



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.01.2010 Bulletin 2010/04

(51) Int Cl.:
B66D 1/22 (2006.01) B66D 1/74 (2006.01)

(21) Application number: **09165953.2**

(22) Date of filing: **21.07.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

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(30) Priority: **21.07.2008 IT RA20080031**

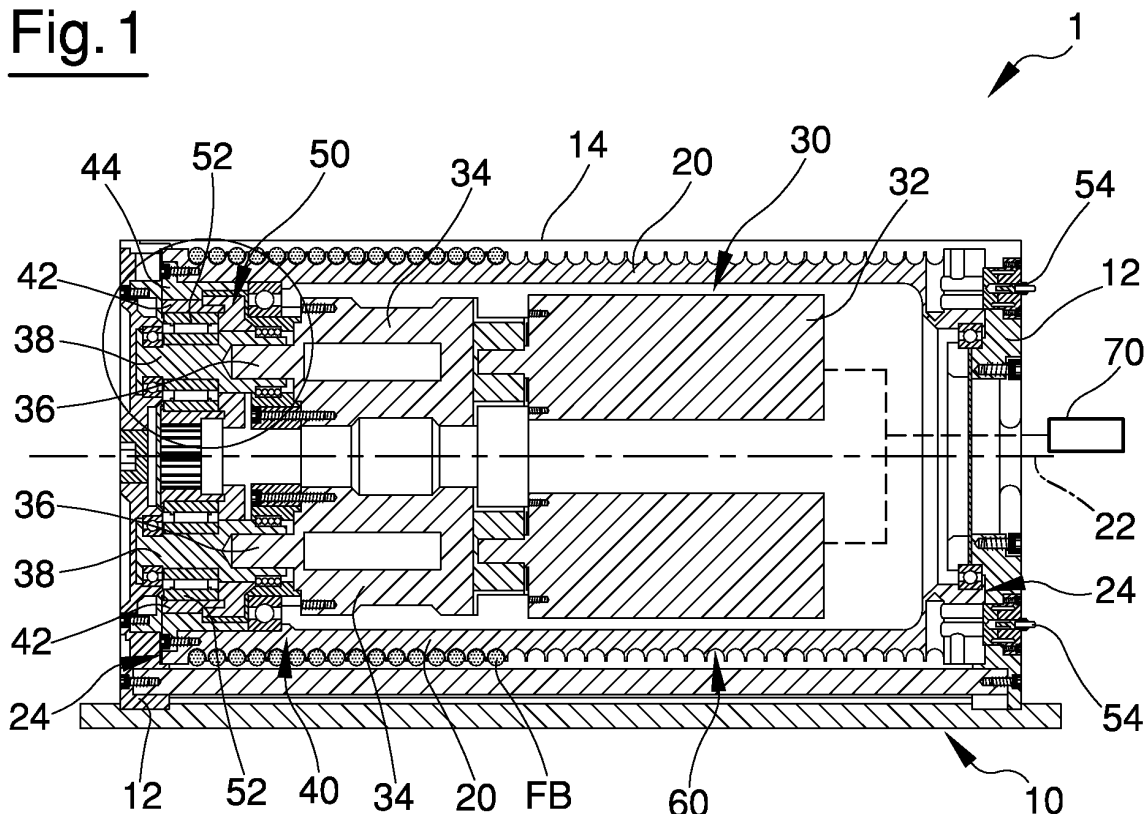
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(54) **Furling group**

(57) A furling group (1) for furling flexible bodies (FB) wherein a frame (10) supports a mandrel (20) in an angularly rotatable manner about a fixed axis (22); an actuating unit (30) being mechanically connected to the mandrel (20) in order to rotate it axially so as to furl a flexible body (FB); a transmission unit (40) being arranged between the actuating unit and the mandrel (20),

in order to transmit a torque to the mandrel (20) according to a given transmission ratio (τ) sufficient to control a furling action for furling the flexible body (FB); the transmission unit (40) comprising mechanical control means (50) suitable to cooperate with the actuating unit (30) in order to condition an unfurling of the flexible body (FB) from the mandrel (20).

