

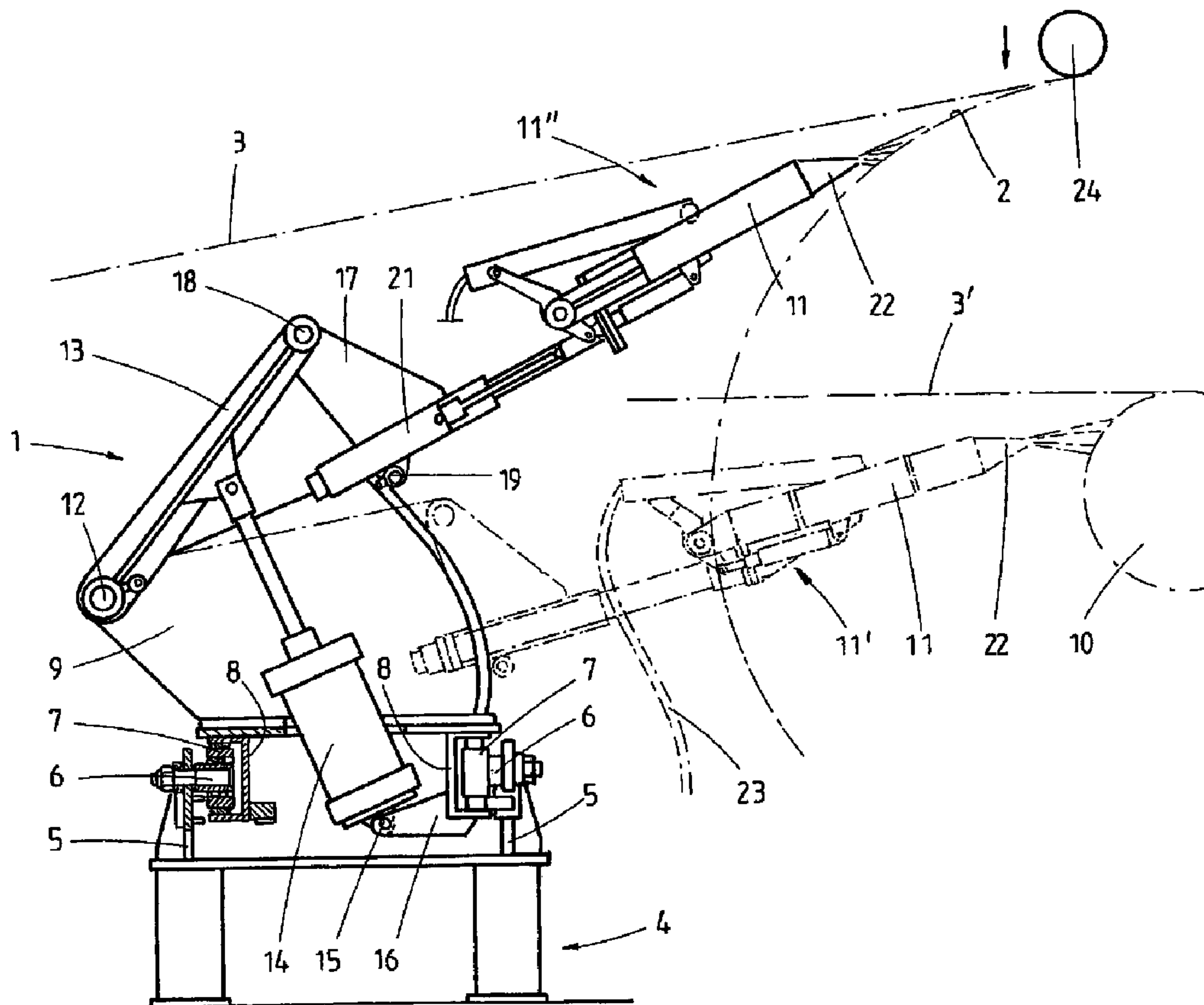


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(54) **Titre : DISPOSITIF ET PROCEDE DE BOBINAGE D'UNE BANDE D'EPaisseur VARIABLE, EN PARTICULIER D'UNE BANDE METALLIQUE**

(54) **Title: METHOD AND APPARATUS FOR WINDING STRIP, IN PARTICULAR METAL STRIP**



(57) **Abrégé/Abstract:**

An apparatus (1) for winding a strip (3), in particular a metal strip of varying thickness, into a coil (2) with a device for applying a deformable material onto the strip (3) that is to be wound, characterized in that the device comprises means (11, 22) for creating a resilient, in particular an elastic material or a self-expanding or foaming material for placement onto the coil (2).



