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(54) "Yarn feeder with rotary drum for textile machines".

(57) A shell (12) has a motor (18) housed therein, which is provided with a driving shaft (20) having a yarn-winding drum (22) mounted thereto. A lever (28) hinged to the shell (12) is slidably engaged by the yarn (F). Return means (42, 44) bias the lever (28) toward a stop position, in which it deviates the yarn coming from the drum (22) with respect to its feeding direction to a downstream machine. The lever (28) is subject to swing in contrast to the return means (42, 44) in relation to the variations of tension of the yarn (F). Sensor means (46, 48) detect the movements of the lever (28) with respect to the stop position and generate a corresponding activation signal. An electronic circuit (50) is operatively connected to the sensor means (46, 48) and is programmed to activate the motor (18) to unwind yarn in response to the activation signal.

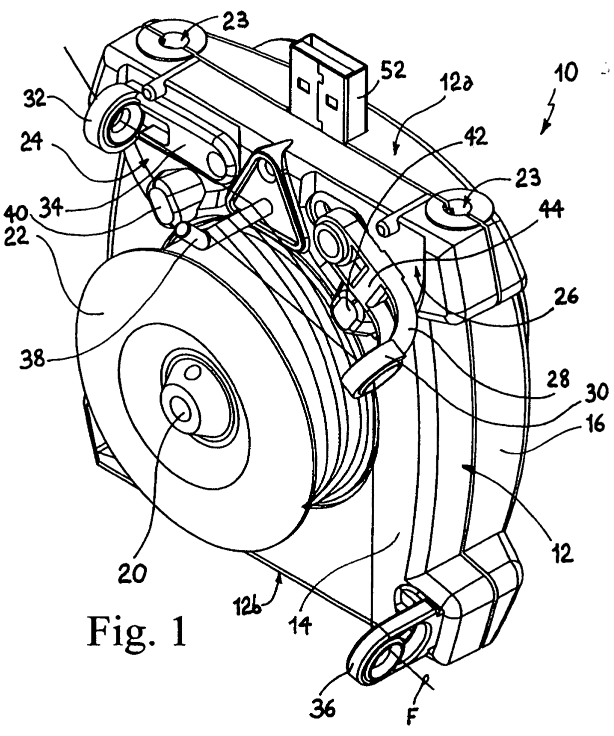

Fig. 1

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Description

[0001] The present invention relates to a yarn feeder provided with rotary drum for textile machines.

[0002] In the textile field, it is known to feed a plurality of yarns to a machine, e.g., a knitting machine, by means of a plurality of yarn feeders, each of which is provided with a rotary drum having a yarn wound thereon. In a relatively inexpensive type of feeder, the yarn is connected to a pulley which is driven to rotate by the motor of the downstream machine via a belt drive, with a gear ratio which is mechanically determined on the basis of the diameters of the pulleys (so called connection "in asse"). In view of this rigid, mechanical connection, with this system all the feeders are always operative when the downstream machine is in motion. Therefore, these feeders are only suitable for basic processes, e.g., which do not provide for selection of one yarn among a plurality of yarns.

[0003] A more sophisticated version of this type of feeder is also known, e.g., from US 6,145,347, which provides for the above-cited selection in order to produce striped patterns by means of so-called "striper" machines. In this version, the feeder is provided with a plurality of drums, e.g., four drums, which are keyed to a same shaft which, likewise the previous case, is connected to a pulley driven to rotate by the motor of the downstream machine by a belt drive. Each drum has one of the yarns under processing coupled thereto. Likewise the previous case, the drums always rotate together with the machine, but the non-selected yarns engage the respective drums only partially, so that they do not adhere to the drums. For the selection of one yarn, each drum is provided with a lever which is operable to deviate the yarn in such a way that it engages a larger portion of the respective drum and adheres to the latter, so that it is fed to the machine.

[0004] An advantage of the above feeders is that they are relatively inexpensive and, in the more sophisticated version, they provide for a selection of the yarn for feeding striper machines. However, they have the drawback that adjusting/calibrating the feeding speed as a function of the operative speed of the machine is an awkward operation, which requires the intervention of an operator for replacing/setting the components of the belt drive (pulleys, belts, etc.).

[0005] In addition, with feeders of the above type the tension of the unwinding yarn is not controlled, which circumstance affects the quality of the process.

