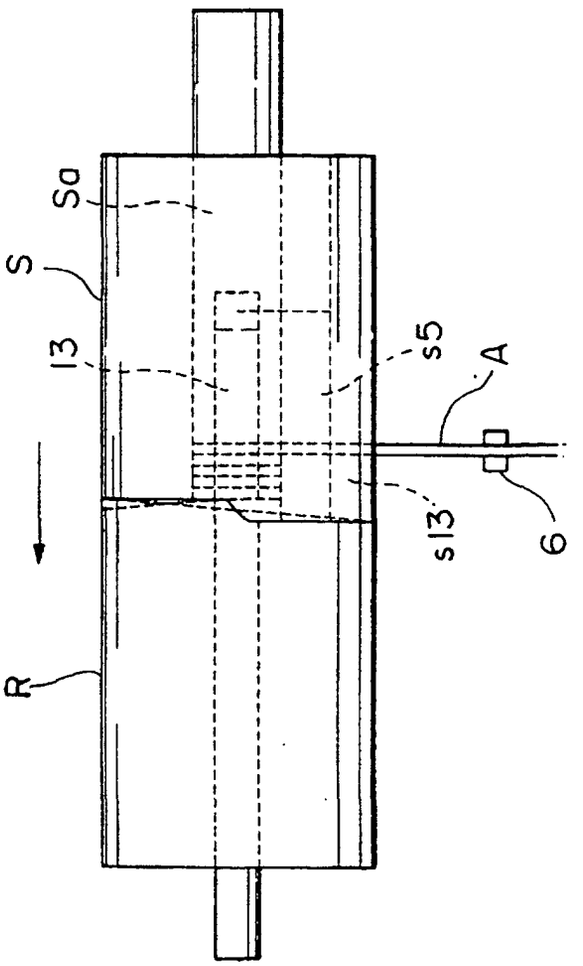

FIG.10