Fig. 1



Description

[0001] The present invention relates to a furling group for furling flexible bodies. In particular, the present invention relates to a furling group provided with a mechanically actuated mandrel for furling flexible bodies. In more detail, the present invention relates to a furling group provided with a mechanically actuated mandrel for furling flexible bodies provided with a control device for controlling the related unfurling.

BACKGROUND TO THE INVENTION

[0002] In the sailing sector it is well known that the need to simplify the management of boats of increasingly greater sizes and the need to minimise the crew necessary to sail the boats requires the engineers to mechanise as much operations as possible. At this end, on the sailboats electric groups for furling the foresails and electric groups for furling the mainsail inside the corresponding mast or inside the corresponding boom are increasingly used, as well as electric winches for furling warps, usually called halyards or sheets depending upon the type of use. Hereinafter explicit reference will be made to winches for winching and tensioning textile lines, but it will be clearly apparent that what is described with reference to that products also applies to furling group for furling panels, covering awnings and sails.

[0003] The use of winches with horizontal axis which can be actuated through hydraulic or electric actuating groups generally called "reel winches" or "captive winches" produces the great advantage of having the deck always free of lines which could get entangled or could hinder those who must or want to cross the deck to reach a given location. These devices therefore allow to store the line by organising it in well-ordered turns, thus greatly increasing the degree of safety of sailboats, with the result that the neophyte user tends to perceive them as increasingly safer, and weighs up increasingly more frequently the purchase or the charter thereof, with the result of increasing profitability of this market sector.

[0004] These winches regularly operate when the line is wound about the mandrel and is unwound from it in a well-ordered manner, about turns parallel to each other, so as to prevent the line from being an obstacle/block for the rotation of the mandrel. However, if the load acting onto the line would be cancelled, the lack of tangential tension/torque acting on the mandrel could cause a loosening of the line, which could be distributed in an unordered manner about the mandrel; the turns could tend to overlap each relative to the other and the winch could jam.

[0005] Among the producers of hydraulic winches with horizontal axis two American firms, Harken and Lewmar, and one Dutch firm, Rondal, are known for the deck equipment.

[0006] The above described problem has been solved in different manners by the various producers. For ex-

ample, Lewmar uses a so called feeder in lowered position, comprising a longitudinally movable eyelet to feed the line to the mandrel at a given step for each revolution of the mandrel, so as to produce well-ordered turns.

[0007] The presence of the feeder, projecting from the mandrel, tends to move the exceeding line away from the mandrel, thus preventing accumulation of the line in positions such as to cause the jam of the rotation of the mandrel.

[0008] In other cases, the movable feeder comprises a pulley with axis transverse to that of the mandrel, and therefore arranged transversally to the tension acting onto the winch. It is well understood that a feeder such as the one described above does not allow completely to solve the problem described above. In this regard, the Applicant has introduced the use of an optical sensor installed in end position on a plate which longitudinally delimits the mandrel. This sensor is connected to a control station for controlling the actuator in order to actuate it to reset a load condition on the line through the actuation of the rotation of the mandrel by the degrees necessary for furling the loose rope and therefore for preventing jams. It should be noted that the choice of using such a device presents some drawbacks, first of all the fact that the sensor is electric, and therefore subjected to break downs due to lack of power, a situation which offshore has more probabilities of occurrence and can be solved with more difficulties than in onshore environments; furthermore, the fact that the sensor is of the optical type, and therefore sensitive to the dirt and to the deposits of saltiness, requires a frequent and careful maintenance.

[0009] In view of the situation described above, it would be desirable to have available a curling group which, in addition to allow to limit and possibly to overcome the drawback illustrated above of the known art in a simple and economic manner, could define a new standard for this type of equipment.

SUMMARY OF THE PRESENT INVENTION

[0010] The present invention relates to a furling group for furling flexible bodies. In particular, the present invention relates to a furling group provided with a mechanically actuated mandrel for furling flexible bodies. In more detail, the present invention relates to a furling group provided with a mechanically actuated mandrel for furling flexible bodies provided with a control device for controlling the related unfurling.

[0011] The object of the present invention is to provide a furling group which allows the drawback illustrated above to be solved, and which is suitable to satisfy a plurality of requirements in the current state of the art still without answer, and therefore suitable to represent a new and original source of economic interest, suitable to modify the current market of the furling groups for furling flexible bodies.