[0006] In order to overcome the above drawbacks, more sophisticated feeders could be used, such as the one disclosed in EP 2 218 670A. In this case, the feeder is provided with a motor whose speed is controlled by a feedback loop. The latter receives a signal by a tension sensor incorporated in the feeder and accurately modulates the speed of the motor in such a way as to maintain the yarn tension (which depends on the difference between the yarn-feeding speed and the yarn-drawing speed of the downstream machine) substantially constant at a predetermined value.

[0007] Feeders of the above type have the drawback that they are very expensive, mainly in consideration of the fact that a single machine is often fed by several dozens of feeders; accordingly, using these feeders for basic processes, such as those carried out by striper machines, is not cost-effective. Furthermore, in order to provide for the selection of the yarn, the number of feeders should be multiplied by the number of different yarns to be fed, with further multiplication of the costs and complications during installation.

[0008] Therefore, it is a main object of the invention to provide a yarn feeder provided with a stationary drum for textile machines, which is not expensive to manufacture, which allows the speed of rotation of the yarn-winding drum to be easily adjusted based on a predetermined ratio with respect to the speed of the downstream machine, and which is also suitable for being selectively used in combination with other feeders of the same type, e.g., in order to feed striper machines.

[0009] It is another object of the invention to provide a yarn feeder which, without making use of expensive tension sensors, allows the tension of the unwinding yarn to be adjusted with an accuracy suitable for basic processes, such as those carried out by feeders driven by belt gears of the above mentioned type.

[0010] The above object and other advantages, which will better appear from the following description, are achieved by a yarn feeder having the features recited in claim 1, while the dependent claims state other advantageous, though secondary features of the invention.

[0011] The invention will be now described in more detail, with reference to a few preferred, non-exclusive embodiments, shown by way of non limiting example in the attached drawings, wherein:

- Fig. 1 is a perspective view showing a yarn feeder with rotary drum according to the invention;
- Fig. 2 is a view in front elevation of the yarn feeder of Fig. 1 in a first operative configuration;
- Fig. 3 is a view in cross-section of Fig. 2 along axis III-III;
- Fig. 4 is a view in front elevation of the yarn feeder of Fig. 1 in a second operative configuration;
- Fig. 5 is a view in cross-section of Fig. 4 along axis V-V;
- Fig. 6 is a diagram showing the relation between certain operative parameters of the feeder according to the invention;
- Fig. 7 shows an assembly of feeders according to the invention interconnected for a combined use on

a selective basis.

[0012] With reference to the above Figures, a yarn feeder 10 according to the invention comprises a shell 12 molded in a synthetic material, which consists of a front wall 14 closed at the rear by a cover 16.

[0013] A motor 18 (which is only diagrammatically shown with dotted lines in Fig. 3) is arranged within shell 12 with its axis lying at right angles to front wall 14, and is provided with a driving shaft 20 which projects outside front wall 14 of shell 12 and has a yarn-winding drum 22 keyed thereto.

[0014] An upper, flat peripheral surface 12a and a lower, flat peripheral surface 12b of shell 12, both of which extend at right angles to front wall 14, can respectively match with the lower surface and the upper surface of another identical feeder, in order to allow a plurality of feeders to be modularly connected in a stacked configuration by means of screws (not shown) engaging holes such as 23 formed in the surfaces.

[0015] Two seats 24, 26 are formed on front wall 14 at mirror-like positions with respect to the plane containing the axis of the drum and perpendicular to the upper surface and the lower surface; a lever 28 is received in one of these seats, 26, which is hinged about an axis parallel to the axis of drum 22. Lever 28 supports a yarn-guide eyelet 30 at its free end, which is adapted to be slidably passed through by yarn F unwinding from drum 22.

[0016] A stationary, inlet eye-guide eyelet 32 is received in the other seat, 24 and is provided with a mounting arm 34 anchored to the seat. An outlet, eye-guide eyelet 36 is supported on front wall 14 at a diametrically opposed position. A separating pin 38 slightly inclined to the axis of the drum projects from front wall 14 at an intermediate position between the two seats 24, 26. Yam F, which is typically unwound from an upstream reel (not shown), passes through inlet yarn-guide eyelet 32, is wound between drum 22 and separating pin 38 (in order to spread the yarn loops on the whole longitudinal extension of drum 26), then passes through eyelet 30 of lever 28 and outlet, yarn-guide eyelet 36, and finally is fed to the downstream machine (not shown).

