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ABSTRACT

The invention relates to a friction motor spindle (10) having a housing (15) and a spindle (11), and having a bearing unit (13), which is provided for bearing the spindle (11), and also an electromotive drive (16) which is provided for directly driving the spindle (11), wherein a regulator assembly (19) for operating the electromotive drive (16) is arranged in or on the housing (15) of the friction motor spindle (10), and to a method for operating a friction motor spindle system comprising at least two friction motor spindles (10), in which system, according to the invention, at least one friction motor spindle (10) controls or regulates another friction motor spindle (10).

Fig.1

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We claim

1. Friction motor spindle (10) with a spindle (11) and a bearing unit (13) provided for mounting the spindle (11) as also an electromotive drive (16) provided for the direct driving of the spindle (11) characterised in that a controller sub-assembly (19) for operating the electromotive drive (16) is integrated in the friction motor spindle (10).

2. Friction motor spindle (10) according to claim 1, characterised in that the controller sub-assembly (19) is provided for a regulation or control of the speed of rotation of the electromotive drive (16).

3. Friction motor spindle (10) according to one of claims 1 or 2, characterised in that the controller sub-assembly (19) is provided for operating at least one further friction motor spindle (10).

4. Friction motor spindle (10) according to one of claims 1 to 3, characterised in that the controller sub-assembly (19) comprises at least one electronic interface.

5. Friction motor spindle (10) according to one of claims 1 to 4, characterised in that the controller sub-assembly (19) is provided for synchronizing the speed of rotation of the friction motor spindle (10) with the speed of rotation of at least one further friction motor spindle (10).

6. Friction motor spindle (10) according to one of claims 1 to 5, characterised in that the controller sub-assembly (19) comprises at least one low voltage regulator.

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7. Friction motor spindle (10) according to one of claims 1 to 6, characterised in that the controller sub-assembly (19) comprises at least one high voltage regulator.

8. Friction motor spindle (10) according to one of claims 1 to 7, characterised in that the controller sub-assembly (19) comprises at least one micro controller (27).

9. Friction motor spindle (10) according to one of claims 1 to 8, characterised in that the friction motor spindle (10) comprises an angular position indicator (22), preferably a Hall sensor.

10. Method of operating a friction motor spindle system comprising at least two friction motor spindles (10), characterised in that a friction motor spindle (10) according to at least one of the claims 1 to 9 controls or regulates at least one other friction motor spindle (10).

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To
The Controller of Patents,
Patent Office, Delhi

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SCHAEFFLER TECHNOLOGIES AG & CO. KG