Abstract

An apparatus (1) for winding a strip (3), in particular a metal strip of varying thickness, into a coil (2) with a device for applying a deformable material onto the strip (3) that is to be wound, characterized in that the device comprises means (11, 22) for creating a resilient, in particular an elastic material or a self-expanding or foaming material for placement onto the coil (2).

METHOD AND APPARATUS FOR WINDING STRIP,
IN PARTICULAR METAL STRIP

The invention relates to an apparatus for winding a strip of varying thickness, in particular a flat or profiled strip, a flexibly and/or a profile-rolled metal strip, in particular of steel, into a coil with a device for applying a deformable material to the strip being wound.

Above all, the invention concerns the winding of slit strips. Slit strips are created when elongated material, in particular wide metallic strip, is pulled off a coil and cut longitudinally into narrow strips, i.e. split. The thus created narrow split strips are subsequently wound up on a common mandrel or wound onto separate respective mandrels. Preferably, composite coils each containing a number of adjacent split strips are created. To adjust for deviations in thickness over the width of the strip, which lead to tapered or angled surfaces in particular at the edges of the strips, while winding the split strips, intermediate layers must be inserted into the coils of the split strips.

Even when winding split strip material onto a continuous drum with several coaxially adjacent winding coils of longitudinal machines that are separated from each other by sheet metal disks, as a consequence of varying strip thickness and coating thickness more or less tightly wound coils with correspondingly different strip sagging results. The uneven winding of the coils has a disadvantageous effect on their appearance, packaging, the unwinding behavior and the friction between the individual strip coils. In order to avoid these problems it is known to wind paper

or cardboard strips of appropriate lengths between the turns of the split strips. Frequently, this is done in that the paper strip is manually inserted into the wound section slot between the winding strip and the coil.

A device is known from DE 80 06 563 [DE 30 09 200] for fitting spacer strips into the winding slot of strip material that is to be wound into coils, where the paper strip is transported in the direction toward the winding slot by means of a pair of drive rollers. Here, the supply for the paper strip is designed as a drum that contains the intermediate paper strip, upstream of whose strip slot the pair of driving pulleys that are driven by an electric motor is provided. Upstream of the pair of driving pulleys a strip separating and perforating device is provided. This way, the intermediate strip can be projected into the winding slot at high speed as the result of the pair of driving pulleys with simultaneous temporary deformation into a stable, air-carried profile that is open toward the bottom. The intermediate strip must be deformed by the roof-shaped profiling of the driving pulleys in such a way that it retains a sufficiently stable shape that is supported by air that ensures that it can also be shot into the winding slot across a larger distance of free flight, whereby in addition to the effect of being borne by air, the effect of acceleration is also utilized.

The intermediate strips are either removed from a stack container containing the strips in appropriate lengths and individually shot into the wound section of the metal strip or pulled off a supply strip coil and cut into the required lengths.

In EP 0 166 795, a method of winding several split strips created by longitudinal cutting of linear material onto a joint

winding mandrel is described, in which the elongated material deviates in thickness over its width.

The method is characterized in that the split strips are wound simultaneously into a composite coil with a deformable elongated intermediate layer of adjacently running split strips across its width.

Here, the thickness of the intermediate layer is larger than the deviation of thickness over the width of the elongated material. During winding of the split strips, as the result of the exertion of a force onto the respectively uppermost winding position of the split strips and/or the intermediate layer in the radial direction of the composite coil, the thicker split strips are pressed more than the thinner ones into the intermediate layer, and the split strips are wound by a corresponding deformation of the intermediate layer into a composite coil with cylindrical enveloping surface. As per this method, uncoated or coated metallic strip can be wound as elongated material. Preferably, paper, mash, plastic, in particular, foam or paper impregnated with an agent that protects against corrosion is used.