[0012] According to the present invention a furling group is provided, whose main characteristics will be de-

scribed in at least one of the attached claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Further characteristics and advantages of the furling group according to the present invention will be more apparent from the description below, set forth with reference to the accompanying drawings which illustrate at least one non limiting example of embodiment, in which identical or corresponding parts of the device are identified by the same reference numbers. In particular:

- figure 1 is a view in longitudinal section of a preferred embodiment of a furling group according to the present invention;
- figure 2 is a view in enlarged scale of a detail extracted from figure 1; and
- figure 3 is an exploded schematic perspective view of figure 1.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0014] In figure 1, number 1 indicates, in its entirety, a furling group for furling a flexible body FB, which can comprise, for example but without limiting the scope of the present invention, a covering curtain or awning, a sail, a textile warp or a cable in metallic material.

[0015] It should be specified that in the attached drawings the particular embodiment of the furling group according to the present invention is illustrated by showing the mechanical members which are necessary for the operation of the group together with the auxiliary mechanical components, necessary to couple the mechanical members according to the operation prescriptions. However, for the sake of simplicity, in the description below these auxiliary components, such as for example bearings for centering rotary members, elastic rings for fixing longitudinally these bearings, sealing members, threaded connecting members - the need and knowledge of which is known to those skilled in the art and therefore requires no explanations, which could only make the description heavy reading - will not be described.

[0016] With reference to figure 1 again, the group 1 comprises a frame 10 supporting a mandrel 20 in an angularly rotatable manner about a fixed axis 22 by means of a pair of adequately shaped plates 12 of the frame 10, through the interposition of known rolling bearings, illustrated but not described for the sake of convenience. This mandrel 20 represents the member provided for furling the flexible body FB, is axially delimited by a pair of faces 24, substantially transverse to the axis 22, and presents, at this end, an helical groove 60 dimensioned so as to house in a substantially exact manner flexible cable FB. It should be noted that this groove 60 represents an engaging device 60 associated with the mandrel 20 for guiding each flexible body FB while furling about the mandrel 20. Therefore, for the sake of simplicity, hereinafter the

term "flexible body FB" will mean a line, which has been illustrated in the attached drawings exclusively in cross section wound about the mandrel 20 inside a portion of the groove 60.

[0017] Furthermore, the group 1 comprises an actuating unit 30 mechanically connected to the mandrel 20 so as to rotate it in such a manner as to wind a flexible body FB. A transmission unit 40 is arranged between the actuating unit and the mandrel 20 so as to transmit to the mandrel 20 a torque according to a given transmission ratio τ sufficient to bring the mandrel 20 in rotation so as to control a furling of the flexible body FB. The transmission unit 40 comprises a control device 50 of the mechanical type, suitable to cooperate with the actuating unit 30 in order to condition an unwinding of the flexible body FB from the mandrel 20 only after having applied a tangential traction on the flexible body, in particular a tension applied to the flexible body FB. It is not necessary to specify that the transmission ratio τ can also be unitary or it can move away from this value significantly in the case of transmissions of the planetary type without however varying or limiting the scope of the present invention.

[0018] The actuating unit 30 comprises at least a rotary actuator 32 which can rotate a drive shaft 36 clockwise and counter-clockwise. In particular, in the solution illustrated in the attached drawings, a plurality of actuators 32 is provided, arranged in a uniform manner about the axis 22 so as to give engine power to the mandrel 20 in a balanced manner, and each actuator 32 comprises a geared motor of the reversible type, provided with a related coaxial gearing group 34 which ends with a drive shaft 36.

[0019] On the other hand, it should be noted that the teachings given in this description can be validly applied also in the case in which low power is required to the furling device 1, and therefore only an actuator 32 can be used. In any case, again with reference to the attached drawings, for each actuator 32 the transmission unit 40 comprises a first transmission member 42, arranged between the mandrel 20 and a sleeve 38 acting as elongation for the drive shaft 36 of the actuator 32 so as to exchange torque between the actuator 32 and the mandrel 20. A control device 50 is provided in combination with each actuator 32, and comprises a second transmission member 52 arranged between the first transmission member 42 and the related drive shaft 36 so as to avoid free rotations of the mandrel 20 in a direction opposite to the furling direction set by the actuating unit 30 and such as to reduce the tension acting on the flexible body FB tangentially to the mandrel 20, and therefore to cause probable malfunctions difficult to be foreseen, due to, just by the way of non limiting example, accumulation of portions of the flexible body FB between the mandrel 20 and parts rigidly connected to the frame 10, for example below a protection lid 14 which closes at the top the group 1. Each second transmission member 52 comprises a free gear 52 which, as it is known, is a mechanical transmission member provided with a pair of concentric