Application No: ____/DELNP/2014

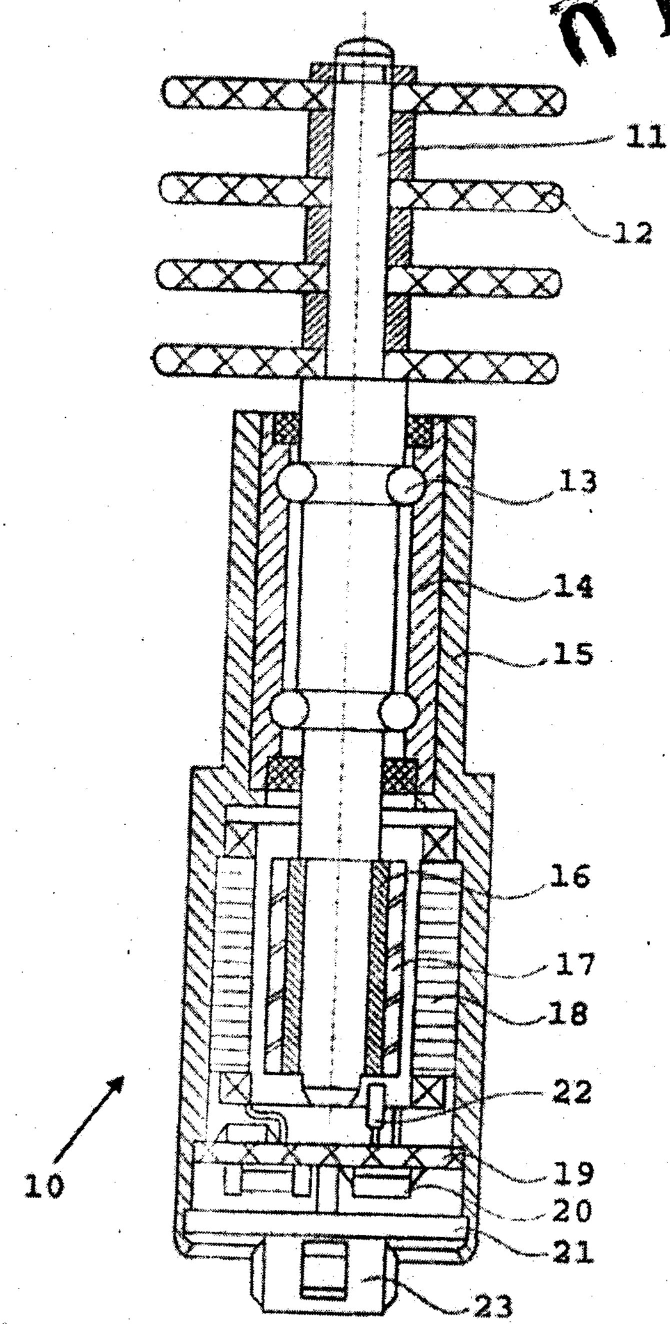

Fig. 1

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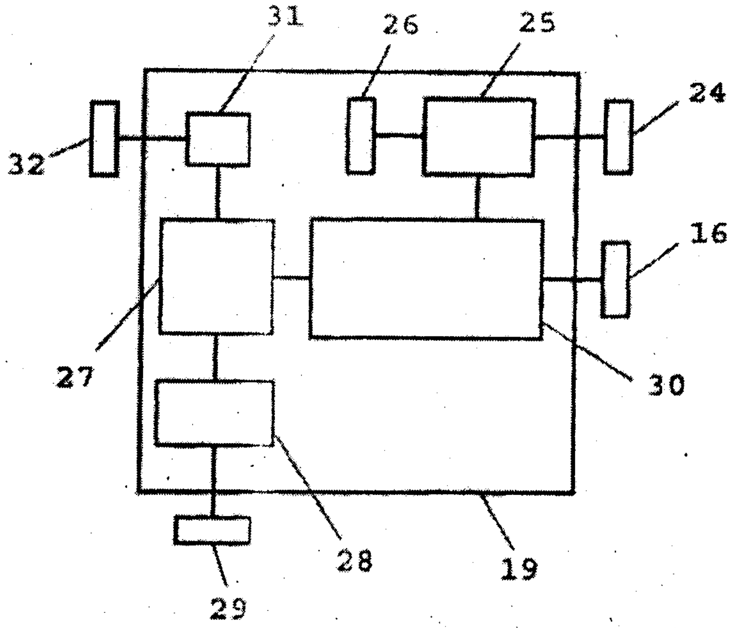

Fig. 2

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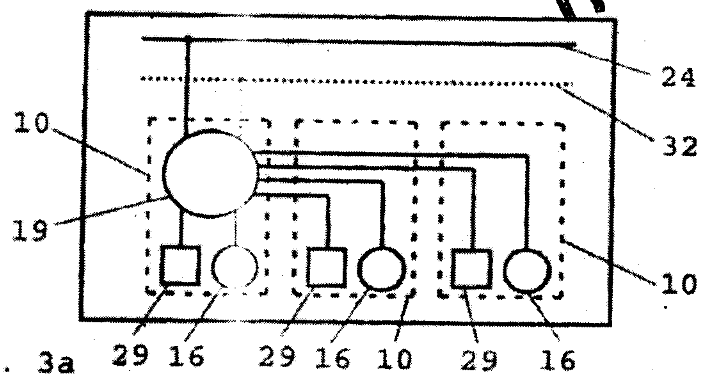

