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(12) # EUROPEAN PATENT APPLICATION

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(54) **System for regulating the temporary speed of rotation of a take-up spindle, and a device adopting said system.**

(57) System for regulating the temporary speed of rotation of a spindle (16) taking up yarn on bobbins (25), whereby the regulating system tends to restore and keep substantially constant the temporary speed of winding of the yarn of the bobbin (25) being formed and comprises in coordinated cooperation with each other and with the bobbin or bobbins (25) being formed:

a drive roll (10) actuated by a synchronous motor and regulated with variable frequency to the desired peripheral speed and revolving in contact with the bobbins (25) being formed: a shaft (11) of the drive roll (10), supported in an oscillating manner and in a position of equilibrium in relation to a given desired peripheral speed of the drive roll (10); means (26) to monitor and read the temporary angular position of the shaft (11) of the drive roll (10); means (33) to balance and equilibrate the reacting moment of the shaft (11) of the drive roll (10); and a control and regulation unit (27), whereby there are advantageously included start-up brake means (28), means (18) to signal and eliminate the presence of fibres wound on the drive roll (10) and means (34) to damp the sensitiveness of corrective action.

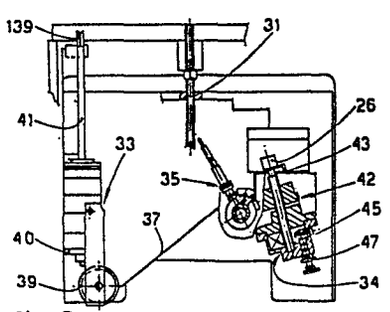

Fig.6

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1. Description of the invention entitled:
"SYSTEM FOR REGULATING THE TEMPORARY SPEED OF ROTATION OF A TAKE-UP SPINDLE, AND A DEVICE ADOPTING SAID SYSTEM"
in the name of OFFICINE SAVIO Spa at Pordenone

This invention concerns a system for regulating the temporary speed of rotation of the take-up spindle of a bobbin winder, and also concerns a take-up spindle of a bobbin winder adopting said system.

To be more exact, this invention concerns a system that serves to regulate and keep substantially constant the temporary speed of winding the yarn being wound on a bobbin being formed and mounted on a take-up spindle of a bobbin winder, and also concerns a device suitable for embodying said system.

The present tendency to process yarns of a low yarn count, namely fine yarns, at higher and higher speeds is known.

Said tendency involves the need to impart to the mass of yarn being rotated, that is, to the bobbin being formed, a growing power with an increase in the take-up speed, whereby said growth is necessary to overcome the various losses and dissipations, among which but not least of which are those due to the friction with the air and on the bearings.

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It is known that beyond a given limit said yarn cannot withstand pulling tensions of components of torque owing to the nature of the yarn itself.

It is therefore indispensable to motorize the spindle of the bobbin winder, that is to say, it is necessary to provide the shaft on which the bobbins of yarn are wound and conformed, with its own torque, which will ensure for the yarn a substantially constant traction kept within desired limits, which have to be restricted advantageously within a very small range.

Motorization of said spindle, therefore, makes necessary a device to keep constant the peripheral speed of the package be varying constantly the winding speed to suit variations in the diameter of the bobbin itself.

Various regulating systems are known. For instance, a system in the name of the present author is known which envisages the instantaneous reading of the speed of the yarn and a consequent regulation of the speed of the bobbin-bearing spindle.

A system is also known which reads mechanically and constantly the momentary peripheral diameter of the bobbin and relates it to the speed thereof, and then conditions said speed and tends to keep it constant.

These known systems are in themselves unsatisfactory owing to delays in response or to inaccuracies inborn in said systems or, lastly, because at the speeds at which up-to-date bobbin winding system operate, said known regulating systems have been found to be substantially unsuitable and iadequate for industrial use.

It is to be noted that other prior art systems exist as can be evidenced by EPO Search referenced RS 63800 IT.

For example US-A- 4.009.839describes a take-up apparatus for winding strandular material.

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The overall arrangement of the device incorporates a stationary supporting spindle onto which a rotable package support is mounted for receipt of strandular material wound thereon.

The support and the strandular material wound thereon as the package is progressively built, is adapted for contact with a rotatable drive drum.

A traverse device to guide the strandular material to the rotatable package and control the manner in which the strandular material is wound thereon is also included.

Both the drive means and the traverse means including the motors therefor are mounted on a freely vertical movable carriage supported within a frame member and uniquely counter-balanced by a pulley suspended counterweight system.

The spindle and the package support are mounted on said frame independent of such carriage.

