WO 2005/082558 A1

(34) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published: 13 December 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: WINDING MACHINE FOR ROLLED WIRE OR DRAWN WIRE

(57) Abstract: Winding machine with wire-guide extension (7) hinged upstream (70) on a slide (5) that moves vertically, parallel to said reel axis (1) by means of control and independent guide means (6) and wherein separate orientation means (71) are provided with a wire-guide extension (7), that consist in a dynamic-fluid cylinder (71) hinged on said slide (5) on one side and on an intermediate part of said wire-guide extension (7) on the other.
WINDING MACHINE FOR ROLLED WIRE OR DRAWN WIRE

Technical Field

This invention refers to a winding machine for rolled wire or drawn wire
according to the characteristics of the preamble of the main claim.

Background Art

Many winding machines for rolled wire or drawn wire are known.
GB2058703 d.4/1981 is cited as an example of an automatic coiler.
More pertinent is DE0821666 d.11/1951 that describes a wire winding
system alternatively in two winding reels (11,12, Fig.8) that includes a
device to form wire coils downstream of a wire working plant, provided with
a guide wire (13/14) with guide wire moving means (15-13) to guide the wire
to the respective winding coil (11,12) with guide wire moving means (17) to
move the end of the guide wire to the coil (13) on one side and on the other
above the respective reel (11-12) substantially parallel to the reel axis.

Even more pertinent to the object of the present invention is
US4664329 (May 12,1987 in the name of Essex Group Fort Wayne Indiana
US). This refers to a winding system for a segment of wire to form a wire
coil that contains the stages of rotating a mandrel by means of the contact
of the external surface of the mandrel with a belt in motion and guiding the
wire above the rotating mandrel between the belt and the external surface
of the mandrel. The belt keeps the wire against the mandrel (reel) and when
the mandrel rotates, the wire is wound in a coil on the external surface of
the mandrel. The belt maintains contact with the external surface of the coil
and rotates the mandrel until the full length of the segment of wire is wound.

When the thickness of the coil increases, the belt partially loosens on the
external surface of the coil to adjust the belt tension. In the entire
description and figures this patent also provides (Fig.1) a device to form a
wire coil in the winding machine (26, 27) with winding reel, (508) situated downstream of a wire working plant, provided with driver wire rollers (13) and thereafter:
- a first guide wire (24/25) with first guide wire movement means (510/511) to guide the wire from said driver rollers (13) to said winding machine (26, 27) and first moving means (504) to move the end of the guide element to the coil (510/511) on one side and on the other over said reel (544) substantially parallel to the reel axis (579-508-588-589, see Fig.5a and Fig.5i) and second moving means (567, 577-579,588-585-581-588-589-591 see also Fig.5i) in order to be able to move said end of said first guide wire element (24) as it moves away perpendicularly to the reel axis in order to follow the increase of diameter of the coil during the winding (544-27) and
- a wire-guide extension (510 from 24 / 511 from 25), separated from the first (24.25), capable of guiding at least one section of said wire immediately before to unwinding over said reel.

WO0025952 (EP1126935 – Daniell) explains and claims (preamble – non-characterizing part of main claim) substantially the same structuring as described above with the difference that the said wire-guide extension (510-511, 503-500) has devices that are always to be held perpendicular to the rotation axis of said reel.

**Drawbacks of the Background Art**
The solution US4664329 presents a variable wire alignment angle during winding according to the inclination of the first guide wire, that can lead to drawbacks during winding, e.g. the superimposing of the turn of the wire (on one side = end of winding run) or moving away from the adjacent wire (on the other = start of the return run), this taking place particularly depending on the width of the reel, its diameter and length of the first guide wire.
The solution WO0025952 (EP1126935), though trying to resolve only a part
of the problem with the fixed position of the wire-guide extension, positions said cord in a fixed way perpendicular to the reel axis. This solution can work to a limited degree with wires of a small diameter with respect to the reel diameter or coil diameter, while for wires with a greater diameter and particularly in the unfavourable ratio between the wire diameter and the reel/coil diameter, it is possible to see the superimposing of the turn with the malformation of the coil. In fact with the perpendicularity of the guide wire it is always possible to note friction between the wound wire of the last turn and the wire in winding that precisely for its perpendicularity tends to always surmount the wound wire. For this reason, in unfavourable or particularly critical conditions, instead of sliding on the winding layer positioned underneath, the wire is superimposed thus causing the deformation of the coil.

Another considerable drawback is the fact that when turns almost perpendicular to the reel axis are produced, the result is the formation of a coil that when released from the movable external flange of the reel to withdraw the coil and carry it to the binding-machine, the lateral turns of the coil can loosen and unwind from the coil hampering both its transportation and subsequent binding.

