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(71) Applicant: **Promatech S.p.A.**
24020 Colzate (Bergamo) (IT)

(72) Inventors:
- **Franchina, Gian Luigi**
  24023 Clusone (Bergamo) (IT)
- **Belingheri, Maurizio**
  24020 Villa di Serio (Bergamo) (IT)

(74) Representative:
Faggioni, Carlo Maria, Dr. Ing. et al
Fumero
Studio Consulenza Brevetti Snc
Pettenkoferstrasse 20-22
80336 Munich (DE)

(54) Slow-gear and pick-finding clutch having an improved magnetic flux and manufacturing method therefor

(57) A slow-gear selection and pick-finding clutch device in a weaving loom and method therefor is disclosed, of the type comprising a stator (1) integral with the loom and a flange (2) fixed to a driven shaft, equipped with opposing, flat bevelled toothing, between which a disc (3) is located integral with the loom main shaft, provided with corresponding flat bevelled toothing, translatable from a coupling position to said stator (1) to a coupling position to said flange (2), said disc being displaceable under the action of a magnetic force developed by a solenoid (E) integral with said stator (1), at the toothing (1a) of said stator (1) a flat circumferential surface (1a') being provided, so as to define, together with a flattened area (3a') in the corresponding toothing (3a) of said disc (3), at least a pair of flat coupling surfaces (1a', 3a'') intended to come into contact when the solenoid (E) is energised.

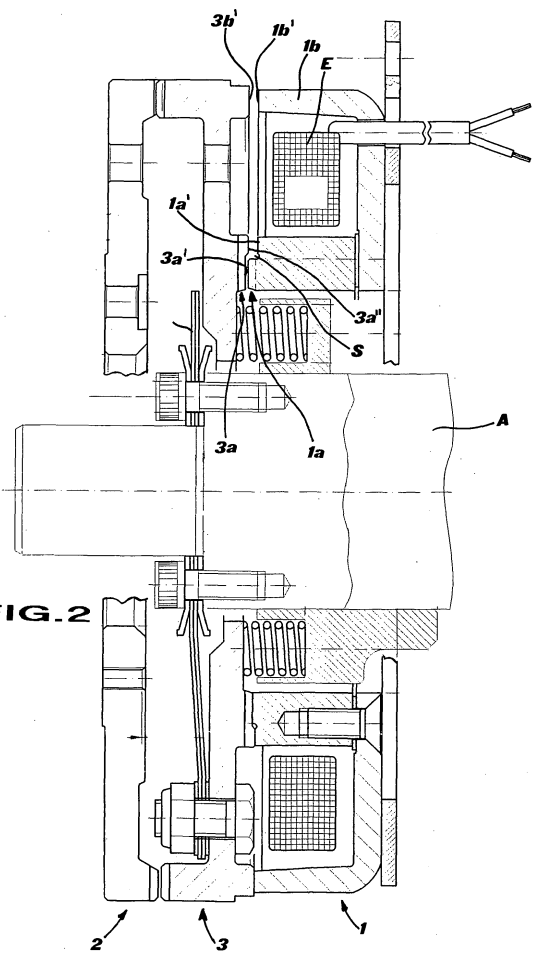

FIG.2

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Description

[0001] The present invention relates to a slow-gear-selecting and pick-finding clutch mechanism in a weaving loom. In particular, it relates to a solenoid-controlled clutch mechanism and a manufacturing method therefor.

[0002] It is known that the main shaft of a weaving loom controls the weaving members (sley, grippers, etc.) on the one hand, and also a weaving machine serving the weaving loom itself on the other.

[0003] In some specific cases it is necessary to be able to select a slow-running condition for a weaving loom, as well as to release the motion of the main members of the weaving machine from the main shaft of the loom. For example, in the case of breakage or fault-insertion of a weft yarn, it is necessary to stop the loom, then perform some loom cycles running slow - if necessary reversing the loom operation - in order to identify the failure or the fault and to fix it, and finally to start again at a steady speed without leaving defects in the fabric.

[0004] To operate the loom running slow, the loom is sometimes equipped with an auxiliary motor which acts - through a suitable high-reduction-ratio kinematic chain - onto the shaft of the weaving machine and/or onto the loom main shaft. However, it is required that the auxiliary motor be engaged with the weaving machine only when the loom is running at low speed; in all other conditions of the loom the auxiliary motor should be disengaged. To this purpose a device for selecting a slow-running gear is provided which couples the auxiliary motor to the weaving machine and/or to the main shaft only when it is explicitly required.

[0005] At the same time, for the same operations of halting, maintenance and restart of the weaving loom, it must be possible to set the motion of the weaving machine and that of the main shaft independently from each other.

[0006] Therefore, also the main shaft and the weaving machine shaft are linked by a coupling clutch. Such clutch must not only establish or shut the coupling, but it must also guarantee that it is univocally determined, i.e. so that the angular phase between the two shafts always corresponds to that set out in the design. This is accomplished, according to the prior art, in various ways: here, for brevity's sake, we shall generically state that means to determine the phase are provided which allow to achieve the desired aim.

