Aug. 18, 1964 F. J. TEN BRINKE 3,144,997

BRAKING DEVICE

Filed April 19, 1962

3 Sheets-Sheet 1

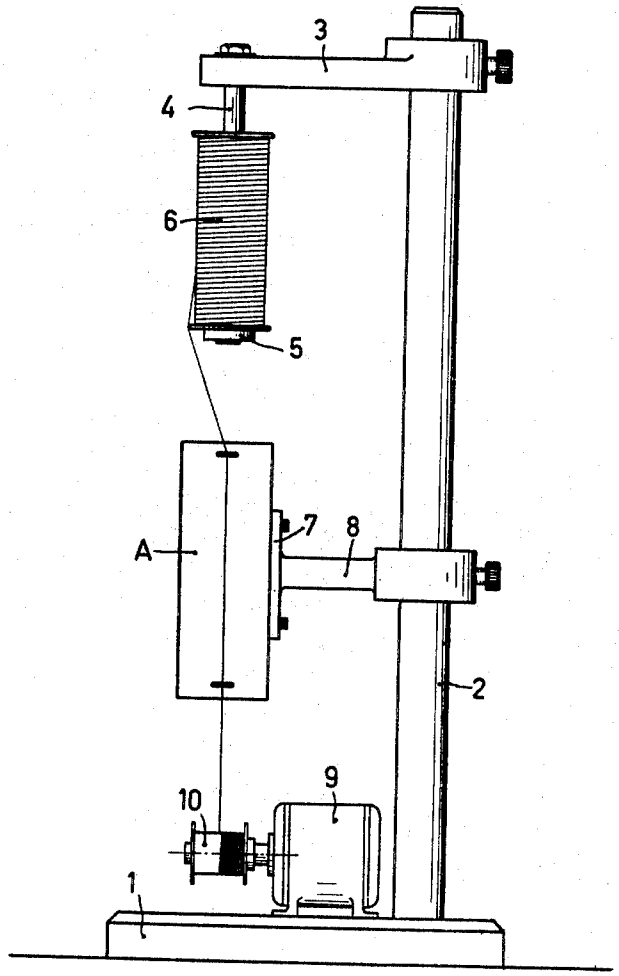


FIG.1