The drive and traverse means are thus free to move upwardly while the package progressively builds on the stationary spindle.

Initial pressure means are further included to apply an initial higher pressure between the drive means and the package support to prevent skidding during the required acceleration of the support to its operational winding speed.

Additionally, differential pressure means are included to progressively descrease the amount of drive pressure between the drive drum and the package as the package builds.

Due to the presence of the above-mentioned carriage, the whole device is rather bulky and expensive to construct.

Furthermore, since the spindle which receives the package supports is externally driven by its contact with the rotating drum, the yarn progressively wound on said supports is directly contacted by said rotating drum.

While this contact between yarn and drive drum is acceptable for strandular material, it is not desiderable for other types of filamentary material such as synthetic yarn since the heat generated by the friction between the drive drum and the package surface could ruin the filamentary material.

The present invention provides the packages carrying spindle with own drive means which is constantly regulated externally by a signal corresponding to the difference between the instantaneous peripherical speed of the packages mounted on said spindle and a constant peripherical speed of an external feeler drum provided with independent drive means, arranged to be in contact with the surface of said packages as they are progressively formed.

According to the present invention no exchange of power takes place between said externally driven feeler drum and the packages carrying spindle either through the surface of the packages or otherwise.

This eliminates or drastically reduces the danger of thermal damage to the filamentary material being wound.

Another patent worth mentioning as a representative of a common type of prior art is FR-A-2.290.370 which provides for the filamentary material being wound by a driven spindle to drive a feeler roller acting as a signal generator whereby said signal, proportional to the peripherical speed of the package, is fedback to the drive means of said spindle as a corrective signal.

Unfortunately this method is inadequate in that it requires the filament to have a substantial tension and to generate a substantial friction on the surface of the feeler roller; two requirements which can not always be fulfilled.

FR-A-1.343.049 provides a driven feeler roller mounted on an oscillating arm whose oscillation is converted to an on/off signal which is then fedback to control the drive means

of the spindle through a servo control acting on the excitation of the spindle's motor means.

This system has the disadvantage of having the drive means of the feeler roller and the spindle electrically coupled between themselves which may lead to mutual disturbance aggravated by the on/off control employed.

Another patented device is disclosed in US-A-2.140.555.

This patent describes a take-up device in which the control is obtained directly from the element carrying the thread which is so positioned as to bear lightly against the spool as it is wound.

An electric circuit is controlled by the movement of said thread carrying element to decrease the speed of spindle's motor with the aid of a barrel cam which moves the thread carrying element along the package.

In addition to the above mentioned disadvantages this device is unsuitable for today's fast winding take-up devices due to the nature of the mechanical and electrical means employed therein.

FR-A-2.208.405, also mentioned in the above cited EPO Search, concerns an anti-rolling device for false-twisting machines which device provokes the cutting of the yarn when rolling takes place.

The speed regulation offered by this system is in no way suitable for yarn take-up devices.

There are other prior art patents such DE-A-2.535.457, FR-A-2.074.310, US-A-3.163.914 and US-A-3.384.322 which teach systems for regulating the take-up speed, yarn tension or pressure between the spindle and the drive drum.

Each of these devices however has one or more of the draw-backs mentioned above which the present invention aims at eliminating.

According to the invention the regulating system consists

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of a drive roll operated by a synchronous motor and regulated with variable frequency.

Said drive roll is in constant contact with the bobbin being formed and has the same peripheral speed, namely the same pre-set peripheral winding speed.

According to the invention the shaft of the drive roll is not clamped to its support but can perform an angular travel while revolving its supporting bearings.

With variations in the peripheral speed of the bobbin the drive roll begins to slip against the bobbin itself and therefore tends either to reduce or to increase its speed, depending on the type of variation taking place in the peripheral speed of the bobbin.

This modification of the state of movement of the drive roll involves a resultant and automatic variation in the tangential stress which the drive roll itself exerts on its carrying axle.

Since the axle of the drive roll has been balanced, that is, has been conditioned in such a way as to rotate neither in one direction nor in the other in correspondence with a given speed of rotation of the drive roll itself, if said given set speed then varies, as may happen by way of an increase or a drop in said speed, the state of equilibrium of the axle of the drive roll also becomes changed.

This change in the conditions of equilibrium induces in said axle a rotation which tends to displace it from its position of equilibrium towards another position of equilibrium.

By monitoring the accurence of said rotation and measuring the angle of rotation it is possible, by means of a very simple function, to relate it to the variation which has taken place in the peripheral speed of the bobbin.