20 **Aim of the Present Invention**

The aim of this invention is to avoid the aforementioned drawbacks to allow the formation of perfectly adjacent turns in the coil without the danger of superimpositions or the distancing of one turn from another.

An additional aim is also to be able to form a much more tightly wound coil with less danger that its lateral turns may loosen or unwind during the extraction from the winding mandrel or reel and/or its transportation to a binding machine that is at a distance and separated from the winding-machine.
Solution to the Problem and Disclosure of the Invention

The problem is solved with the characteristics of the claim main.
The depending claims provide particularly advantageous solutions.

Advantages

In this way it is possible to obtain the great advantage of a wire coil
with perfectly aligned and adjacent turns and not superimposed according
to the exact calculated angle of spiral winding (Y) that corresponds to the
ratio between the diameter of the wire and the diameter of the reel/diameter
of the coil.

In fact, in this way it is impossible to superimpose wires since the
wire in winding has the same angle and therefore the same inclination as
the turn that is already wound.

The solution regarding the medium diameter of the coil Dm=(D-d)/2.
Where D= maximum coil diameter and d= reel diameter.

Advantageously the inclination angle (Y) is determined by comparing
the angle at the top of a triangle whose height corresponds to the diameter
of the current or average coil (d, D, Dm) and whose base is equal to the
diameter of the wire Df.

Advantageously, the orientation of the inclination devices (71) can be
provided as variable according to the winding passes. Namely, decreasing
progressively.

Furthermore it is well known that to avoid the superimposition of
turns particularly for wires with a thin diameter, the solution is to carry out
the winding substantially diagonally, namely with more inclined turns in the
away and return direction. In this case the coil will have turns with crossed
ends in positive and negative inclination, therefore no longer running the
risk of being raised from the coil by elastic loosening when the coil must be
extracted and carried to the binding-machine.
Description of a Preferred Form of Realization

The invention will be now better described with the aid of the enclosed figures showing a form of a preferred embodiment, wherein:

Fig. 1 and Fig. 1A schematically represent two views, a lateral view of the winding group, respectively with the entire first guide wire (4) and enlarged in the end portion of said first guide wire on the winding machine-winding reel (1), wherein there is a single guide wire (4) which is designed in double in its oscillation from side to side on the reel, namely from its maximally lowered position "B" to its maximally raised position "A", the reel being positioned by its vertical rotation axis (1).

Fig. 2, 2A, schematically represent an overview with respect to the Figure 1, in full and partially enlarged on the reel side, in the stage with minimum diameter, namely at the beginning of coil formation (C position).

Fig. 3, 3A, schematically represent an overview with respect to Figure 1, in full and partially enlarged on the reel side, in the stage with maximum diameter, namely at the end of coil formation (position D).

Detailed Description of the Figures

As disclosed by the previous figures, it is clear to see that the wire (F) originates from a rolling-mill plant or from a wire-drawing plant (not shown as prior art).

Wire-cutting means are also provided upstream, so that once the coil (R) is completed the wire can be deviated according to the prior art to another winding-machine (only one illustrated), thus allowing the unwinding of the coil already made by sending it to the binding-machine while at the same time another coil is formed.

Schematically therefore upstream of the first guide wire (4) there are advancing means, for example, rolls (2) that convey the wire (F) to a guide
wire entrance (3) that is hinged to allow its second oscillation according to an away and return run on a vertical surface (4A-4B) for each run of turns (5-6) and with oscillation on a horizontal surface (6-8) to progressively distance from the mandrel of the reel/reel winder (1), as the diameter of the coil gradually grows.

These solutions are of the prior art, through the structure of the base with horizontal guides (8) on which the slide moves carrying the guide wire group (6) which in turn supports on a vertical surface (5) an articulated arm hinge (41) of the end of said first guide wire (4).

In this way the end of the guide wire (4) can follow any forming point of the coil (R) according to an established program.

On the same vertical surface (5) a respective extension of the wire-guide (7) is hinged (70) with a respective countersunk entrance to allow the wire to proceed toward the reel (1) for the formation of the coil (R).

The wire-guide extension is carried near to a medium vertical surface passing through the axis of the reel for a suitable coil winder.

Thanks to said hinge (70) and with the aid of a suitable dynamic-fluid cylinder (71), said wire-guide extension (7) can be directed on one side and on the other inclined with respect to the orthogonal axis of the reel to achieve the perfect winding of the wire in turns without the danger of superimposing one turn over the other that could otherwise occur with an orthogonal wire-guide extension fixed to the axis of the reel (front solution EP1126935).

In this way the problem of the wire-guide extension aligned to the first guide wire (previous solution US4664329) that involves the enlargement of the turns to the ends and with the danger of superimposition in the intermediate zone as in the previous solution (EP1126935) is solved.

Furthermore with this solution it is possible to a greater degree to
incline the turns allowing, thanks to the superimposing cross (+Y, -Y), a better winding that prevents the lateral or marginal turns of the coil from loosening precisely because they are crossed.