Fig. 3a

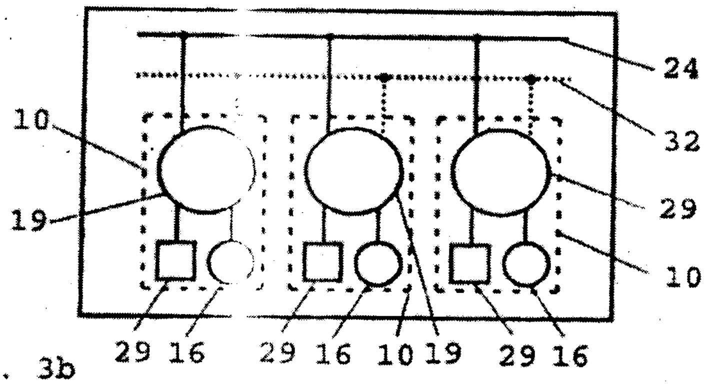

Fig. 3b

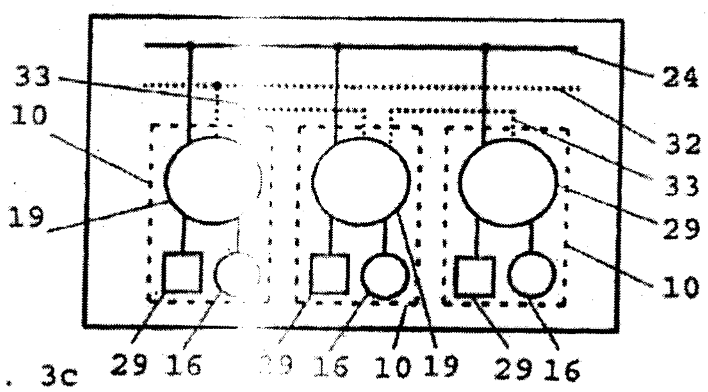

Fig. 3c

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Title of the invention

Friction motor spindle and method for operation

The invention concerns a friction motor spindle with a housing, a spindle and a bearing unit provided for mounting the spindle as also an electromotive drive provided for the direct driving of the spindle. The invention further concerns a method for operating a friction motor spindle system.

Friction motor spindles are used in textile machines for texturing smooth, untreated filament or yarn. As a rule, three friction motor spindles are combined into a texturing unit or also a friction motor spindle system, the friction motor spindles being arranged in form of an equilateral triangle relative to one another. Through disk-shaped friction elements, the system imposes a turning on the filament that is pulled through between the friction motor spindles. In this way, the filament is twisted, that is to say, textured in order to enhance the elastic extensibility of the original smooth filament. Friction motor spindles are known, for example, from DE 10 2005 023 928 A1 or EP 0 828 872 B1. The control units and the power delivery units are connected through cables to the electromotive drives and sensors of the spindles and are arranged together as a rule in a switch cabinet for a textile machine. Typically, a textile machine comprises more than 200 friction motor spindle systems.

The object of the invention is to provide friction motor spindles suitable for texturing filaments and yarns and comprising an electric direct drive, and a method for their operation, which friction motor spindles must be characterised by a high rotational speed stability, energy-efficient operation and low complexity and costs of cabling.

The invention achieves the above object starting from the preamble of claim 1 and in connection with its characterising features. The then following dependent claims concern respective advantageous developments of the invention. A friction motor spindle comprises a housing and a spindle as also a bearing unit for mounting the spindle. The friction motor spindle further comprises an electromotive drive provided for the direct driving of the spindle. According to the invention, the friction motor spindle comprises a controller sub-assembly that is provided for the operation of the electromotive drive and integrated into the friction motor spindle. The controller sub-assembly is associated to the friction motor spindle. It can be arranged in or on a housing of the friction motor spindle. In this way, a decentralised arrangement of the controller sub-assemblies for the friction motor spindles is created in the textile manufacturing equipment.

The construction according to the invention is particularly advantageous because, compared to the usual use of one or more central controller stations, e.g. in a switch cabinet of the textile manufacturing equipment, the complexity and expenses for cabling are clearly reduced and simplified. Hitherto, it was necessary to lay a separate power cable and a separate sensor cable from the friction motor spindle to the switch cabinet for each friction motor spindle. Besides the complex installation work and high costs, this is also a drawback, above all, due to the possible disturbance and error sources. Among the disturbance sources is also to be counted a deterioration of the electromagnetic compatibility, because due to the plurality of long and parallel cables, an undesired inductive crosstalk can occur. The transmissions of the sensor cables are particularly interference-prone. Furthermore, by reason of the large cable lengths, voltage drops and signal reflections can occur. These factors have a detrimental effect on the behaviour of the controllers as a whole and thus also on the rotational speed stability of the friction motor spindles.