This monitoring and measuring enable action to be taken to redress and restore the optimum speed of peripheral rotation

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of the bobbin itself and therefore to bring the drive roll back into a condition of equilibrium.

Having determined the desired take-up working speed, steps are taken, according to the invention, to set it; in our example said setting can be carried out by employing a plurality of suitable counterweights.

This setting is perfomed in such a way that, when the drive roll revolves at the speed wished, an angular position, which is pre-set or can be pre-set, of the axle of the drive roll corresponds to a nil value, namely the position of equilibrium.

As the diameter of the bobbin increases during take-up of the yarn, a difference in peripheral speed begins to be created between the feeler roll, or drive roll, and the outside winding circumference of the bobbin.

As said earlier, this difference in speed causes a radial stress on the drive roll and, as a result, an angular rotation of its axle or central shaft.

This angular rotation of the axle or shaft of the drive roll is read and converted so that the necessary action can be taken to cause a variation in the number of revolutions of the motor means of the spindle, and this continues until the temporary peripheral speed of the bobbin has been brought to the value desired.

For reasons of stability a damping means in the system can be envisaged which is able to provide the desired sensitiveness of corrective action to meet every variation, that is to say, which is able to damp and level out peaks and micro-variations, whether temporary or otherwise.

The invention, therefore, is embodied in a system for regulating the temporary speed of rotation of a spindle for winding bobbins, and is also embodied in a device adopting said regulating system, whereby the regulating system tends

to restore and keep substantially constant the temporary speed of winding the yarn of the bobbin being formed, said invention being characterized by including in coordinated cooperation with each other:

- a drive roll moved by a synchronous motor and regulated with variable frequency to the desired peripheral speed,
- a shaft of the drive roll sustained in an oscillating manner and in position of equilibrium in relation to a given desired peripheral speed,
- means to monitor and read the temporary angular position of said shaft of said drive roll;
- means to balance and equilibrate the reacting moment of said shaft of said drive roll;
- and a control and regulating unit,

whereby there are advantageously comprised a start-up brake, means to signal and eliminate the presence of fibres wound on said drive roll, and means to damp the sensitiveness of corrective action.

With reference to the invention, the attached tables give one solution of said invention as a non-restrictive example.

Referring to the tables we have as follows:

Fig. 1 shows an outline diagram of the invention;

Fig. 2 shows the cooperation of the drive roll with the spindle during the start-up phase of winding the bobbin;

Fig. 3 shows the system for signalling that the yarn is wound on the drive roll;

Fig. 4 gives a system of anchorage of the reader means in a position at an angle to the shaft;

Fig. 5 gives a possible lay-out of the balancing means;

Fig. 6 shows Figs. 4 e 5 in an overall view;

Fig. 7 shows the anchorage of the balancing means to the

shaft, and also the means signalling the angular limit positions;

Fig. 8 shows the start-up brake;

Fig. 9 shows some damping means.

With reference to the figures, the drive roll 10 is revolvably installed on the shaft 11 supported by the bearings 12.

The shaft 11 is also supported in an oscillating manner by the support 13 by means of the bearings 112.

The shaft can consist of several pieces rigidly connected together, depending on the specific design requirements.

The drive roll 10 has an outer contact drum 14 which comprises advantageously, in correspondence with its inner end, a bulge 114 suitable for coming into contact with a coordinated zone 15 with accentuated friction during the start-up phase of the winding of the first layers of yarn of the bobbin mounted on the spindle 16.

On the spindle 16 are mounted in a known manner the cardboard tubes 17 onto which the yarn is wound to form the bobbin or bobbins.

Means 18 to signal and eliminate the presence of fibres wound on the drive roll 10 are envisaged as cooperating with the surface of the contact drum 14.

Said means 18 to signal and eliminate the presence of wound fibres consist in our example of a bar 19 oscillating at 20, the distance of which 21 from the contact drum 14 can be ragulated with regulating means 22.

A signalling means 23, a switch means for instance, is included and is activated by the bar 19 whenever the yarn wound onto the drive roll 10 is more than the pre-set value 21.

As is shown in Fig. 1, the drive roll 10 is activated with variable frequency in a known way and is brought to

the desired peripheral speed.

The drive roll 10 comprises a shaft 11 which oscillates on bearings 112 and which, to remain still, has to be equilibrated with a torque equal to and opposite to that which the drive roll 10 induces by reaction in the shaft 11 itself.

It is clear, therefore, that the condition of equilibrium, namely the condition according to which, when the drive roll 10 rotates, the shaft 11 does not start rotating as well, depends directly on a specific speed of rotation of the drive roll 10, and for this speed the shaft 11 has to be equilibrated.