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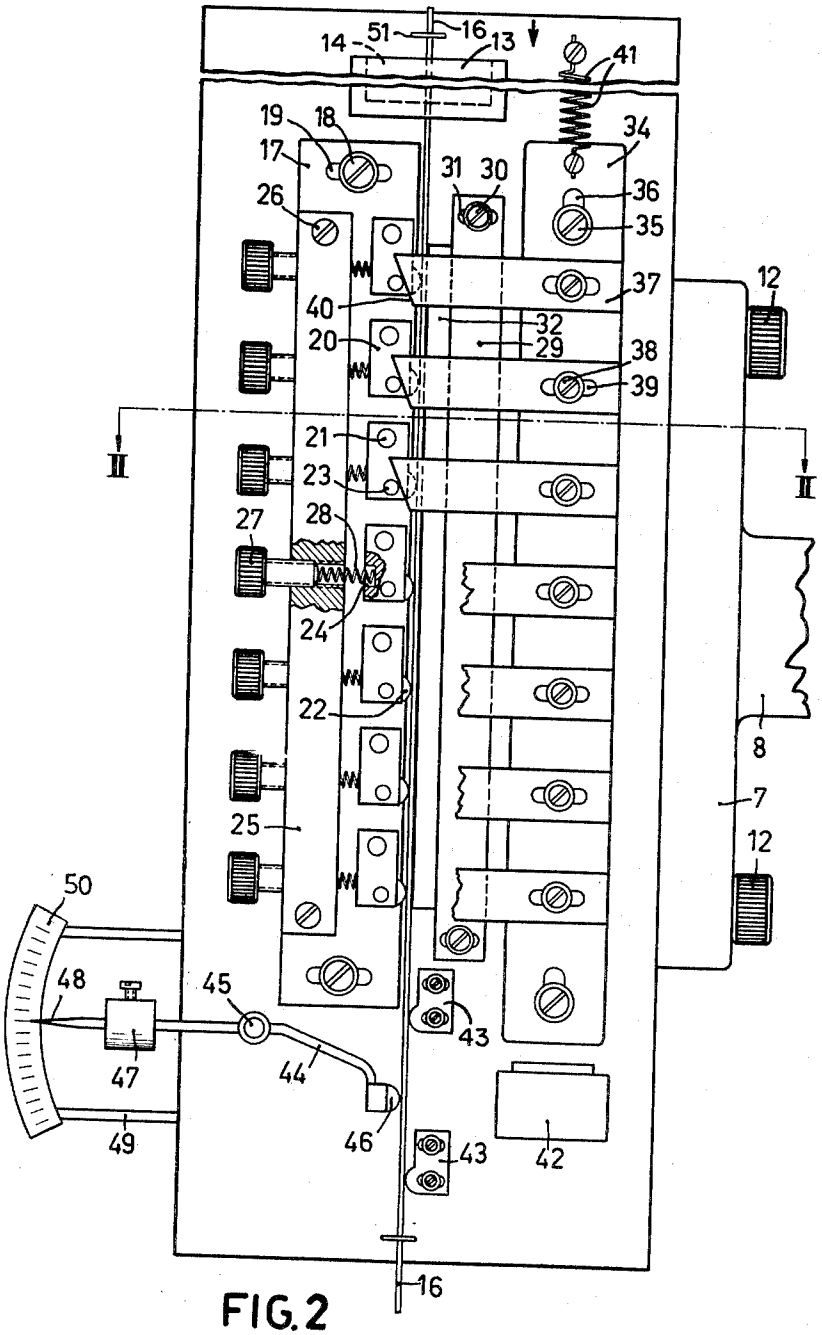


FIG. 2

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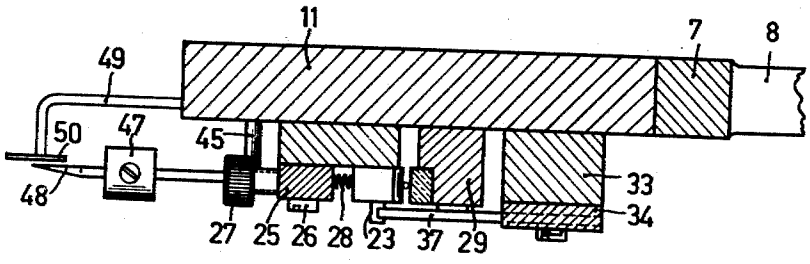