According to the invention, through the arrangement of a controller sub-assembly immediately next to the friction motor spindle, these drawbacks can no longer occur in this form so that a high rotational speed stability and clearly reduced complexity and costs of cabling are achieved. The required electric power for the operation of the electromotive drive can be made available to the controller sub-assembly through the connection to a mains supply to which a plurality of friction motor spindles can be connected at the same time. By reason of the possibility of using distributors and the free allocation, the laying of the cables is very simple as compared to the laying of power cables, as described above.

By electromotive drives are to be understood all types of known electro motors that are suitable for creating a rotational movement of an axle such as, for example, stepper motors, reluctance motors, synchronous and asynchronous motors as well as commutated direct current motors, also known as brushless direct current motors.

Preferably, the controller sub-assembly is provided for effecting a rotational speed regulation or a rotational speed control of the electromotive drive.. The electric and electronic components required for this purpose are grouped together in the controller sub-assembly. This also comprises any possibly required components that are configured for reading out and evaluating sensor signals from sensors to or in the friction motor spindle. Moreover, the controller sub-assembly can also comprise components that are suitable for frequency regulation and commutation. The controller sub-assembly is not necessarily a spatially coherent sub-assembly; for example, a spatial separation of individual components of the controller sub-assembly in the region of the friction motor spindle concerned is possible. The achievable regulation quality of the controller sub-assembly is notably positively influenced through the arrangement of the controller sub-assembly with very short line paths.

In a further development, the controller sub-assembly of a friction motor spindle is provided for driving at least one further friction motor spindle. Because, as a rule, three friction motor spindles are grouped together into one friction motor spindle system, the advantages of short line paths and of the limited cabling costs remain unchanged in this possible development, while, through the grouping together of the controller sub-assemblies further advantages e.g. a simplified control of the entire textile machine and reduced costs are created.

In a preferred embodiment of the invention, the controller sub-assembly of a friction motor spindle comprises at least one electronic interface.

This interface is configured so as to receive the defined rotational speed requirements for the textile machine and to report e.g. any irregularities to the central equipment controls. Furthermore, the electronic interface enables the transmission of further desired states of the central equipment controls of the textile machine to the controller sub-assembly e.g. equipment stop, equipment start and other different operational states. The interface can be a connection to a digital bus system that enables the digital allocation of the friction motor spindle in a central system for equipment control e.g. a storage-programmable control SPS. This significantly simplifies the connection and installation of a friction motor spindle because, in this case, too, similar to the mains supply, distributors can be used. In addition, through digital transmission protocols, an error-free data transmission via the bus system is guaranteed.

Preferably, the controller sub-assembly of a friction motor spindle is provided for synchronizing the rotational speed with at least one further friction motor spindle. This can be achieved on the one hand by the fact that, as described above, one controller sub-assembly is used for operating a plurality of friction motor spindles, particularly if grouped together into one friction motor spindle system, so that all necessary information and intervention options are united in one controller sub-assembly, which fact enables synchronization to be achieved. On the other hand, a synchronization of a plurality of friction motor spindles all of which comprise a controller sub-assembly can be achieved by the fact that the central bus system or data network serving for the communication of the controller sub-assemblies with one another is used for synchronization. Over and above, it is also possible to use another electronic interface of the controller sub-assembly that is not connected to the central data bus of the textile machine but only to those friction motor spindles of the system that are involved in the desired synchronization. On the whole, through the use of an electronic interface in the controller sub-assembly according to the invention, the synchronization is also possible via a data connection of a larger number or of all the friction motor spindles of a textile machine.

Preferably, the controller sub-assembly comprises a low voltage power regulator. The power requirement of the electromotive drive is thus covered by a regulator or power provider which can be typically operated with a supply voltage of 24 V DC. Furthermore, all supply voltages in the range of extra-low voltage are suited to drive the low voltage regulator. By reason of the reduced safety requirements, the use of a low voltage regulator results in multiple simplifications in the structure and in the joining method as also further cost advantages.