If the speed of the drive roll 10 is varied, the reactive torque induced in the shaft 11 and, therefore, the pre-set conditions of equilibrium are also modified; said variations, as compared to the pre-set conditions, can be excessive or insufficient, depending on whether the variation which has taken place in the speed of the drive roll 10 is an increase or a decrease.

Depending on whether the condition of equilibrium preset for the shaft 11 is found to be excessive or insufficient, said shaft 11 will tend to rotate in a negative or positive direction.

The monitoring, first of all, of the tendency of the shaft 11 to rotate and the reading of the value of the rotation of said shaft 11 enable parameters to be obtained which, when suitably computed, make it possible to act with means able to restors the desired peripheral speed of the drive roll 10.

The means able to restore the desired peripheral speed of the drive roll 10 consist of the motor 24 which drives the spindle 16 on which the yarn to form the bobbins 25 is wound.

If the diameter of the bobbins 25 changes, their peripheral speed also changes, and the aforesaid disturbance in the

peripheral speed of the drive roll 10 is thus created inasmuch as said drive roll 10 revolves in contact with the periphery of said bobbin 25.

The distrubance induced by the variation in the speed of winding onto the bobbins 25 is transmitted to the drive roll 10 and is induced by the latter in the shaft 11.

The variation induced in the shaft 11 is monitored and read by the means 26 which monitor and read the temporary angular position, and is transmitted by said means to the control and regulation unit 27, which in its turn conditions the motor 24 on the basis of a pre-set function and in a known manner until it has re-equilibrated the peripheral speed of the bobbin 25 with the pre-set peripheral speed of the drive roll 10.

Said means 26 which monitor and read the angular oscillation can, in this example, consist of rheostat means or other means suitable for the purpose.

During the start-up of the drive roll 10, it may be necessary to clamp the shaft 11, and this is done with the brake 28 shown in Fig. 8.

The brake 20 includes a shoe 29 which is hinged at 30 and can be operated with screw means 31, elastic pressure means 32 being advantageously envisaged.

Figs. 4, 5 and 6 show both an equilibrating system, or balancing and equilibrating means 33, and also means for measuring angular oscillation 26 and, lastly, means for damping 34 the sensitiveness of corrective action.

Means 35 oan also be included for reading the maximum permitted angular rotation of the shaft 11, as in the detailed example shown in Fig. 7.

The balancing and equilibrating means 33 shown in our example envisage some weights 36 for adjusting the reacting moment to be applied on the shaft 11 so as to equilibrate

the moment induced by the drive roll 10 when the latter revolves at the derired tangential speed.

According to the example shown in Figs. 4, 5, 6 and 7 a cord 37 is fixed to the shaft 11 at 38.

Said cord runs on the pulleys 39-139 before being anchored to the bar 40, which is able to run on the guides 41, said bar being guided there by 41.

Depending on the reacting moment necessary, that is, in relation to the tangential speed desired or pre-set, this being one and the same thing, for the drive roll 10, weights 36 are applied which are enough in number to create the desired value of tangential pull, namely or reacting torque, in relation to the peripheral speed of the drive roll 10 pre-selected or pre-determined.

The example of Fig. 4 visualizes an angular transmission 42 between the shaft 11 and the means 26 measuring angular oscillation.

On the same axis as the means 26 measuring oscillation, of which the axle is 43, means 34 to damp the sentitiveness of corrective action have been envisaged.

In the example shown said means 34 to damp the sensitiveness of corrective action consist of a revolvable partition wall means 44 (with a chamber 45 and paddle 46) and of means 47 to regulate flow.

By acting on the flow regulator 47, or, in our example, by causing said flow regulator 47 to rotate, the speed of transfer of the fluid from one part of the chamber to the other is conditioned, and thereby the speed of movement of the paddle 46 is also conditioned.

As the paddle 46 is solidly fixed to the shaft 11 through the angular transmission 42, the damping means 34 acts directly on the shaft 11 and on the measuring means 26.

On the shaft 11 can be envisaged suitably angled sensor

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means 49 which, in cooperation with the proximity reader 48, form the means 35 that reads the maximum permitted angular rotation of the shaft 11.

We have described here one particular preferential lay-out of the invention, but variants are possible.

Thus, proportions and sizes can be varied, and parts can be added, removed or integrated; parts can be replaced with mechanical equivalents, and alternative solutions can be envisaged; it is possible to visualize the damping means 34 as being of another type or in another position (concept of mechanical equivalents) and so on.

These and other variants are all possible to a technician in this field without departing thereby from the scope of the idea of the solution.