FIG.3

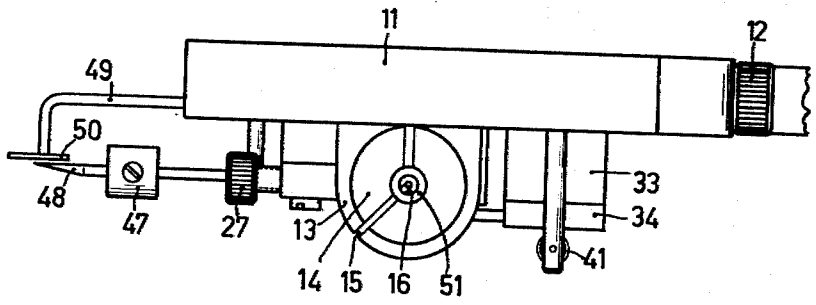


FIG.4

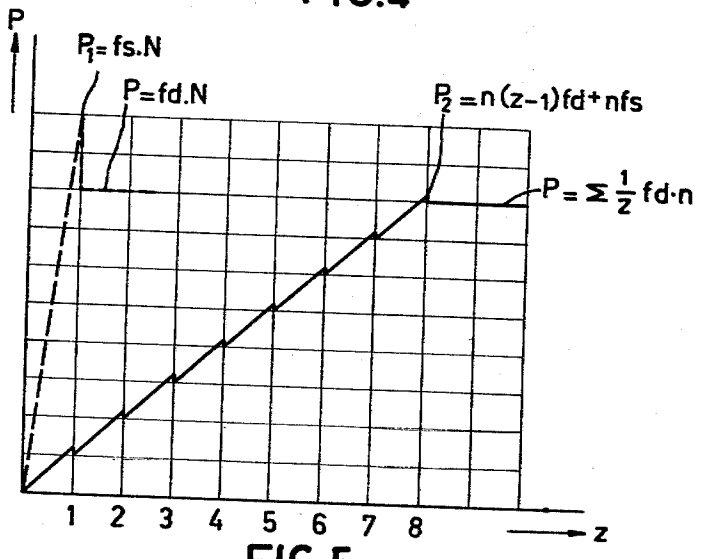


FIG.5

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3,144,997

BRAKING DEVICE

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Claims priority, application Netherlands May 8, 1961
3 Claims. (Cl. 242—149)

The invention relates to a braking device, particularly suitable for a coil winding machine, in which the metal wire, which is preferably insulated and which is to be wound on a coil member, is laterally unwound from a delivery spool, the wire being braked between the point where it leaves the delivery spool and the point where it engages the coil member.

Braking devices for coil winding machines are known. In particular when winding coil members with polygonal cross-section, the wire is preferably drawn laterally from a spool since in a rotating delivery spool, the mass of this spool has each time to be accelerated and delayed. The harmful influence hereof may be decreased by braking the delivery spool, but nevertheless the possibility exists that the wire stress becomes inadmissibly high. A resilient arm may be provided between the supply spool and the coil member to be wound, but in this case also, the accelerating forces may play too large a part. In the case of lateral unwinding, the coil mass plays no role, but in this case it is necessary to provide a braking device between the point where the wire leaves the delivery spool and the point where it engages the coil member, since otherwise the space factor of the wound coil becomes much too small. It is known to use a retarding wheel for this braking device around which the wire has been turned a few times, but then accelerating forces again occur which harmfully influence the wire stress.

The invention avoids the drawbacks of the known constructions and is characterized in that the braking device consists of a number of friction elements arranged behind each other in the direction of the wire and adjustably loaded separately or in sections, which elements are all arranged opposite to friction elements which are rigidly provided during operation and in which the wire travels between the adjustably loaded elements and the fixed friction elements. The desired braking action of the wire may be obtained according to the invention, while the tensile stress maximally occurring in the wire is smaller because no accelerating forces of rotating parts occur.

Although all the rigidly connected friction elements may be constructed and connected separately, it is simpler according to an embodiment of the invention to combine these friction elements to one element. The construction and the adjustment of the braking device also becomes simpler if, according to a further embodiment of the invention, all the adjustably loaded friction elements together with the associated pressure members are incorporated in a holder which is adjustable with respect to the rigid friction member and at right angles to this member.

The adjustably loaded friction elements according to an embodiment of the invention each comprise a friction surface which is part of a cylinder surface, the axis of which crosses the direction of the wire at right angles, in which these elements are connected to the holder in a manner such that they can rotate about a shaft which also crosses the direction of the wire at right angles, and the point of rotation of each element with respect to the direction of travel of the wire lies above the axis of the cylinder surface. In this case, it is ensured that the wire engages the friction element only at one point and dust dragged along by the wire or other contamination does not readily adhere to the friction member or cylindrical surface thereof. Preferably, according to a further embodiment of the invention, the adjustably loaded friction elements, at least as far as the cylinder surfaces are concerned, are manufactured from sapphire, while according to another embodiment of the invention, the rigidly connected friction member consists of glass. As a result of this, the wear of the friction surface is very small, while both materials can be highly polished smooth.

It is sometimes desired during winding of a coil to form a loop in the wire which is passed outside the coil, which loop may be used as a tapping in the finished coil. In order to render this possible, means are present, according to an embodiment of the invention, to cause one or more adjustably loaded friction elements to rotate about their centre of rotation against the action of the adjustable load. As a result of this, the braking action upon the wire is reduced or removed, so that the wire can be easily pulled through the brake to form the loop.