rings, wherein one ring is a drive ring and the other is a driven one. In the most known case, which is applied in the bicycles, the drive ring is the outer one and the driven ring is the inner one. Usually, the inner ring presents an outer shell provided of caves arranged in a uniform stepped manner and present the respective concavity arranged in the opposite direction relative to the direction of orientation of the torque which can be transmitted from the outer ring to the inner ring. Each cave houses a roller against the thrust of a deformable elastic body in relative free rotation phase of the two rings, and substantially not deformed in phase of transmission of the torque from the outer ring to the inner ring. It is easy to understand that, without a torque to be transmitted from the outer ring to the inner ring, each elastic body will tend to shorten and to allow the corresponding roller to insert in the respective cave, where it can roll freely excluding the transmission of torque between the two rings, till the speed of rotation of the outer ring tends to be equal to the speed of rotation of the inner ring. Hereinafter, as the speed of rotation of the outer ring increases, the roller is ejected from the cave due to the action of the elastic body and therefore the condition will be recovered, which allows the transmission of the torque between the rings. Clearly, in the case in which the inner ring is rotated in the opposite direction, there will be the possibility to transmit torque also at speed of rotation of the outer ring absolutely lower relative to a fixed reference.

[0020] Therefore, each free gear 52 mechanically connects in a direct-drive manner the drive shaft 36 to the first transmission member 42 and, in use, it is suitable to block selectively an inverse rotation of the first transmission member 42 relative to the drive shaft 36 or, in the case in which the corresponding actuator 32 is actuated in a direction opposite to the direction which determines the furling of the mandrel 20, to rotate in opposite direction so as to maintain the flexible body FB tensioned on the mandrel 20 and therefore to prevent an overlapping of turns and/or the occurrence of interferences between the mandrel 20 and the flexible body FB and consequent jams.

[0021] With reference to figure 1 again, it is easy to note that the actuating unit 30 and the transmission unit 40 are longitudinally and radially contained inside the mandrel 20. This presents the great advantage of minimising the overall bulk of the group 1 along the axis 22, and therefore the group 1 can be installed in an easier manner in limited spaces.

[0022] Furthermore, the transmission unit 40 is of the planetary type and comprises a solar gear 44 which is coaxial to and rigidly connected with the mandrel 20; the transmission unit 40 furthermore comprises a plurality of planet gears contained inside the solar gear 44 and engaging with this latter so as to allow the transmission of the torque from each actuator 32 to the mandrel 20. In particular, each planet gear matches a first transmission member 42 and each free gear 52 carries, keyed/shrunk on its own outer ring, the corresponding planet gear which

is indicated, for the sake of simplicity, with the same reference number 42. It should be furthermore specified that the actuating unit 30 comprises an actuator 32 for each planet gear 42, four in the attached drawings, and each actuator 32 carries a planet gear 42 shrunk on its drive shaft 36.

[0023] In order to recover the allowances between the mechanical components which can inevitably occur due to the use of the group 1, and therefore to avoid micro rotations of the mandrel 20 for unwinding the flexible body FB from the mandrel 20, the control device 50 comprises at least a thrust member 54 carried by the frame 10 in combination with the mandrel 20 so as to hinder a motion of axial rotation thereof. This thrust member 54 comprises an axial brake element 54 facing one of the two faces 24 of the mandrel 20 parallel to the axis 22 and screw-adjustable against the thrust of a spring so as to produce a friction stall torque suitable to dissipate energy of rotation of the mandrel 20.

[0024] The group comprise a control unit 70 electronically connected with the actuating unit 30 so as to actuate simultaneously each rotary actuator 32 and therefore to control each actuator 32 in clockwise or counter-clockwise rotation at a speed adjustable at will.