CLAIMS

1 - System for regulating the temporary speed of rotation of a spindle (16) taking up yarn on bobbins (25), whereby the regulating system tends to restore and keep substantially constant the temporary speed of winding the yarn on the bobbin (25) being formed, said system being characterized by comprising in coordinated cooperation with each other and with the bobbin or bobbins (25) being formed:

- a drive roll (10) actuated by a synchronous motor and regulated with variable frequency to the desired peripheral speed and rotating in contact with the bobbins (25) being formed;
- a shaft (11) of said drive roll (10), supported in an oscillating manner and in position of equilibrium in relation to a given desired peripheral speed of said drive roll (10);
- means (26) to monitor and read the temporary angular position of said shaft (11) of said drive roll (10),
- means (33) for balancing and equilibrating the reacting moment of said shaft (11) of said drive roll (10),
- and a control and regulation unit (27),

whereby there are advantageously included start-up brake means (28) and means (18) to signal and eliminate the presence of fibres wound on said drive roll (10), and whereby means to damp (34) the sensitiveness of corrective action are also advantageously included.

2 - System for regulating the temporary speed of rotation of a spindle taking up yarn on bobbins, as in Claim 1, characterized by the fact that the shaft (11) of the drive roll (10) is installed on bearings (112), whereby there are balancing and equilibrating means (33) which create on said shaft (11) the reacting moment that equilibrates the torque induced by said drive roll (10) revolving at the desired tangential speed pre-set.

3 - System for regulating the temporary speed of rotation of a spindle taking up yarn on bobbins, as in Claim 1 or 2, characterized by the fact that means are included which monitor and read (26) the temporary angular position of the shaft (11) and which are connected in a coordinated manner to the axis of said shaft (11).

4 - System for regulating the temporary speed of rotation of a spindle taking up yarn on bobbins, as in Claim 1 and in one or the other of the Claims thereafter, characterized by the fact that means to damp (34) the sensitiveness of corrective action are included which are connected in a coordinated manner to the axis of the shaft (11), whereby means (47) to regulate the sensitiveness of corrective action are comprised.

5 - System for regulating the temporary speed of rotation of a spindle taking up yarn on bobbins, as in Claim 1 and in one or another of the Claims thereafter, characterized by the fact that brake means (29) which can be temporarily applied are included and cooperate in a coordinated manner with the shaft (11).

6 - System for regulating the temporary speed of rotation of a spindle taking up yarn on bobbins, as in Claim 1 and in one or another of the Claims thereafter, characterized by the fact that means (18) for signalling and eliminating the presence of wound fibres are included which cooperate in a coordinated manner with the drive roll (10) and which cooperate with at least one means (23) for signalling the presence of an axcess of wound fibres.

7 - System for regulating the temporary speed of rotation of a spindle taking up yarn on bobbins, as in Claim 1 and in oen or another of the Claims thereafter, characterized by the fact that in coordinated cooperation with the monitoring and reading means (26) there is included a control

and regulation unit (27) which is controlled by the variation in the peripheral speed of the drive roll (10) induced by the bobbins (25) being formed and which itself controls the motor means (24) actuating the spindle (16) bearing the bobbins (25).

8 - Device for regulating the temporary speed of rotation of a spindle (16) taking up yarn on bobbins (25), whereby the regulating device tends to restore and keep substantially constant the temporary speed of the winding of the yarn on the bobbin (25) being formed and adopts one or another of the systems according to the Claims hereinbefore and is characterized by including in coordinated cooperation with each other and with the bobbin or bobbins (25) being formed:

- a drive roll (10) activated by a synchronous motor and regulated with variable frequency to the peripheral speed desired and rotating in contact with the bobbins (25) being formed,
- a shaft (11) of said drive roll (10), supported in an oscillating manner and in a position of equilibrium in relation to a given desired peripheral speed of said drive roll (10),
- means (26) to monitor and read the temporary angular position of said shaft (11) of said drive roll (10),
- means (33) to balance and equilibrate the reacting moment of said shaft (11) of said drive roll (10-,
- and a controlling and regulating unit (27),

whereby there are advantageously included start-up brake means (28) and means (18) to signal and eliminate the presence of fibres wound on said drive roll (10), and whereby means (34) to damp the sensitiveness of corrective action are also advantageously included.

9 - System and device according to one or another of the Claims hereinbefore, as described and shown and for the purposes

allowed.

