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(54) Title: WIRE-WINDING MACHINE AND METHOD FOR CONTROLLING THEREOF

(57) Abstract: A wire winding machine comprises a winding station for a wire into a reel, measuring means of the weight of the reel and electronic control means for adjusting the amount of wire to vary the weight of the reel. The weighing means comprise a weighing device arranged in the winding station and directly coupled to the electronic control means for weighing the reel directly into the winding station.

# WIRE-WINDING MACHINE AND METHOD FOR CONTROLLING THEREOF

## Description

### Technical Field

The present invention finds its application in the field of machine for handling wire, cable and the like and relates to a wire-winding machine for the production of coils and the relative control method.

### State of the art

The known wire-winding machines, in particular those used for winding welding wire, are generally designed to draw a continuous wire from a relatively large spool or from a thread wrap provided by the manufacturer thereof.

In particular, the machines are provided with a winding station with a rotating spindle adapted to drag the wire and wrap it on the reel designed to be mounted on the welding machine.

The welding wire, produced in several alloys and diameters, can be wound on supports or spools of various types, sizes, shapes or materials according to modality of so-called "random" or "juxtaposed coils" type.

At this stage, it is very important that the amount of the wound wire which will define the reel is precisely measured so that the reel contains the right amount of wire.

As matter of fact, these reels usually are sold according to their weight and for this reason each manufacturer must abide by a very specific nominal weight, which may still have some tolerance, albeit contained.

Thus, it becomes apparent that it is essential that the reels have a weight that is closer to the nominal value in order to avoid the sale of reels less than nominal, with the risk of disputes by the buyer, or with higher weight, resulting in economic damage, not irrelevant given the enormous amount of wire normally wrapped in this type of machine.

The eventual margin of error must be so much smaller as the commercial value of the wound wire is greater, with maximum tolerances that can be contained in a few grams.

Regardless of their particular configuration, which may vary depending on the manufacturer, on the type of wire and on the greater or lesser degree of automation, the wire-winding machines are usually installed in line, with rows consisting of a number of variable machines depending on requested productivity.

In this case, one or more weighing stations are arranged at intermediate positions between

the various machines and the operators are more or less frequent with the newly produced coil to verify their true weight.

After checking the weight of the reel and in case of deviation from the nominal weight, the operators can modify the operating parameters of the machine by setting, though roughly, the new weight that the new reel should have.

Possibly, you could return to the weighing station with the new reel to verify that the correction is right.

The correction made by the operator on the machine can be done by setting a new length of the wire to be wound, which will be converted into weight as function of the known specific weight of the wire, or by directly setting the new weight, with more reliable results.

However, in the first case, the final weight thus determined will differ more or less from the real one because inevitably there are small errors on the determination of the meters, wire diameter and specific weight. Even decimal errors can be sufficient to overcome the established tolerances.

The second setting mode, in addition to not being affected by possible deviations of the set length than the effective one, does not vary with the different wire diameters.

However, it is difficult to weigh the reel directly during its winding and for this reason the net weight is derived from the much easier counting of the wrapped meters.

By setting or measuring in various ways the diameter of the wire the volume is automatically calculated and knowing the specific weight of the material it is possible to obtain the weight.

CN202897669 describes a wire winding machine equipped with a load cell for adjusting the reel weight. Adjustment is achieved by controlling the speed of rotation of an electric motor connected to a braking system that operates to achieve the desired weight.

## Scope of the invention

The object of the present invention is to overcome the above mentioned drawbacks by providing a wire winding machine which is particularly effective and with increased productivity compared to known type machines.

A particular object is to provide a wire winding machine that allows to obtain weighing measures of wound wire reel that are as precise as possible.

Another object is to provide a wire winding machine that allows weighing of each single

reel directly on the machine, allowing to make the necessary corrections in a simple, immediate and, if necessary, automatic manner.

Yet another object is to realize a wire winding machine which allows corrections to be made also directly on the winding reel, thus completely eliminating reels not compliant in the weight.

Not last object is to provide a wire winding machine that improves working conditions as it does not require operators to transport the reels to ne weighted to the weighing stations.

Such objects, as well as others that will become more apparent hereinafter, are achieved by a wire winding machine which, according to claim 1, comprises a station for winding a wire into a reel, means for measuring the weight of said reel, electronic control means to adjust the amount of wire to vary the weight of said reel.

According to a peculiar feature of the invention, weighing means comprise a weighing device arranged in said winding station and directly coupled to said electronic control means for weighing said reel directly into said winding station.

Thanks to this feature you will not have to continuously pull the reel wound on the spool to bring it to a weighing station common to winding several machines in the same row.

In this way, besides simplifying the work of the machine operators and increasing the productivity of each machine, it will be possible to carry the weight of all the reels so that the necessary corrections are made immediately.