[0017] Lever 28 is normally biased towards a stop position defined by the profile of the seat (as shown in Figs. 2 and 3), at which it applies a maximum deviation to the yarn, by means of a stationary magnet 40, 42 having a N-S polarization (one magnet per each seat), which is incorporated in front wall 14 near the respective seat 24, 26 and cooperates, in a relation of magnetic repulsion, with a movable magnet 44 having a N-S polarization, which is incorporated in lever 28; the lever is subject to swing in relation to the variations of the yarn tension, in contrast to the repulsive force between the magnets.

[0018] As shown in Figs. 3, 5, shell 12 incorporates a pair of magnetic sensors 46, 48, preferably Hall sensors, each of which monitors a respective seat 24, 26 in order to detect the movements of movable magnet 44 with respect to the stop position and to generate a corresponding enabling signal.

[0019] Shell 12 houses an electronic circuit 50 which receives signals from Hall sensors 46, 48 and controls motor 18 as a function of them. In particular, electronic circuit 50 is programmed to activate the motor in the yarn-unwinding direction in response to the enabling signal, which signal is indicative of the fact that the yarn, as drawn by the downstream machine, has been put under tension, thereby causing the lever to rotate.

[0020] Advantageously, electronic circuit 50 has a USB plug 52 connected thereto, which projects from upper surface 12a of shell 12, as well as a corresponding USB port 54 (shown diagrammatically with dotted lines in Fig. 3) opening to lower surface 12b.

[0021] According to a first mode of operation, electronic circuit 50 activates motor 18 at a constant speed which is set via USB, and the motor continues to unwind yarn until lever 28 comes back to its stop position shown in Figs. 2, 3. Accordingly, the lever operates as an automatic switch.

[0022] According to another mode of operation, electronic circuit 50 is not only programmed to activate motor 18 when a movement of the lever is detected, but is also programmed to modulate the speed of motor 18 via a conventional control loop, in order to maintain the lever substantially fixed at a predetermined position corresponding to a desired tension of the yarn.

[0023] The diagram of Fig. 6 represents the relation between the position of lever 28 in terms of voltage (in Volt) across Hall sensor 46, 48 and the yarn tension (in grams), and has been obtained experimentally by carrying out, preferably on each feeder, an initial tuning process. This tuning process consists of substequently applying a series of known tensions to the yarn, e.g., by connecting a series of different weights to the yarn coming out from eyelet 30 of the lever, and then measuring the position of the lever corresponding to each tension applied, in order to obtain a series of operative points which can be interpolated to generate an operative curve; the latter can be used by electronic circuit 50 for converting the operative tension set by the user (typically in grams) into a corresponding operative position of lever 28, which must be maintained constant.

[0024] Using magnets as return means for the lever is particularly advantageous because it allows the accuracy of the detection to be optimized as a function of the tension during operation. In fact, as shown in diagram of Fig. 6, since the repulsion force between the magnets does not have a linear pattern but is substantially inversely proportional to the square of the distance between them, in case of relatively low tensions, e.g., below 4 grams (which circumstance require a higher accuracy with a sensibility, e.g., of 1/10 grams), the stroke of the lever is relatively wide, with voltages across the Hall sensor in the range 2.45 V to 3.10 V, so that tension variations even of a minimum amount can be appreciated. On the contrary, in case of relatively high tensions, e.g., above 7 grams (which circustance only requires a coarse adjustment with a sensibility, e.g., of about 1 gram), the stroke of the lever is relatively narrow, with voltages across the Hall sensor in the range 2.1 V to 2.25 V.

[0025] As shown in Fig. 7, the feeder according to the invention can be connected to other identical feeders in a double-stacked configuration (i.e., two stacks of feeders having their rear covers facing each other), in order to be used in lieu of conventional multi-drum feeders associated to striper machines. In this case, since all the yarns must be fed in the same direction, all the levers of the feeders forming a stack are inserted in the right seats, while all the levers of the feeders forming the opposite stack are inserted in the left seats.