[0025] In view of the above description it is clearly apparent that the presence of this control unit 70 allows a controlled unwinding of the flexible body FB from the mandrel 20, and therefore it allows the operator to slacken flexible body FB according to the current assessment of the real requirements. The condition which determines this possibility is the start of a contrary rotation of each actuator 32 which does not cause the inverse rotation of the mandrel 20 and the unfurling of the flexible body FB, but allows inverse rotations of the mandrel 20 at a speed limited by the actual value of the inverse composite speed of the actuators 32 through the transmission ratio τ .

[0026] The presence of free gears 52 on the axis of the engines allows to produce a situation of function wherein the lack of tension on the mandrel 20 and therefore on the flexible body FB prevents the flexible body/the warp FB from unfurling from the mandrel 20.

[0027] The use of the group 1 is easy to understand from the description below and does not require further explanations. It might be useful to specify that the keying/shrinking of the planet gears 42 on the free gears 52 allows the transmission unit 40 to be interpreted as a limiting device of the mechanical type for limiting the maximum speed with which it is possible to unfurl the mandrel 20, following the inverse actuation of the power unit 30. In view of the above description, by trying, in use, to unfurl the flexible body/the warp FB at a speed greater than the speed of contrary rotation set for the actuators 32, the mandrel 20 tends to rest onto the free gears 52; this causes a limitation of the speed of unfurling of the mandrel 20, thus hindering the idle unfurling of the flexible body/the warp FB. It is clearly possible to set the operation of the control unit 70 in such a manner that the speed of the actuators 32 can be adjusted as the tension acting

on the flexible body FB varies. This will be obviously possible by using inverse torque sensors in combination with the mandrel 20.

[0028] Furthermore, it may be not necessary to specify that the use of the control device 50 of the substantially mechanical type in combination with the transmission unit 40 allows to transmit a torque to the mandrel 20 according to a given transmission ratio τ , of any value, in a preferred direction of furling or, selectively, to rotate it in a backward motion and therefore to allow the unfurling of the flexible body FB wound about it without the need for turning on or switching. Clearly this is due to the use of the free gears 52, which allow to minimise the number of starts up of the actuators 32 necessary to allow the unfurling of the mandrel 20, and therefore the number of the respective voltage peaks, events that, as it is well known, can occur unexpectedly in start up transients, and which can put the respective electric or electro hydraulic circuits out of use. It is easy to understand that this is particularly useful when one operates on powerful actuators such as those sometimes used in the "reel winch" far away from assistance stations, in equipment for ship use.

[0029] Lastly, it is clear that modifications and variants can be applied to the group described herein without however departing from the protective scope of the present invention.

[0030] In view of the above description, it is clearly understood that the furling group 1 produced according to the teachings described above allows to solve the drawbacks described above, irrespective of the number of actuators 32 used to actuate the mandrel 20, and is suitable to satisfy a plurality of requirements in the current state of the art still without answer. Therefore, the furling group 1 represents a new and original source of economic interest, suitable to modify, at low cost and with a solution conceptually easy, as based upon the use of mechanical and therefore particularly reliable members with null power consumption. The solution described above is therefore suitable to modify potentially in a substantial manner the current market of the furlers for furling flexible bodies, such as covering awnings, sails or warps for nautical use.

Claims

1. A furling group (1) for furling flexible bodies (FB), wherein a frame (10) supports a drum (20) in an angularly rotatable manner around a fixed axis (22); an actuating unit (30) being mechanically connected to said drum (20) in order to rotate it axially so as to furl a said flexible body (FB); a transmission unit (40) being arranged between said actuating unit and said drum (20), in order to transmit a torque to said drum (20) according to a given transmission ratio (1) sufficient to control a furling action for furling said flexible body (FB); **characterised in that** said transmission unit (40) comprises a mechanical limiting device (40)

for limiting the speed of unfurling of said drum (20).