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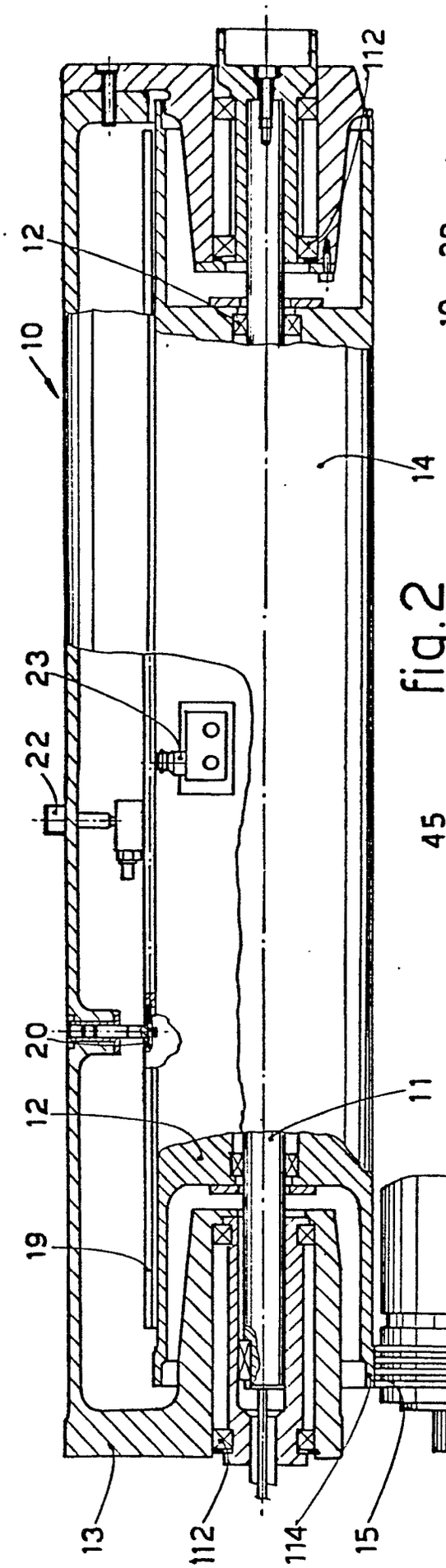