According to an embodiment of the invention, the said means preferably consist of shiftable abutment stops arranged at right angles to the wires, which stops are each provided on the side of the wire with a sloping surface which co-operates with a pin lying below the point of rotation in the direction of travel of the wire and occurring in each adjustably loaded friction element such that by a movement of an abutment stop in the direction of the wire, the associated adjustably loaded friction element rotates about its point of rotation away from the wire.

According to a further embodiment of the invention, all the abutment stops are arranged in a movable slide which extends parallel to the direction of the wire, which slide may be moved electromagnetically according to a further embodiment of the invention. In this case it is possible to effect the winding of a coil having one or more tappings entirely automatically.

It might occur that the tensile stress occurring in the wire during operation of the device, for example owing to wrong adjustment of the adjustably loaded friction element or by contaminations, becomes too high. Too low a tensile stress also is not desired with a view to the space factor of the coil. In order to be able to adjust the adjustably loaded friction elements in the right manner, according to an embodiment of the invention, the device comprises a device for measuring the tensile stress occurring in the wire during operation. This device, according to an embodiment of the invention, comprises two adjustable friction elements at right angles to the direction of travel of the wire which may co-operate with a third friction element arranged on the other side of the wire and between them. The third element is connected to an arm of a two-armed lever which may rotate about a fixed point and in which on the other arm an adjustable force may act in the direction of the wire, while the end of the other arm (remote from the wire) is constructed as a pointer which may co-operate with a scale provided behind it. In order to be able to adjust the measuring device to the exact measure, the lever arm according to an embodiment of the invention, comprises a weight which is movable on the arm.

It is sometimes deseirable to provide the wire with a lubricant. For this purpose, according to an embodiment of the invention, the device comprises means to lubricate the wire before it enters the braking device.

In order that the invention may be readily carried into effect, one embodiment thereof will now be described, by way of example, with reference to the accompanying drawings, in which

FIG. 1 is a schematic front view of a coil winding machine,

FIG. 2 is a detailed front view of the braking device per se indicated in FIG. 1 by A,

FIG. 3 is a cross-section of the braking device shown

in FIG. 2 taken along the line II—II thereof and viewed in the direction of the arrow,

FIG. 4 is a top or plan view of the braking device shown in FIG. 2, and

FIG. 5 is a graphical representation showing the difference of the peak tensile stress in the wire between a simple braking device and a braking device according to the invention.

In FIG. 1, reference numeral **1** is a heavy pedestal on which a cylindrical carrier **2** is rigidly connected. A brace **3** is movably provided on this carrier **2**, in which brace a rod **4** is present which is provided with a support **5**. On this support **5**, a coil **6** is arranged provided with insulated thin copper wire. The carrier **2** also supports a brace **8** provided with a flange **7** which can also be moved along the carrier **2**. A braking device A is connected to the flange **7** by means of bolts. An electric motor **9** is provided on the pedestal **1** on the shaft of which a coil former or spool member **10** is provided which has a rectangular cross-section and on which the wire of the supply coil **6** is to be wound. This wire is laterally unwound from supply spool. It is clear that between the supply coil **6** and the take-up member **10** a braking device should be present for the wire, since otherwise the wire would be wound on the coil **10** without tension and in that case, the space factor would be uncontrollable and the wire would loosely engage the member **10**. In addition, the possibility should be available of providing the coil **10** with tappings.