2. A group according to claim 1, **characterised by** comprising mechanical control means (50) suitable to cooperate with said actuating unit (30) in order to condition an unfurling of said flexible body (FB) from said drum (20) only after having applied a tangential traction on the flexible body (FB).
3. A furling group according to claim 2, **characterised in that** said actuating unit (30) comprises at least a rotary actuator (32) of the reversible type, provided with its own drive shaft (32); said transmission unit (40) comprising a first transmission member (42) arranged between said drum (20) and a respective said drive shaft (36) in order to exchange torque between a respective said actuator (32) and said drum (20); said control means (50) comprising a second transmission member (52) arranged between said first transmission member (42) and said drive shaft (36); said second transmission member (52) being designed so as to allow inverse free rotations of said drum (20) at a limited rotation speed which can be calculated as the product of a maximum value of an inverse rotation speed of each said drive shaft (36) and of said transmission ratio (1).
4. A group according to claim 3, **characterised in that** each said second transmission member (52) comprises a free wheel (52) direct - drive mechanically connected with said drive shaft (36) of said rotary actuator (32) in order to transmit a torque produced by said rotary actuator (32) in a given direction of rotation to said first transmission member (42) and selectively to block an inverse rotation of said first transmission member (42) with respect to said drive shaft (36) and to allow said drum (20) to rotate in an opposite direction if the actuator is actuated in a direction opposite to the direction which causes the furling of the drum avoiding interferences between said drum (20) and said flexible body (FB).
5. A group according to any one of claims 2-4, **characterised in that** said actuating unit (30) and said transmission unit (40) are longitudinally and radially contained inside said drum (20), in order to minimise the total bulk along said axis (22).
6. A group according to claim 5, **characterised in that** said transmission unit (40) comprises a solar wheel (44) coaxial and rigidly connected to said integral drum (20) and a plurality of satellite wheels (42) contained inside said solar wheel (44) and engaging with this latter.
7. A group according to claim 6, **characterised in that** said actuating unit (30) comprises a said actuator (32) for each said satellite wheel (42); each said ac-

tuator (32) carrying a said satellite wheel (42) keyed on its drive shaft (36).

8. A group according to any one of claims 4-7, **characterised in that** said control means (50) comprise at least a thrust member (54) carried by said frame (10) in combination with said drum in order to contrast a movement of axial rotation thereof. 5

9. A group according to claim 8, **characterised in that** said drum (20) is axially delimited by a pair of faces (24) substantially transverse to said axis (22); said thrust member (54) comprising a rudder rope (54) axially adjustable through a screw against one of said two faces (24) of said drum (20) parallel to said axis (22), in order to produce a resistant torque by friction suitable to dissipate energy of rotation of said drum (20). 10
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10. A group according to any one of claims 3-9, **characterized in that** each said free rotation of said drum (20) can be obtained by subjecting said flexible body (FB) to traction tangentially to said drum (20). 20

11. A group according to any one of the previous claims, **characterized in that** said drum (20) presents fastening means (60) associated with said drum (20) in order to guide each said flexible body (FB) while furling on said drum (20). 25
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12. A group according to claim 11, **characterised in that** said fastening means (60) comprise an helical groove (60) dimensioned so as to house in a substantially exact manner flexible cable (FB). 35

13. A group according to any one of claims 3-12, **characterised by** comprising an electronic control unit (70) connected to said actuating unit (30) in order to actuate simultaneously each said rotary actuator (32); said actuators (32) being arranged in as uniform manner around said axis (22) in order to give driving power to said drum (20) in a balanced manner. 40

14. A group according to claim 13, **characterised in that** said control unit is suitable to control each said actuator (32) in clockwise and anticlockwise rotation according to speeds adjustable at will. 45