Fig.2

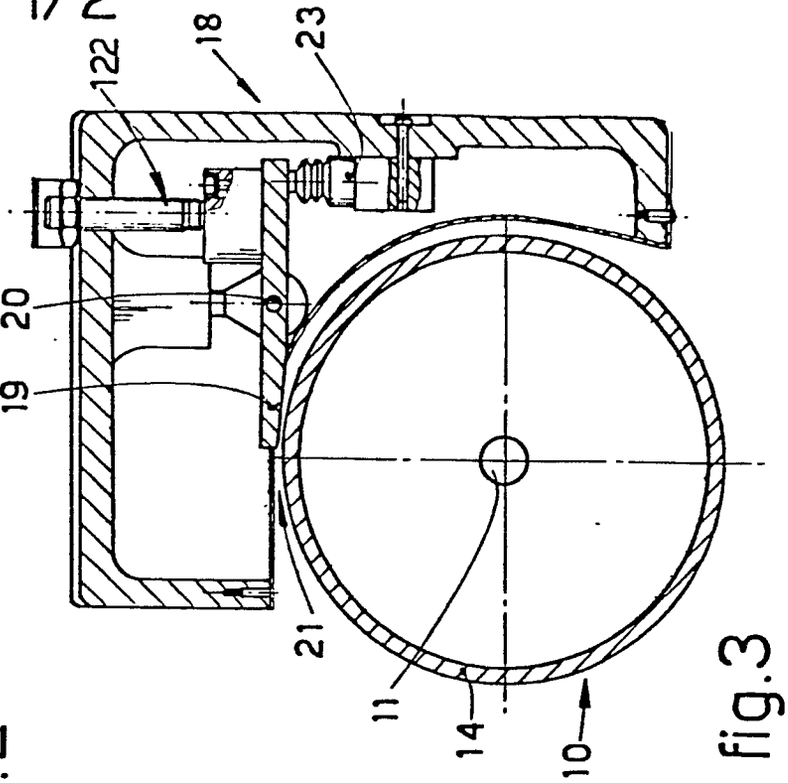

Fig.3

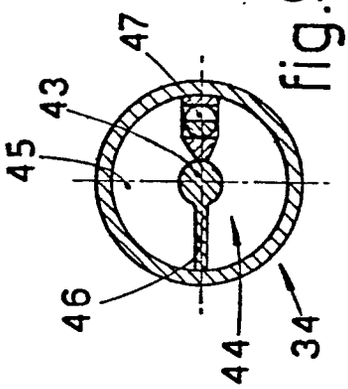

Fig.9

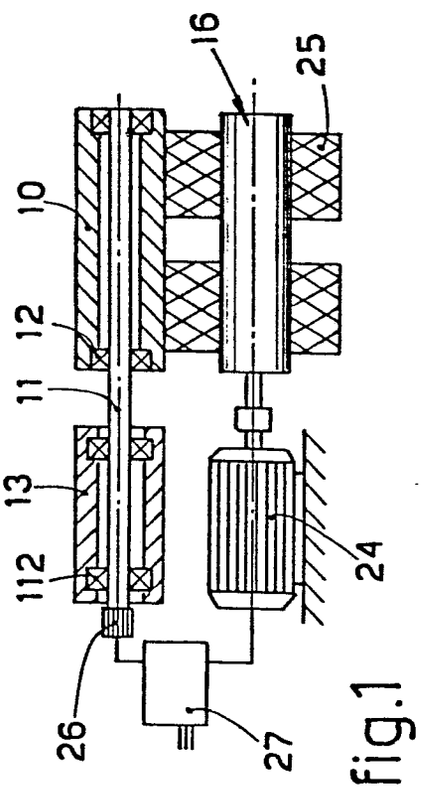

Fig.1

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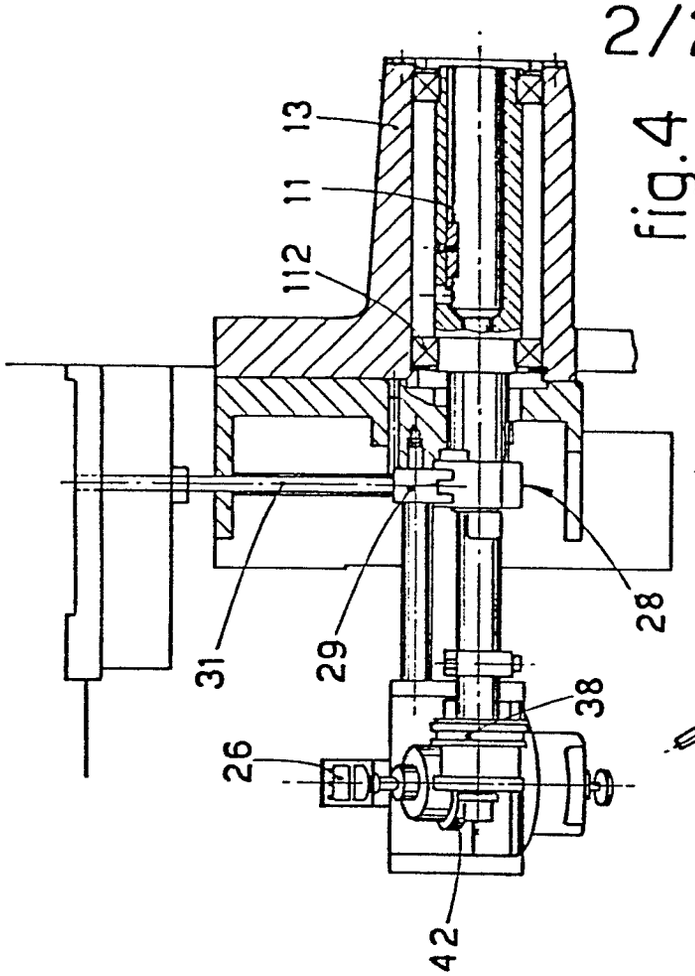