According to a further development, a high voltage regulator is used in the controller sub-assembly if a higher power demand exists or also for other reasons. The supply voltage, typically in the range of 200 V to 400 V is no longer a harmless extra-low voltage for human beings. In contrast to a low voltage regulator, a high voltage regulator necessitates a more complex and expensive installation but, due to the higher voltages, the possible power transmission using comparable cable cross-sections is greater.

The controller sub-assembly of a friction motor spindle according to the invention preferably comprises at least one micro controller. The micro controller can serve for reading out and processing sensor data, for processing data out of an electronic interface as also for implementing the controller or the controller algorithm. The micro controller controls relevant setting variables that are implemented by the power electronics for the operation of an electromotive drive.

According to a further feature of the invention, the friction motor spindle comprises an angular position indicator that, as a sensor, detects and picks up the necessary information on the instantaneous state of the spindle for the controller sub-assembly. This sensor is preferably at least one Hall sensor that as a contactless sensor can serve for detecting the position and the speed of rotation. Moreover, if an electronically commutated electromotive drive is used, the angular position indicator can be utilized as a basis for the commutation.

The object of the invention is further achieved starting from the preamble of claim 10 in connection with its characteristic features. A method for operating a friction motor spindle system controls or regulates a plurality of friction motor spindles, typically three in number. A controller sub-assembly that is arranged on or in a housing of a friction motor spindle controls or regulates at least one further, typically two further friction motor spindles. The regulation is effected through transmission of electric signals and/or through transmission of the electric power for the electromotive drive. The method is characterized by a particularly high quality of regulation that is decisive for the quality and the high-grade of the texturing, and by a simple controllability of the textile machine. The method of operation further includes the possibility of effecting the regulation separately in each friction motor spindle, and the required synchronization is achieved through a data transfer between the controller sub-assemblies of the friction motor spindles.

Further features of the invention result from the following description of the drawings in which preferred examples of embodiment of the invention are illustrated.

The figures show:

Fig. 1, a sectional representation of a friction motor spindle with integrated controller sub-assembly;

Fig. 2, a schematic representation of a controller sub-assembly, and

Fig. 3, a schematic representation of the synchronisation of a plurality of friction motor spindles.

One embodiment of the friction motor spindle 10 according to the invention is illustrated in Fig. 1. On the spindle 11 are arranged texturing disks 12, the number of which can also be different to the one shown in this figure. The bearing unit 13 forms a double-row pre-stressed rolling bearing that serves to mount the spindle 11 and the electromotive drive 16. Alternative forms of embodiment can comprise the most different types of bearings. The rolling elements assure a low-friction rotational behaviour between the outer ring 14 and the spindle 11. The outer ring 14 of the bearing unit 13 is surrounded by the housing 15 of the friction motor spindle 10. The electromotive drive 16 produces the rotational movement of the spindle 11 onto which the rotor 17 of the electromotive drive 16 is glued or pressed which leads to a direct drive of the spindle 11. The stator 18 of the electromotive drive 16 is arranged in the housing 15. The controller sub-assembly 19 is arranged in the housing 15 of the friction motor spindle 10. The controller sub-assembly 19 comprises different electric and electronic components 20 that are connected through short line paths to the stator 18 of the electromotive drive 16. Furthermore, there exists a connection to an angular position indicator 22, in the present example, a Hall sensor, with the help of which a correctly phased commutation or current supply of the stator 18 as also a regulation are effected. The housing 15 is closed with a cover 21 so that the bearing unit 13, the electromotive drive 16 and the controller sub-assembly 19 are shielded from detrimental external influences and contact. For connecting the friction motor spindle 10 to the mains supply 24 and the data net 32 (see Figs. 2 and 3), plug connections 23 are provided in the housing 15 or in the cover 21. In an alternative form of embodiment, appropriate cables are laid through the housing or through the cover 21.