Further, it is also known to not only produce flat metal strips, but also metal strips whose shape varies in the longitudinal and/or the transverse direction. In DE 198 31 882 A1, a method and a rolling system for the production of profiles of any thickness over the width of a linear rolling stock is described. The initial material is here deformed almost only in the direction of width by several rollers that are offset spaced apart other in the roll direction. The rolls make a correspondingly desired profiling of the locally targeted deformation possible, the depth of penetration depending on the control of the respective

individual small drums or rolls. The starting material is either iron or a NE material; cold-forming or warm-forming is used.

From DE 199 62 754 [US 6,336,349], a method of flexible rolling of a metal strip is known. This method is for the production of flat metal strips that have defined, varying strip thicknesses over their length. Thus during the roll process the roll gap is changed in a controlled manner in order to obtain various strip thicknesses of the metal strip. On the one hand, this can take place indirectly by changing the deformation resistance of the material by warming or cooling the metal strip and the correspondingly changed frame spring of the roll stand during the roll process.

EP 1 074 317 [US 6,336,350] also concerns a method of flexible rolling of a metal strip, where the metal strip is guided during the rolling process through a roll gap formed between two working rolls and the roll gap is manipulated in a controlled manner during the roll process in order to achieve various strip thicknesses over the length of the metal strip. Here, during each adjustment of the roll gap or directly afterward, the bending lines of the working rolls are controlled depending on the roll gap that was selected for flattening the metal strip.

It is the object of the invention to provide a method of winding a strip, in particular a flat or profiled strip, a flexibly rolled and/or a profile-rolled metal strip that is improved in such a way that in a simple manner, an even, at least essentially cylindrical coil is created.

In accordance with the invention, this object of the method mentioned is attained in that the device comprises means for

creating a resilient, in particular elastic, material or a self-expanding or foamable material and for applying it to the coil.

According to the invention, the necessary materials are prepared in situ corresponding to the requirements of the strip to be wound, i.e. by considering the consistency of its surface, as well any deviation from the roundness that is to be expected of the coil that is to be wound, in order to provide an elastic substance, in particular, a solidifying foam that is projected into the coil to such a degree that a completely or nearly round coil is created.

This way, the apparatus in accordance with the invention is particularly suited for winding metallic split strips, in particular of steel, but also other strip materials, perhaps made of plastic, for example, thermosetting plastics or thermoplastic resins. The materials serving as intermediate layer in accordance with the invention preserve the strip surfaces and improve the ability of winding. The advantages of evenly wound coils are also reflected in better transportability and in the facilitation of further processing. Even changes in the thickness of the strip, whether in longitudinal or transverse direction can be set at any time by changing the application of the material.

Advantageous further developments of the invention are given by the subordinate claims.

According to the invention, the material of the intermediate layer is doctored onto the uppermost layer of the wound section of the strip with a scraper or sprayed or squirted out of series of adjacent nozzles onto the surface of the wound section. The material, for example a plastic foam can thereby also be sprayed on across the width that corresponds to the desired application thickness in various thicknesses, and individually over

certain zones of the width of the roll. Even in the case of coating with a scraper, the scraper is either set for the entire width of the roll at the same distance or it is angled relative to the axis of rotation of the roll in order to compensate for the emerging tapered winding of the coil.

Preferably, the device extends over the entire width of the coil or at least over a large part of the width of the coil. In the latter case, only the critical zones are covered in which according to experience irregularities tend to form to a greater degree.

In a further advantageous embodiment of the invention the material is applied to the roll in strips. On the one hand, this approach makes it possible to use as little as possible of the intermediate material, on the other hand, as the result of a force exerted radially onto the coil by material during application, the material can escape into sections between the strips, in order to thus create an optimally round coil.

In a different embodiment of the invention, the plastic is advantageously applied to the coil from an extruder.

To increase elasticity the plastic is formed by a continuous layer or is formed by a number of adjacent strips in the roll direction of the strip that have air pockets. On foaming, air or a different gas is inserted into the hardening plastic corresponding to the desired elasticity, in order to later compress the intermediate layer either under its own weight or that of the material to be wound or subject to the influence of a radially exerted contact force.