The braking devices A (FIGS. 2, 3 and 4) comprises a plate **11** which is connected to the flange **7** by means of bolts **12**. On the plate **11**, a metal container **13** (FIG. 4) is present which contains a plug of felt **14** and in which both the container **13** and the plug of felt **14**, have a slit **15** in order to bring the insulated wire **16** into the centre of the felt. As best seen in FIG. 2 holder **17** is connected to the plate **11** by means of screws **18** which are provided in slots **19**. On the holder **17** friction members **20** are present. These friction members are attached to the holder **17** by means of pins **21** and are capable of rotating about the pins **21**. Each friction member **20** contains a friction area **22** which is manufactured from sapphire and has a cylindrical contact surface. In addition, each friction member **20** has a pin **23** projecting forwardly and an inward recess **24**. On the holder **17**, a second holder **25** is provided which is attached to the holder **17** by screws **26** and in which adjustment screws **27** are provided. Between these screws **27** and the friction members **20**, pressure springs **28** are present in the threaded bores of holder **25** and having one end in the recesses **24**. On the other side of the wire **16**, a holder **29** is provided which is connected to the plate **11** by screws **30** which are located in slit-shaped holes **31**. A glass plate **32** is connected to this holder **29**, for example by a glued joint. In addition, a supporting member **33** (FIG. 3) is available on the carrier **11**, on which supporting member **33** a slide **34** is provided. This slide **34** is connected to the supporting member **33** by means of screws **35** which are located in slit-shaped holes **36**. The slide **34** has recesses in which abutment stops **37** are located and connected to the slide **34** by means of screws **38** through slit-shaped holes **39** in stops **37**. The abutment stops **37** have on their front edge a slope **40**. Each slope engages a pin **23** which is present in the friction members **20**. The slide **34** is held in its upper position by a drawing spring **41**. On the lower side of the slide and at some distance remote therefrom, an electromagnet **42** is provided. In addition, on the carrier plate **11** two friction members **43** are available which can be moved in the direction toward the wire, but are otherwise immovable. Between these friction members **43**, and on the other side of the wire, a pressure member **46**, of sapphire, is provided on an arm of a bent lever **44** which can rotate about a fixed point **45**. The other arm of lever **44** has a movable weight **47** and ends in a pointer **48** which co-operates with a scale **50** connected to the carrier **11** by means of supporting members **49**. Finally, two wire guides **51** are provided on the carrier **11**.

With the exception of the braking device A described, there is no other member which influences the stress in the wire between the supply coil **6** and the take-up member **10** to be wound. Notably, no braked wire guides are provided, which are subject to accelerations or retardations and might thus cause undesired peak stresses in the wire.

When adjusting the braking device, first the holder **17** is put in position and then each friction element **20** is adjusted by means of the screws **27** so that they engage the wire **16** with equal pessure. It may be necessary, during winding, to provide a loop in the wire on the take-up **10**, which loop afterwards has to form a tapping of the coil. To accomplish this, the current of the motor **9** is interrupted and then the electromagnet **42** is energized. The slide **34** is then attracted by this magnet and moves downwards. As a result of this, the surfaces **40** on the abutment stops **37** force the pins **23** to the left, as a result of which the friction elements **20** rotate about the pins **21** so that the wire is released or disengaged and the wire freely drawn through the braking device to form said loop.

The weight **47** is adjusted so that the pointer **48** during operation of the machine points to a desired point of the scale. In this case it is ensured that the stress in the wire has an accurate value, since the stress in the wire is measured by the co-operation of the friction member **46** with the rigidly connected members **43**. If the tension in the wire exceeds a certain admissible value, the pointer **48** moves on the scale **50** upwards and may, e.g., actuate a signalling device or may interrupt a contact so that the motor **9** is shut off or disengaged.

It might be thought that all friction elements **20** could be combined in one element which would lie opposite to the rigid friction element **32** under spring pressure and that with this arrangement, the same result would be obtained. That this is not the case, appears from the graphical representation shown in FIG. 5 in which the number of adjustably loaded friction elements is plotted on the abscissa and the tensile stress occurring in the wire is plotted on the ordinate. When winding a take-up member having a polygonal cross-section, accelerations always occur in the wire as it traverses the ridges of a polygonal take-up spool. If the coefficient of friction in the case of quiescent friction between the wire **16** and the friction elements **22** is termed f_s and in the case of a sliding friction f_d, while the force at right angles to the wire is termed N and the admissible tensile stress in the wire P, the force P for one large friction element in the case of an operating braking device equals $f_d N$. With the accelerations each time occurring in the wire, in which this wire expands elastically, the quiescent friction should be taken into account and in that case the peak stress in the wire is $P_1 = f_s N$. Since, as is known, f_s is larger than f_d, this force P_1 is comparatively much larger than P. This is shown in broken lines in the graphical representation. Where a number of friction elements z is available, the peak load occurring is $P_2 = n(z-1)f_d + nf_s$ and consequently smaller. The normal stress occurring in the wire during operation then equals