[0026] A few preferred embodiments of the inventions have been described herein, but of course many changes may be made by a person skilled in the art within the scope of the claims. For instance, though using magnets to bias the lever to its resting position is an advantageous solution for the above-mentioned reasons, of course the magnets could be replaced by other return means, e.g., springs, particularly when the lever is only used as a switch. Furthermore, using magnetic sensors coupled to a magnet integral with the lever should be only construed as a preferable, non-indispensable solution, because other types of sensor can be used, such as optical sensors, mechanical sensors, and the like. Of course, the USB connectors can be replaced by other conventional types of male/female connectors for transferring data. In addition, the materials can be changed, e.g., the shell could be made of a different material, such as aluminum.

Claims

1. A yarn feeder (10) comprising a shell (12) having a motor (18) housed therein, which is provided with a driving shaft (20) having a yarn-winding drum (22) mounted thereto, **characterized in that** it comprises:

- a lever (28) hinged to said shell (12) and slidably engaged by the yarn (F),
- return means (42, 44) arranged to bias said lever (28) toward a stop position in which it deviates the yarn coming from the drum (22) with respect to its feeding direction toward a downstream machine, said lever (28) being subject to swing in contrast to said return means (42, 44) in relation to the variations of tension of the yarn (F),
- sensor means (46, 48) arranged to detect the movements of said lever (28) with respect to said stop position and to generate a corresponding activation signal,
- an electronic circuit (50) which is operatively connected to said sensor means (46, 48) and is programmed to activate said motor (18) to unwind yarn in response to said activation signal.

2. The feeder of claim 1, **characterized in that** said return means consist of a stationary magnet (40) integral with said shell (12) and a movable magnet (44) integral with said lever (28) which cooperate with each other in relation of mutual magnetic repulsion.

3. The feeder of claim 1 or 2, **characterized in that** said shell (12) has two seats (24, 26) formed at substantially mirror-like positions with respect to a plane containing the axis of the drum (22), in which said lever (28) is selectively installable.

4. The feeder of claim 3, **characterized in that** it comprises a stationary, inlet yarn-guiding eyelet (32) which is installable in one of said two seats (24, 28) not engaged by said lever (28).

5. The feeder of claim 3 or 4, **characterized in that** each of said two seats (24, 26) is provided with respective sensor means (46, 48).

6. The feeder of any of claims 1 to 5, **characterized in that** said sensor means comprise at least one magnetic sensor (46, 48) arranged to detect the magnetic field generated by a movable magnet (44) integral with said lever (28).

7. The feeder of claim 1, **characterized in that** said return means consist of a stationary magnet (40) integral with said shell (12) and a movable magnet (44) integral with said lever (28) which cooperate in relation of mutual magnetic repulsion, and **in that** said sensor means comprise at least one magnetic sensor (46, 48) arranged to detect the magnetic field generated by said movable sensor (44).