In order to improve application of the material layer even more, a device for measuring the strip thickness of the metal

strip that is to be wound can be employed that transmits the strip thickness values measured by it to a controller. It then derives a control variable from the signals corresponding to the strip thicknesses, in order to control the material delivery from the nozzles, the addition of the foaming material, of air and the like corresponding to the measured strip thickness of the metal strip or in the case of a scraper, adjust its position at the roll outer surface.

The invention also relates to a rolling mill for cold or warm rolling, one-way or reverse rolling of a metal strip of varying thickness, in particular a flat or profiled strip, a flexibly or a profile-rolled metal strip, in particular of steel, with a roll stand provided with a set of rollers and a control system for adjusting the roll gap, with a device upstream of the roll stand for unwinding the metal strip and a winding apparatus downstream of the roll frame as described above. This way, the metal strip can have all types of profiles in the longitudinal and/or transverse direction. The thickness of the strip can change over the length and/or the width.

In accordance with the invention, the rolling mill distinguishes itself in accordance with the invention in that a controller for controlling the rotation speed of the drives of the two winding apparatuses is provided by a controller for compensating or regulating the mass flow change of the roll strip and the strip tension speed that is dependent on it, as well as for the control of the strip tension, in particular at the points in time at which the strip acceleration changes and when the thickness of the strip profile changes. Rolling of the strip can also take

place in an inline casting and rolling system at the end of which an apparatus for winding a rolled strip is located.

The invention also relates to a method of winding a strip of varying thickness, in particular a flat or profiled strip, a flexibly and/or a profile-rolled metal strip, in particular of steel, into a coil in which during winding deformable material is applied to the coil.

The method is characterized in that the deformable material is applied by nozzles or by means of at least one scraper to the surface of the strip, in particular the metal strip. In accordance with the invention, strips that have variable strip thickness in the longitudinal and/or transverse direction can be wound. In particular, the strips can have special profiles.

Advantageously, the method is further has the step of applying material to the metal strip at a thickness that is larger than the deviation of thickness of the metal strip, and that subsequently, onto the respectively uppermost end of the coil a force is exerted, in particular by means of a roll, in order to compress the material in such a way that at least an essentially cylindrical composite coil is created out of the metal strip and the material.

In particularly advantageous manner, the method is performed such that the material is induced to expand or foam as the result of the addition of an additive shortly before application or during application.

Various forms of irradiation can be used, in particular shortly prior to the application or during the application, in order to promote the expansion or the foaming and/or the hardening.

In the following, the invention is explained in more detail in an example of an embodiment. The sole figure shows a device movable transversely of a coil for spraying foam onto the uppermost turn of the coil into the gap between the winding strip and the coil.

A device 1 (Figure) for applying or spraying a plastic foam onto a coil 2 of a metal strip 3 has a stationary base 4. It carries two pairs of support blocks 5 for axles 6 on which respective rollers 7 can rotate. The pairs of spaced rollers 7 serve to guide respective U-shaped guide rails 8 connected to a support 9 for the device 1. They are so long that they project past the support 9. The base 4 is projects transversely past the strip width that is the same as the length of a winding mandrel 10, so that the device 1 can be move past or underneath the strip upstream of the winding mandrel 10. At the end of the winding process, the coil 2 reaches a maximum outside diameter. At the beginning of the winding process, an extension 11 for spraying or applying the plastic of device 1 is in an inner position 11' shown by a dotted line in order to apply the material close to the surface onto the metal strip 3, while it moves into an outer position 11" toward the end of the winding process.

The device 1 can pivot on the support 9, since the support 9 has a pivot axis 12 for two levers 13 that can be jointly pivoted by a hydraulic actuator 14 that itself is pivoted on a pair of support lugs 16 on the guide rails 8. The device 1 has a pair of arms 17 pivoted on a threaded bolt 18 at free ends of the levers 13 and supported by a pair of rollers 19 on guide edges 20 of the support 9.