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Fig. 1

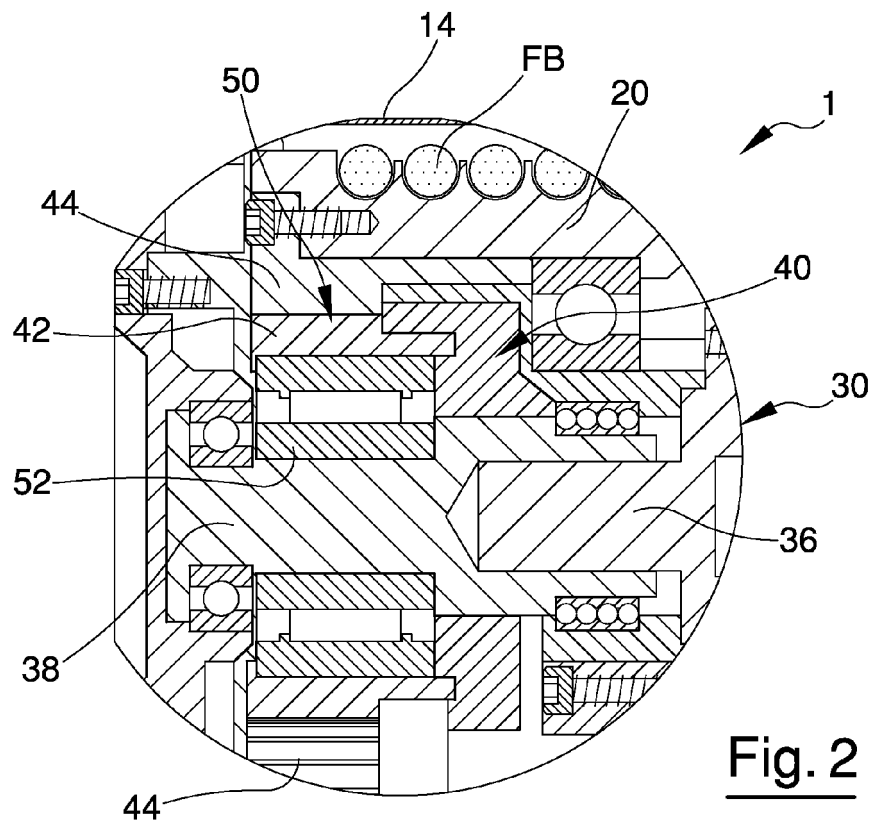
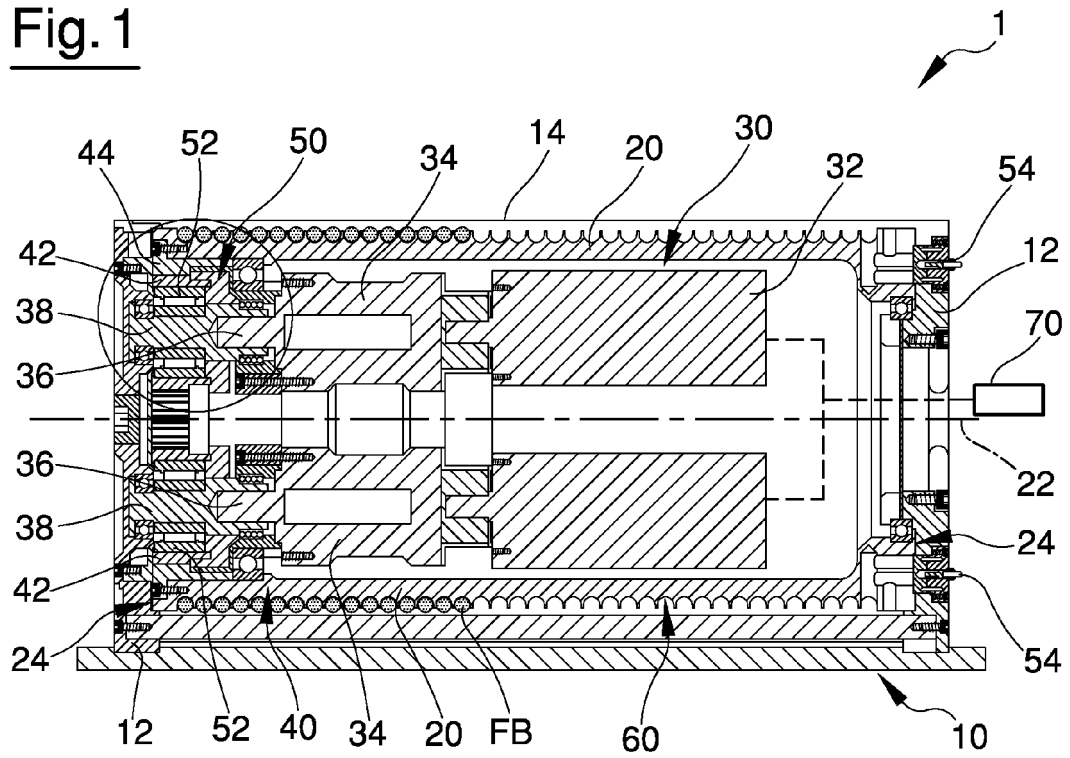