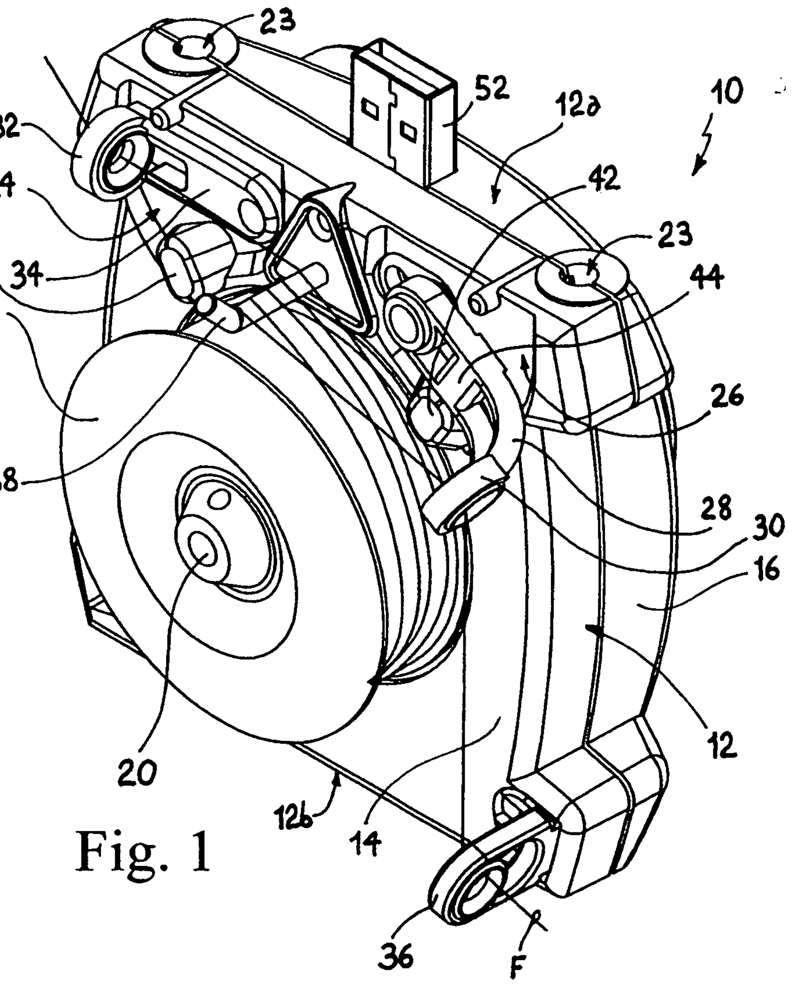
8. The feeder of any of claims 1 to 7, **characterized in that** said shell (12) has a first peripheral surface (12a) and an opposite, second peripheral surface (12b), which are shaped for coupling with the second peripheral surface and the first peripheral surface respectively of another identical feeder, for the connection of a plurality of feeders in a stacked configuration.

9. The feeder of claim 8, **characteized in that** it comprises a male electrical connector (52) projecting from one of said first peripheral surface (12a) or second peripheral surface (12b), and a corresponding female electrical connector (54) opening to the other one of said first peripheral surface (12a) or second peripheral surface (12b), which are mutually engageable in case of connection of a plurality of feeders in a stacked configuration for transferring data through said feeders.

10. The feeder of any of claims 1 to 9, **characterized in that** said electrical circuit (50) is also programmed for modulating the speed of said motor (50) in such a way as to substantially maintain said lever (28) at a predetermined position.

11. A tuning process for a yarn feeder according to claim 10, **characterized in that** it comprises the steps of:

- applying a series of successive known tensions to the yarn;
- per each of said tensions applied, measuring the position of the lever thereby obtaining a series of known operative points;
- interpolating said operative points to generate an operative curve usable by said electronic circuit (50) for converting a desired operative tension set by a user into a corresponding operative position of the lever (28) to be maintained constant.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52
12a
10
32
24
42
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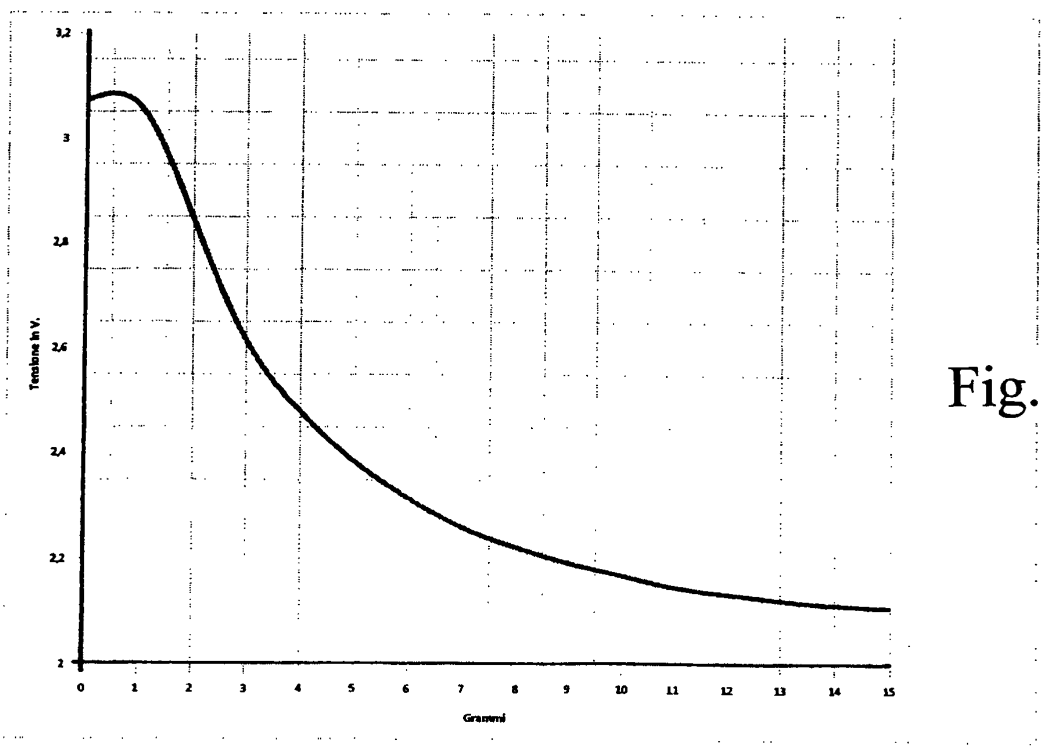
12b
14
36
F