fig.4

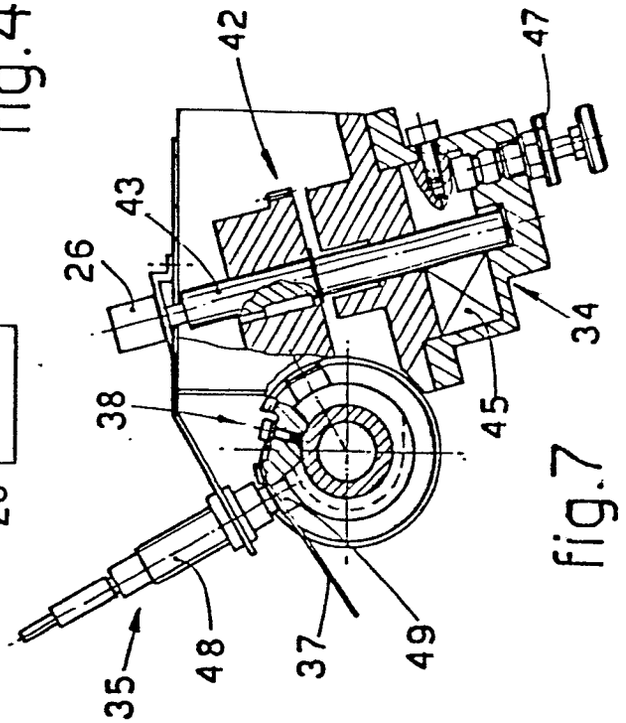

fig.7

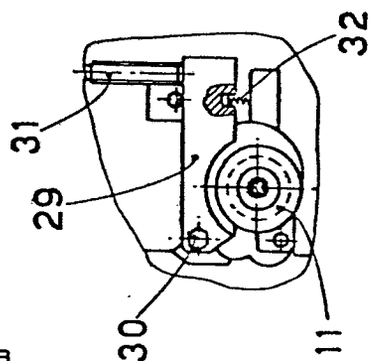

fig.8

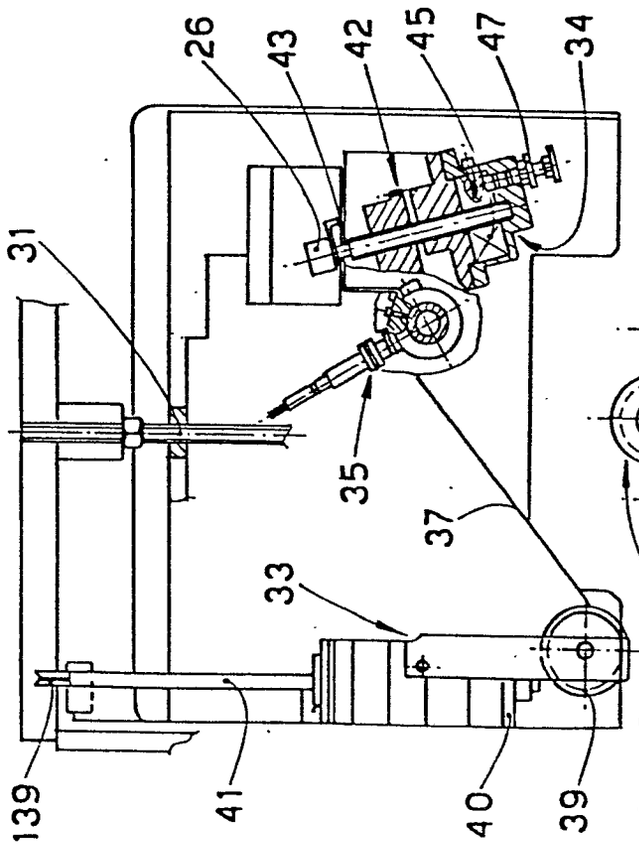

fig.6

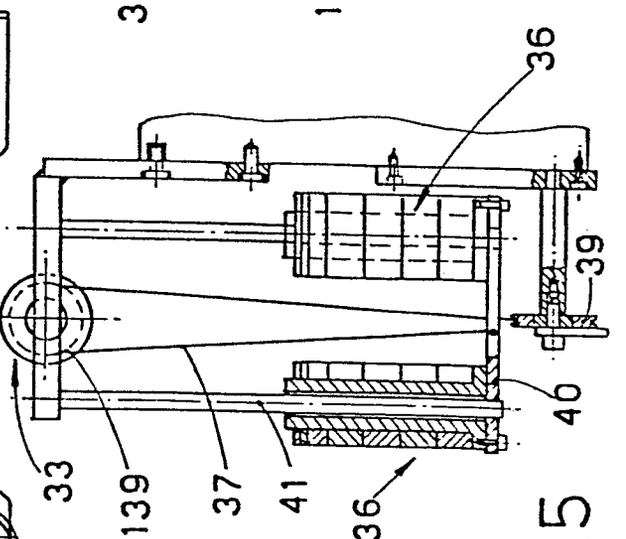

fig.5

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EUROPEAN SEARCH REPORT

Application number

EP 82 83 0004

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
D,A	US-A-4 009 839 (LEESONA CORP.) *Abstract*	1,2,4,8	B 65 H 59/38
D,A	FR-A-2 290 379 (TEIJIN LIM.) *Pages 6-9; page 18, lines 9-35, figures 3,10*	1,2,8	
D,A	FR-A-1 343 049 (INDUSTRIE-WERKE KARLSRUHE) *The whole document*	1,8	
D,A	US-A-2 140 555 (H.A.SATTERLEE) *The whole document*	1,8	
D,A	FR-A-2 208 405 (LE GOUIC P.) *The whole document*	1,6,8	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 65 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-04-1982	DEPRUN M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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