Suitably, the electronic control means may comprise a microprocessor unit or other electronic control system wherein a predetermined weight is stored for said reel, said electronic control means being adapted to automatically adjust the amount of wire to be wound as function of the difference between the stored weight and the measured weight.

In this way, the same machine will be self-regulating to cause the subsequent reels to contain the right amount of wire.

Preferably, the winding station will comprise a spindle capable of dragging the wire from an outer casing or coil and a spool that is removably anchored to said spindle for winding said wire wounded on the reel.

In addition, the electronic control means may adjust the number of turns of said spindle to vary the length of the thread carried out according to said stored weight.

Adjusting the weight of the reel by checking the length of the wire to be unwound, that is possible once known the specific weight of the wire and measured the diameter of the

wire according to any of the known techniques, will allow for a much simpler weight adjustment.

Advantageously, the weighing device may be arranged directly under the spindle so that it is possible to carry out the weigh directly on the reel during winding and possibly without the need for wire cutting.

In this way, you can also make corrections directly on the winding coil, eliminating all non-conformities and thus obtaining significant economic benefits.

According to a further aspect of the invention there is provided a method for controlling a wire winding machine comprising a setting step of a predetermined weight for the reel, a winding step of said wire to form a reel, a step of measuring the weight of said reel and comparing said measured weight with said set weight.

Advantageously, the metering step is carried out directly in said winding station so that the measure may be directly carried out on the machine and not on a weighing station outside it, in order to make the necessary corrections immediately and, if necessary, automatically.

This feature is preferable for those machines designed to wrap a particularly expensive wire for which even a single reel out of standard may represent a significant economic loss.

According to a particular and advantageous operating mode, said measuring step may be performed before the wire cut and the correction step adapted to return the difference between the set weight and the measured weight to a value less than a predetermined maximum error will be performed before of said cutting and unloading of the reel from the spindle.

Advantageous embodiments of the invention are obtained according to the dependent claims.

## Best mode of carrying out the invention

A wire winding machine according to the invention may be essentially configured as any rewinder machine commonly used for winding a reel continuously unwound from a large sleeve or reel, such as the reels provided directly by the wire manufacturers.

A preferred embodiment provides that the machine is used to wrap solder wire in reel having relatively small weight, usually between 1Kg and 18Kg, designed to be mounted on welding machines.

The machine may be either completely manual, or semi-automatic or, even, automatic.

Moreover, the machine may carry out either a "random" rewinding or a rewinding with juxtaposed coils.

An example of a wire winding machine that can be adapted to be transformed into a machine according to the present invention is described in EP1050502.

The machine according to the invention may comprise a continuous unwinding station of a wire taken from an unwinding reel or alternatively the wire may be taken directly from a hank placed outside the machine in a storage area.

The machine further comprises a winding station for winding the wire into a reel which generally comprises a spindle having a motorized rotation axis, usually horizontal, on which a spool is mounted to be rotated by the spindle in order to produce the winding of the wire and form the reel.

The technical features of the spool are not essential for the purpose of the present invention and will therefore not be described in more detail.

In particular, both metal supports, commonly called baskets, and plastic supports may be used.

The spindle comprises a countertop that prevents the spool from axially slipping and will be removed once the winding of the reel has been completed for the removal thereof together with the spool.

If the machine is of the juxtaposed coils type, the spool is enclosed between a pair of opposed flanges, one of which will be movable to allow their reciprocal distance to be adjusted ad function of the number of coils.

The movable flange will also provide a counter-thrust to keep the coils always aligned with each other, avoiding that an interspace may be formed that would undermine the proper winding.

At the spool, cutting means will be normally provided for cutting off the wire as the set weight and/or length are reached.

The machine is also provided with electronic control means adapted both to count the coils and to adjust the amount of wire to vary the weight of the second reel.

In an example, the electronic control means may be associated with an idle pulley rotated by the winding wire and provided with sensor means such as encoders or the like, allowing to calculate the length of the unwound wire according to known techniques, so

as to obtain a reel of predetermined length corresponding to a set nominal weight for the winding reels.

However, other counting systems may also be used, without departing from the scope of the present invention.

The electronic control means are adapted to automatically adjust the amount of wire to be wound according to the difference between the stored weight and the actual weight of the reel which will be measured by direct measurement means.

The electronic control means may comprise a microprocessor unit connected to a PLC or other type of electronic circuit to control the operation of the machine in order to regulate the length of the wound wire.

An HMI interface may also be provided to allow the operator to enter and/or vary the different working parameters of the machine.

The weighing means comprise a weighing device arranged directly in the winding station and which is directly coupled to the electronic control means for weighing the reel directly at the winding station.