Fig. 1


3,2
3
2,8
2,6
2,4
2,2
2
Tensione in V.
0
1
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3
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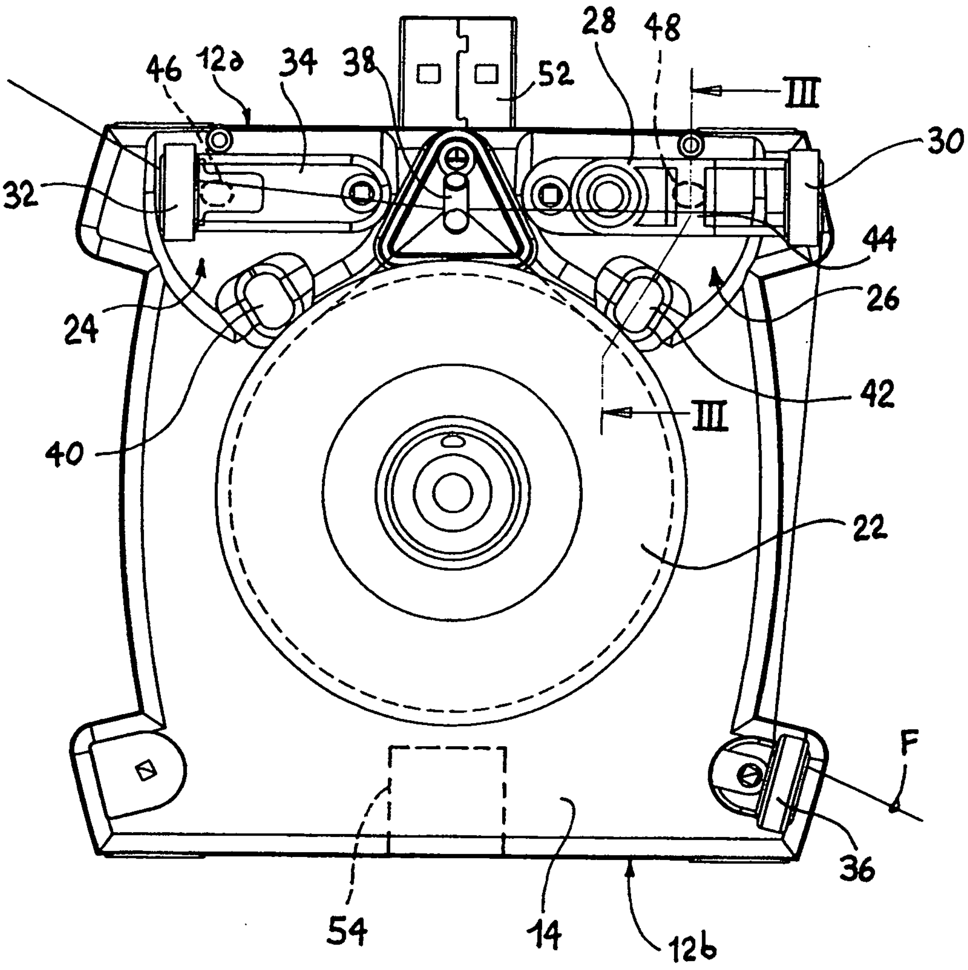
14
15
Grammi