Obviously while the angle (Z) of the first guide wire varies continuously, the angle (Y) of the wire-guide extension remains constant but alternates between positive and negative for each run.

The advantages of the new solution are therefore evident, in fact said wire guide extension cord always takes an orientation according to the hypotenuse of a right-angled triangle whose cathetus corresponds to the orthogonal to said axis reel/mandrel that is the corresponding angle to the height the turn inclination of the wire whose winding inclination therefore corresponds also to said hypotenuse, on the contrary to the solution explained in EP 1126935 Danieli, whose direction corresponds to said cathetus and contrarily to solution US 4664329 Essex Group, whose direction can in one case correspond to said cathetus (intermediate position of the wire guide) and with much difficulty or only in particular cases can correspond to said hypotenuse. And therefore, contrary to the present solution in which the direction always corresponds in a fixed way to said hypotenuse both clockwise and counter-clockwise according to the away or return movement on the reel for the formation of the turns.
**Claims**

1. Winding machine for rolled wire or drawn wire (F) with a device to form a wire coil (R) in a winding machine with one or more winding reels (1) placed downstream of a wire working plant, provided with wire advancing means (2-3) and thereafter:

- at least one first guide wire (4) with first guide wire movement means (6) to guide the wire from said advancing means (2-3) to the reel or mandrel (1) in question of said winding machine with first moving means (6-5) to move the end (40) of said first guide wire (4) to the coil (R) on one side and on the other over said reel/mandrel (1) substantially parallel to the axis reel/mandrel (1) and second moving means (8-6) in order to be able to move said end of said first guide wire (4) in the away direction perpendicularly to the axis of said reel/mandrel (1) in order to continue with the increase in diameter of the coil (R) during winding and

- a wire-guide extension (7), separated from the first guide wire (4), capable of guiding at least one section of said wire (F) immediately prior to winding over said reel (1), **characterized in that** said wire-guide extension (7) includes:

  i. separate orientation means (71), independent from said first moving means (6-5) for the orientation of said guide wire (4) parallel to the axis of the reel/mandrel (1);

  ii. said separate orientation means (71) are conceived and controlled in such a way that:

    - it is never possible to arrange said wire-guide extension (7) orthogonally to the rotation axis of said reel (1);

    - said wire-guide extension (7) inclines in a constant way according to a “Y” spiral winding angle in one direction and according to the same “Y” spiral winding angle on the other but in the opposite direction, with respect to said
to said rotation axis of said reel (+y, -y):
- this takes place independently of the inclination (Z) during the movement
of said first guide wire (4).
2. Winding machine according to claim 1, characterized in that:

said wire-guide extension (7) is hinged upstream (70) on a slide (5) that
moves vertically, parallel to said reel axis (1) by means of control means
and an independent guide (6);
said separate orientation means (71) of said wire-guide extension (7),
consisting of fluid dynamic cylinder means (71) with hinging on said slide (5)
on one side and on an intermediate part of said wire-guide extension (7) on
the other.
3. Winding machine according to claim 1 and/or 2, characterized in that it
comprises control means such that said separate orientation means (71)
are operated in inversion of the angle on one side (+y, -y) or vice-versa on
the other (-y, +y), with contact means at the end of the oscillation run of
said first guide wire (4), namely when it inversed its direction of travel.
4. Winding machine according to claim 1 and/or 2., characterized in that it
comprises control means such that said separate orientation means (71)
are operated at an angle width (Y) in relation to the average diameter of the
coil Dm=(D-d)/2 in relation to the diameter of the wire (Df), where “D” is the
maximum diameter of the coil and “d” is the minimum diameter of the coil =
diameter of the reel-mandrel (1).
5. Winding machine according to claim 1 and/or 2, characterized in that it
includes control means such that said separate orientation means (71) are
operated at an angle width (Y) according to the minimum diameter of the
coil = reel diameter (1) and the maximum diameter of the coil Dm in relation
to the diameter of the wire (Df) with variable progression at every away and
return run for one or more turns at a time.
6. Winding machine according to claim 1 and/or 2, characterized in that it comprises control means such that said separate orientation means (71) are operated at an angle width (Y) that decreases progressively with the increase of the diameter of the forming coil (R).

7. Winding machine according to claim 1 and/or 2., characterized in that it comprises control means such that said separate orientation means (71) are operated at an angle width of (Y) that is the same or greater than the equivalent to an angle at the top of a triangle having for its height the turn winding diameter and as base the diameter of the wire “d”, therefore for basic values substantially equal to "d" or “>d".
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 B21C47/12 B65H54/02

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)

IPC 7 B21C B65H

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, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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Date of the actual completion of the international search: 5 April 2005

Date of mailing of the international search report: 13/04/2005

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