Fig. 2 shows in a schematic representation a possible form of embodiment of a controller sub-assembly 19 that is arranged according to the invention in or on the friction motor spindle. The controller sub-assembly 19 is provided with a plurality of connections to external components 16, 24, 29, 32, the mains supply 24 being connected to a voltage transformer 25. The voltage transformer 25 transforms, on the one hand, the voltage of the mains supply 24 for electronic components of the controller sub-assembly 19 and makes this available as an internal supply voltage 26 for electronic components. On the other hand, the voltage of the mains supply 24 is made available to the power electronics 30 either directly or transformed. The power electronics 30 can comprise transistors, thyristors and triacs that actuate the windings of the electromotive drive.

The micro controller 27 performs the regulation on the basis of the regulating algorithms deposited thereon. Moreover, different pre-adjustments, regulating limits and parameters can be deposited on the micro controller 27 or on an additional storage unit in the controller sub-assembly. For the purpose of regulation, the reference input values from the interface sub-assembly 31, which establishes the connection to the data net, are compared to the instantaneous values out of the sensor operation sub-assembly 28, which establishes the connection to different sensors. On the basis of these two values, a regulation signal is emitted from the micro controller 27 and transmitted to the power electronics 30. The power electronics 30, in turn, operates the electromotive drive 16.

Fig. 3 shows different possible examples of embodiment for the control or regulation and synchronization of a plurality of friction motor spindles 10.

Fig. 3a shows three friction motor spindles 10 of which only one comprises the controller sub-assembly 19 according to the invention. In this example of embodiment, the controller sub-assembly 19 concerned takes over the reading-out of the sensors 29 and the operating of the electromotive drives 16 of two further friction motor spindles 10. The three friction motor spindles 10 shown preferably form a friction motor spindle system and are therefore arranged spatially very close to one another, so that the power cables for the electromotive drives 16 and the cables required for the sensor equipment 29 are correspondingly short. In the example of embodiment of Fig. 3a, only one friction motor spindle 10 according to the invention is required, so that the controller sub-assembly 19 can be omitted in the other two friction motor spindles 10 shown so that a cost advantage is created.

In the example of embodiment of Fig. 3b, three friction motor spindles 10 according to the invention which constitute a friction motor spindle system are shown. Each of the friction motor spindles 10 is connected to the mains supply 24 and to the data net 32. The controller sub-assembly 19 of each friction motor spindle 10 regulates or controls the electromotive drive 16 with the help of the sensor equipment 29. The synchronization is effected by the central data net 32 of the textile machine with help of the interface sub-assembly 31.

In a further example of embodiment shown in Fig. 3c, three friction motor spindles 10 are illustrated, all of which are provided with a connection to the mains supply 24 whereas only one of the friction motor spindles 10 is provided with a connection to the data net 32. The other two shown controller sub-assemblies 19 of the friction motor spindles 10 are connected to each other through a data connection 33 via a further electronic interface. This data connection 33 is used preferably for the synchronization of the friction motor spindles. In an alternative form of embodiment, only one controller sub-assembly 19 of the friction motor spindles 10 effects the regulation, preferably the friction motor spindle 10 comprising the connection to the data net 32, and transmits the control commands through that data connection 33 through which the sensor data of the sensor equipment 29 are also transmitted. Different gradations between these two forms of embodiment are possible.

In the examples of embodiment of Figs. 3b and 3c, it is possible to use friction motor spindles according to the invention with identical structures. In the example of embodiment of Fig. 3b, it is simpler to realize the operation of each friction motor spindle 10 through the central control system of the textile machine. The example of embodiment of Fig. 3c enables a further shortening of the data cables required because cabling to the next distributer of the data net 32 must be provided only for one friction motor spindle 10. The other two friction motor spindles can be connected through short patch cables.

List of reference numerals

10	Friction motor spindle
11	Spindle
12	Texturing disk
13	Bearing unit
14	Outer ring
15	Housing
16	Electromotive drive
17	Rotor
18	Stator
19	Controller sub-assembly
20	Electric and electronic components
21	Cover
22	Angular position indicator
23	Plug connection
24	Mains supply
25	Voltage transformer
26	Internal supply voltage
27	Micro controller
28	Sensor operation sub-assembly
29	Sensor equipment
30	Power electronics
31	Interface sub-assembly
32	Data net
33	Data connection