Fig. 6


46
12a
34
38
52
28
48
III
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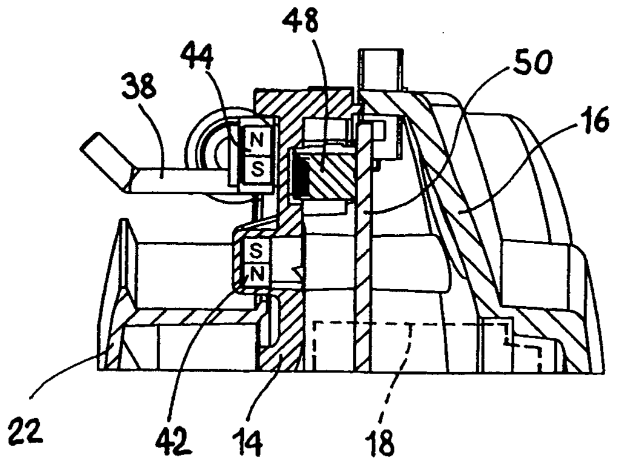
32
44
24
26
42
40
III
22
F
36
54
14
12b

Fig. 2


48
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50
38
16
N
S
S
N
22
42
14
18

Fig. 3

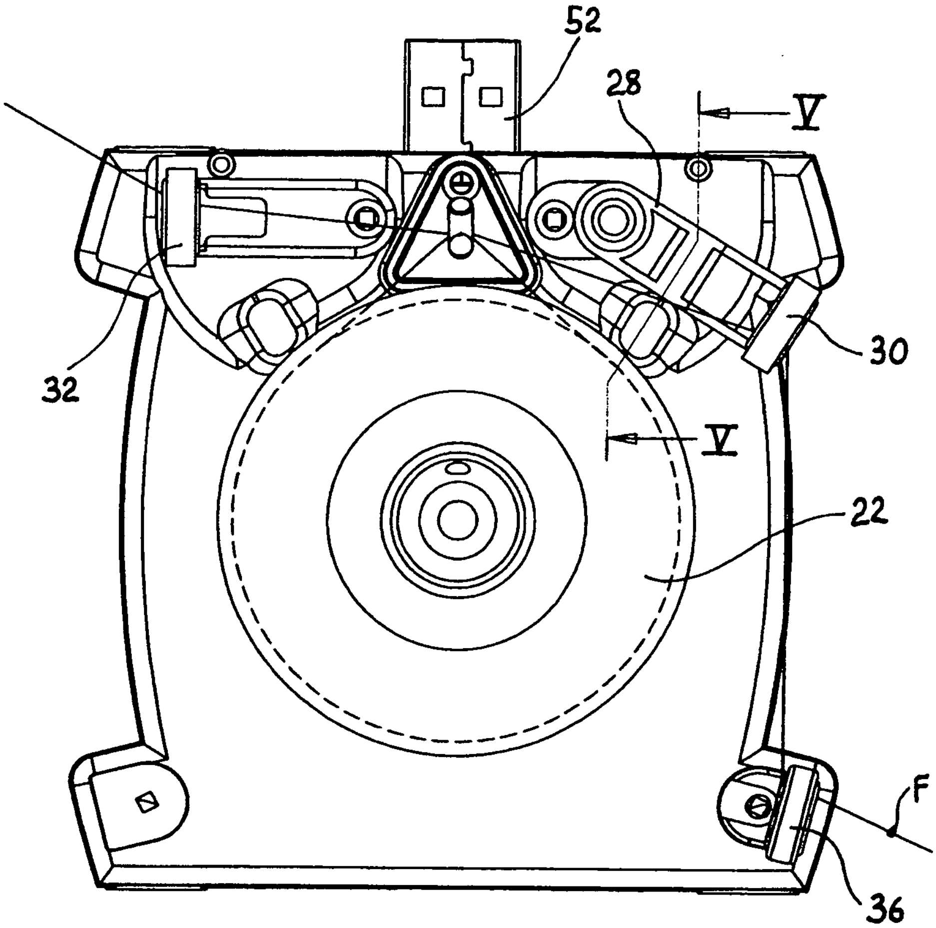

Fig. 4