$$P = \Sigma \frac{1}{z} f_d n$$

This is shown with the solid line in the graphical representation. It should be considered that in the case of a number of friction elements, during the acceleration of the travel of the wire each time first a small elastic expansion occurs in the wire between each friction element which, however, is much smaller than if only one friction element were available. In addition, a wire never engages a friction element throughout its length and the

possibility of contamination of the surfaces and resulting increased friction is also avoided.

Sometimes it is recommendable to wet the wire before it enters the friction elements. For that purpose, the plug of felt may be soaked in a wetting agent, for example paraffin, for which purpose, for example, a dropper is provided on top of the plug of felt.

The device described may particularly advantageously be used when winding rotors of small motors. In practice, it appears that a fourfold increase of the winding speed is possible when using the braking device and when using insulated wire of a diameter of approximately 100 microns or smaller, without breakage of the wire occurring. The wear of the sapphire surfaces and the glass friction element turned out to be extremely small. Naturally, also other hard and dense materials may be used.

It is also possible to divide the rigidly connected friction element 32 into a number of separate elements which are all located opposite to the adjustably loaded friction elements 22. The construction illustrated, however, is simpler. Also the movement of the adjustably loaded friction elements away from the wire may be effected in another manner, for example by a pulling device which, in FIG. 2, is connected to the carrier 17 on the lefthand side and which is actuated by a wedge-shaped member (not shown).

What is claimed is:

1. A wire braking device for wire winding machines having a wire inlet end and an outlet end comprising means for feeding and drawing a wire through said device, an elongated mounting plate over which said wire passes, a first holder member connected to said mounting plate at one side thereof, a series of adjustable friction members including a cylindrical friction surface, said friction members being pivotally supported on said first holder member having said friction surface parallel with said wire, the pivotal support of said friction element being offset from said friction surface in the direction of the inlet end of said braking device, a second holder member mounted on said first holder member in the plane of said adjustable friction members, adjustable means on said second holder member operatively interconnected with said adjustable friction members for adjustably biasing said friction members against a wire extending across said plate; a second friction element immovably mounted on said mounting plate for engaging said wire in the plane of said adjustable friction members, a slide member movably mounted on said mounting plate, a plurality of abutment stops supported on said slide member, said abutment stops engaging said adjustable friction elements upon movement of said slide member in one direction for disengaging said cylindrical friction surfaces from said wires.

2. A wire braking device according to claim 1 wherein each said adjustable friction member has an outstanding pin, said slide member is movable in a plane parallel to said wire and said abutment stops have an inclined surface for engaging a pin on said adjustable friction members for pivoting said friction members out of engagement with said wire.

3. A braking device for wire winding machines having a wire inlet end and an outlet end comprising a series of separate friction elements having a point of contact with a wire within said device and disposed along said wire at one side thereof, means for adjustably biasing said friction elements against said wire, a second friction element disposed along said wire at the opposite side thereof and operatively associated with said separate friction elements for frictionally braking said wire, each said separate friction element being pivotally supported at a point offset from the point of contact of said elements with said wire, the pivotal support of said friction elements being spaced from said point of contact in the direction of the inlet end of said brake device for preventing movement of the wire in the direction of said inlet end; means comprising a pin on each of said friction elements, a plurality of abutment stops, one of said abutment stops engaging the pin on each said adjustable friction element, said abutment stops having an inclined surface engaging said pins, means supporting said abutment stops for moving said inclined surface whereby said adjustable friction elements are rotated about their pivotal supports for disengaging said friction elements from said wire.

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