Fig. 2

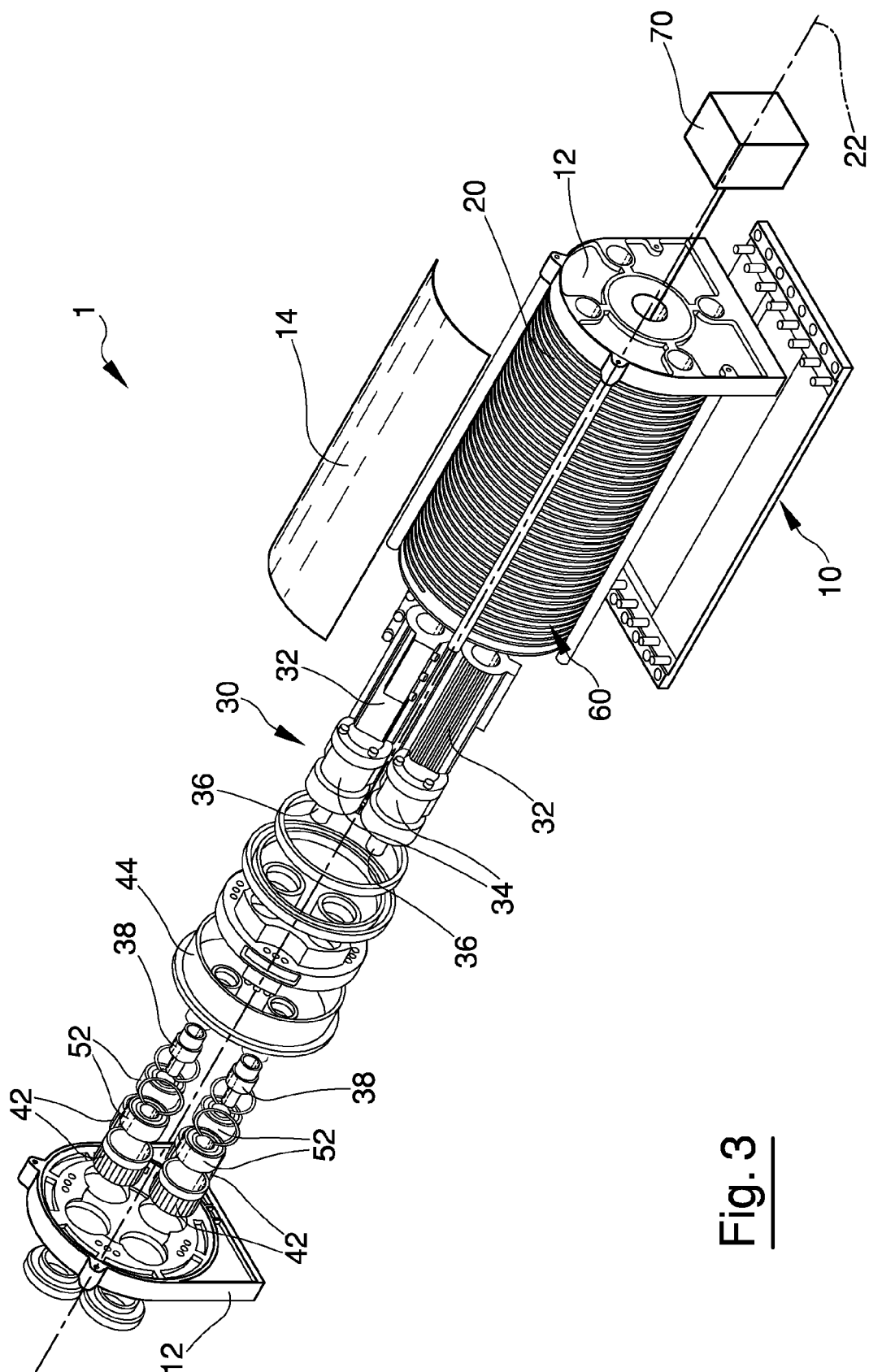


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 09 16 5953

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search		Date of completion of the search	Examiner
The Hague		22 September 2009	Faymann, L
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 09 16 5953

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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