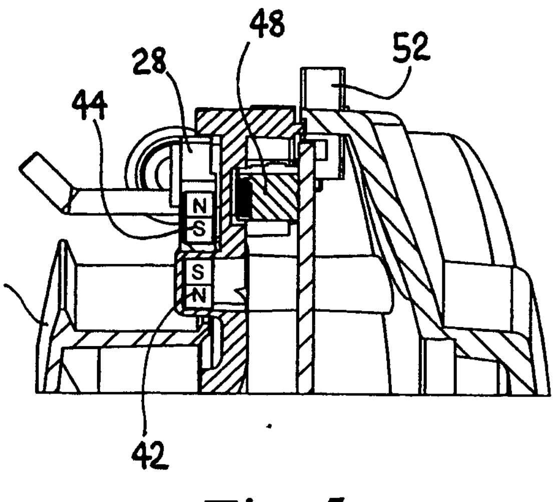

Fig. 5

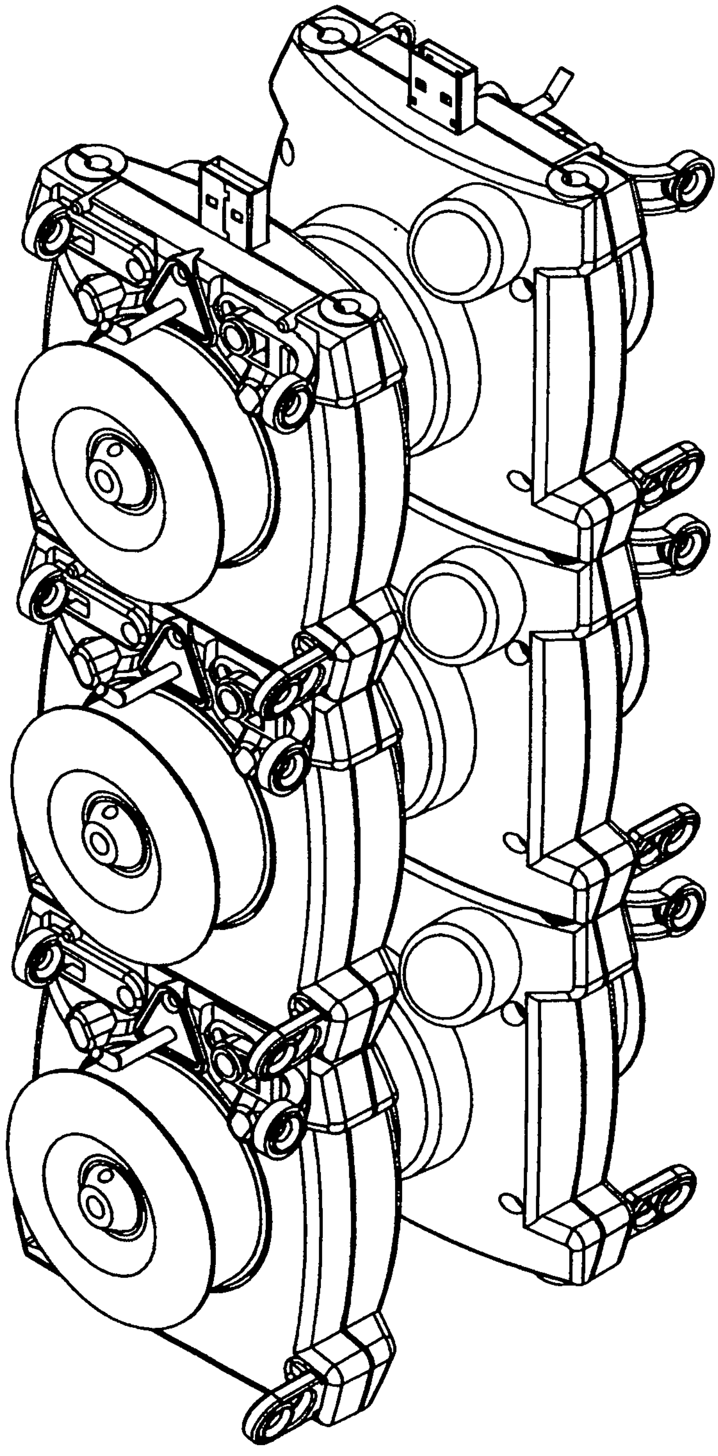

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 13 00 0427

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	13 August 2013	Zirkler, Stefanie

CATEGORY OF CITED DOCUMENTS

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