In this way, the electronic control means will receive information about the weight measured directly from the weighing station to make the necessary adjustment and regulate accordingly the length of the wire to be wound as function of the new measured weight.

The correction of the weight corresponding to the new length of the wire to be wound may be carried out either manually by the operator through the interface or automatically by the PLC or other electronic control means, depending on the automation degree of machine.

In addition, the reel may be moved from the winding station to the weighing device either in an automatic manner or by the operator in the case of manual and semiautomatic machines. In the latter case the weighing of the coil could be a sample weighing.

The weighing device may be arranged in any position with respect to the spindle, depending on the specific configuration of the machine and on the space requirements.

Possibly, the weighing device may be placed directly under the spindle so that the weighing of the reel may be carried out before cutting.

In this case, weighing can be carried out by removing the spindle countertop and moving the spool together with the reel on the weighing device to verify that the difference

between the nominal weight and the measured weight is less than the maximum error.

If not, the spool will be returned to the spindle to continue with the winding, in the case of lower measured weight, or with partial unwinding of the reel in case of higher weight.

The use of a weighing device directly below the spindle will be particularly suitable for automatic machines.

An additional configuration may comprise the presence of automatic discharging means adapted to move the reel of wound wire toward an area for temporary storage and then to the weighing station.

In an exemplary manner, a slider may be provided under or near the spindle to move the reel discharged from the spindle directly to or near the weighing device, depending on whether weighing is either automatic or manual.

The technical features of the weighing device are not limiting to the present invention, depending on needs and on the technical and dimensional requirements of the machine and of the reel to be wound.

From the foregoing, it will be apparent that the invention realizes the foregoing objects and in particular that it provides a winding machine and a control method thereof which enable accurate and simple measurements of the weight of the reels in order to reduce or eliminate errors.

The machine and the method according to the invention are subject to numerous modifications and variants which are all within the inventive concept expressed in the appended claims. All details may be replaced by other technically equivalent elements and the materials may be different according to the needs without departing from the scope of the present invention.

## Claims

1. A method for controlling a wire-winding machine, wherein a machine comprises a station for winding the wire into a reel provided with a spindle, means for measuring the weight of said reel and electronic control means adapted to adjust the weight of the reel, which method comprises the following steps:

a) setting a predetermined weight for the reel of wounded wire;

b) winding said wire to form a reel by rotating the spindle with a predetermined number of turns;

c) measuring the weight of said reel directly into said winding station and comparing said measured weight with said set weight;

d) possible adjusting the weight of said reel to bring it to the value of said set weight apart of a predetermined maximum error or tolerance;

e) cutting said wire upon said set weight is reached apart of said maximum error;

f) unloading of said reel;

**characterized in that said** measuring step (c) and said adjusting step (d) are carried out before said cutting step (e) and said unloading step (f), a correction step being provided to bring said weight difference to a value less than said predetermined maximum error, the step being carried out before said cutting step (e) and said unloading step (f) of the reel from the spindle and carried out by winding or unwinding said reel with a number of turns of said spindle as function of the specific weight of said wire.

2. Method as claimed in claim 1, characterized in that the reel is obtained by continuous unwinding of a wire from a reel or hank and subsequent cutting as the predetermined weight is reached.

3. Method as claimed in claim 1 or 2, characterized in that weight of said reel is measured indirectly by measuring the unwound wire.

4. A wire-winding machine for carrying out a method according to the preceding claims, comprising:

- a station for winding a wire into a reel having a spindle adapted to unwound the wire from a stocking reel or hank and wound it as a reel on a sprocket removably anchored to said spindle;
- means for measuring the weight of said reel;
- electronic control means adapted to adjust the amount of wire to vary the weight of

said reel;

wherein that said weight measuring means comprise a weighing device arranged in said winding station and directly coupled to said electronic control means for carrying out the weighing of said reel directly into said winding station.

wherein control means are provided for automatically adjusting the amount of wire to be wound according to the difference between said stored weight and the weight measured by winding or unwinding said spindle for a number of turns calculated as function of the specific weight of said wire.

5. Machine as claimed in claim 4, characterized in that said electronic control means comprise a processor unit wherein a predetermined weight wanted for said reel is stored, said processor unit being adapted to automatically adjust the amount of wire to be wound as function of the difference between said stored weight and the measured weight.

6. Machine as claimed in claim 5, characterized in that said electronic control means are adapted to adjust the length of the wire to be wound as a function of said stored weight.

7. Machine as claimed in claim 5 or 6, characterized in that said weighing device is arranged directly under said spindle.

8. Machine as claimed in claim 5, 6 or 7, characterized in that said winding station comprises means for automatically unloading the reel from said spindle toward said weighing device.

# INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. B65H63/08
ADD.

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)
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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Lemmen, René |

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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