The device 1 has a telescopic actuator 21 that is carried on the arms 17 in order to position the extension 11 at a suitable spacing from the surface of the strip 3 or in order to, for example for cleaning, move it temporarily away from the coil 2. The extension 11 preferably holds an exchangeable cartridge for applying the application material that is preferably sprayed on by one or more nozzles 22 spaced along the axis of winding mandrel 10.

At least one hose 23 can supply various substances required to make the application medium, in particular also along with a pressurized gas in order to force the substance that is to be applied out of the cartridge. In addition, a heater (not shown) can be provided in the proximity of the nozzles 22 to promote hardening of the material that has been applied.

In place of a fluid, foam-like or viscous material, in particular a plastic, a granulate, in particular along with a plastic or an adhesive or a quilt-like material, for example, with selectively optimized small cells can also be inserted into the roll 2 in order to promote even winding. Depending on need, the cells are intact, filled, at least in certain sections, with suitable materials or media. These can then, subject to certain pressure or temperature conditions, in particular after the conclusion of the winding process, leave the cells.

According to the invention, the use of (here shown only schematically) a contact pressure roll 24 can also be provided that evens out the foam or the cushion material or the granulate located in the coil 2 by pressing radially inward after it has been applied.

Reference numbers

- 1 device
- 2 coil / roll
- 3 strip
- 3' position of strip 3
- 4 base
- 5 support blocks
- 6 axles
- 7 rollers
- 8 guide rails
- 9 support
- 10 winding mandrel
- 11 extension
- 11' position of extension 11
- 11" position of extension 11
- 12 pivoting axis
- 13 pivoting lever
- 14 actuator
- 15 bearing
- 16 support lugs
- 17 pair of lugs
- 18 threaded bolt
- 19 pair of rolls
- 20 guide bar
- 21 operating control
- 22 nozzle
- 23 supply hose
- 24 contact pressure roll

CLAIMS :

1. A device for winding a strip of varying thickness into a coil, comprising a coating device having means for creating a resilient, self-expanding, or foamable material, and, means for applying the material to the strip being wound, characterized in that a pressing device is provided to exert a pressure on the coil in order to deform the material that has been applied by compressing it.
2. The device defined in claim 1, wherein the means for applying has a scraper or nozzles for spraying or squirting the material onto the strip.
3. The device defined in claim 1, wherein the means for applying the material extends over the entire width of the coil or at least over a part of the width of the coil covering only critical zones.
4. The device defined in claim 1, wherein the material is applied to the coil in strips.
5. The device defined in claim 1, wherein the means for applying is an extruder.
6. The device defined in claim 1, wherein the means for applying applies plastic to the strip as a one-piece layer or as a plurality of strips next to each other on the coil with air pockets.
7. The device defined in claim 1, further comprising:
sensor means for measuring the thickness of the strip; and
control means connected to the sensor means and to the means for applying for regulating the application of the material in accordance with a measured thickness to the strip.
8. A rolling mill for rolling of a metal strip of varying thickness with a roll stand provided with a set of rollers and an adjustment system for adjusting a roll gap, an apparatus upstream of the roll stand for unwinding the metal strip to be rolled and the winding device

downstream of the roll stand defined in any one of claims 1 to 7, wherein a controller for controlling the rotational rate of the drives of the two winding devices has a controller for compensating or regulating the mass flow changes of the roll strip and the strip tension speed dependent on same, as well as for controlling the strip tension.

9. In a method of winding a strip of varying thickness into a coil, comprising:
applying deformable material to a surface the strip immediately before winding it into the coil by nozzles or at least one scraper, characterized in that a pressure is exerted on the coil by a pressing device to deform the material that has been applied by compressing it.

10. The method defined in claim 9, wherein the material applied to the metal strip has a thickness that is greater than a deviation of thickness of the metal strip and that subsequently a force is exerted by a roller onto the uppermost portion of coil in order to compress the material in such a way that at least an essentially cylindrical composite coil is created by the metal strip and the material.

11. The method defined in claim 9, wherein the material is made to expand or foam shortly before application or during application as the result of the addition of an additive.

12. The method defined in claim 11, wherein the material is induced to expand or foam or harden shortly before or during application by means of irradiation.

13. The device of claim 1, wherein the pressing device comprises a roller radially engageable with the coil being wound downstream from the means for applying.