[0007] The step in which, upon slow running of the loom, the relative phase between the main shaft and the weaving machine is correctly found out and established is called "pick-finding step", which shall be referred to in the following.

[0008] In modern looms the functions described above are performed by a complex clutch which is capable of establishing/releasing a coupling, on the one hand between the main shaft and the weaving machine shaft, and on the other hand between the auxiliary motor and the weaving machine.

[0009] Such a clutch device is for example the one described in the Italian application MI2000A/1157 and EP 1.245.707, in the name of the same Applicant, which will be incorporated here as reference.

[0010] In the case illustrated therein, the mechanism comprises, amongst other things, two separate gears, with flat bevelled toothing, enclosing sandwich-wise a toothed and axially mobile disc meshing with the one or the other, according to suitable operation modes. The main shaft and the weaving machine shaft are co-axial and their ends lie opposite each other.

[0011] Fig. 1 shows, in a cross-section, an example of prior art coupling. A flat bevelled toothed stator is opposite a toothed flange integral with the weaving machine shaft; a double-sided toothed disc is suitably attached to the end of the main shaft of the weaving loom, which passes through the stator. The disc is axially displaceable with respect to the shaft on which it is mounted, under the contrasting action of a membrane-and-thrust-spring assembly and of a solenoid. The latter is mounted integral with the stator case and through the stator develops a magnetic field that allows it to attract the toothed disc. Thrust springs are further provided, which press the toothed disc against the toothed flange, holding the coupling between the main shaft and the weaving machine.

[0012] It is apparent that in the coupling mechanism just described the good overall functioning and the effectiveness of the coupling between the front toothed gears depends mainly on the balanced combination of the thrust developed by the springs and the attraction force developed by the solenoid magnetic field. In particular, holding of the coupled condition between the disc and the stator (condition wherein the loom main shaft is stopped and the phase is maintained) is all the more guaranteed, the stronger the magnetic field is.

[0013] The Applicant found out, in more cases than one, that the construction of the prior art coupling does not always guarantee adequate levels of magnetic coupling; as a matter of fact, often attraction forces manifest themselves that are variable and non-repeatable because they are conditioned by the mechanical couplings, by the tooth profiles, by the magnetic gap, and so on, which may vary from one coupling to another.

[0014] Even more so, if an adequate magnetic force cannot be relied upon, it is not possible to use thrust springs which develop a high spring thrust, consequently negatively affecting the coupling load between the disc and the toothed flange (condition in which the weaving machine is driven by the main shaft).

[0015] It is therefore an object of the present invention to overcome this type of drawback supplying a clutch according to the preamble of the main claim, wherein a clever solution is provided to improve the magnetic field flux in the coupling condition of the flat bevelled toothed gears, to always develop a sufficient and repeatable coupling force.

[0016] It is a further object of the present invention to supply such a clever solution and a manufacturing method therefor which is economically viable both on new, mass-manufactured clutches, and as a retro-fit applied to clutches already manufactured according to the prior art.

[0017] Such objects are achieved by means of a clutch and a manufacturing method therefor as described in their essential features in the attached claims.

[0018] Further features and advantages of the device and of the method according to the invention will become apparent from the following detailed description of a preferred embodiment of the invention, given as an example and illustrated in the accompanying drawings, wherein:

[0019] fig. 1 is a cross-section view, partially interrupted, of a prior art coupling device: in the top part, with the disc shifted to the left hand side, and in the bottom part, with the disc shifted to the right hand side;

[0020] fig. 2 is a view similar to that of fig. 1 depicting a clutch according to the invention; and

[0021] fig. 3 is an elevation front view of the clutch portion depicted in fig. 2 with parts partially cut out.

[0022] A clutch manufactured according to what has been cited before consists, in a manner known per se, of a stator 1 and of a toothed flange 2 between which a disc 3 is located.

[0023] The stator 1 is fixed to the loom chassis and features a flat bevelled toothing 1a. At the same time it features a raised perimeter edge 1b ending with a circular rim surface 1b'.

[0024] On a flange 2, mounted at the end of a weaving machine drive shaft a flat bevelled toothing 2b is further provided.

[0025] The disc 3 features two series of front flat bevelled toothings: a first inner series 3a, intended to mesh with the corresponding toothing 1a of the stator 1, and a second outer series 3b, intended to mesh with the corresponding toothing 2b of the flange 2. Also, the disc 3 features a raised perimeter edge ending with a circular-rim surface 3b' intended to abutt with the surface 1b'.

[0026] The disc 3 is mounted axially translatable at the end of a shaft A. In particular, according to the illustrated embodiment, the disc is mounted by means of membrane springs 4 and is constantly pushed to the left (with reference to the figure), i.e. meshed with the flange 2 (top part of fig. 1), by means of a series of springs 5, for example twelve springs arranged equally circumferentially spaced apart.

[0027] In the stator 1 a coil E which acts as a solenoid is further provided to establish a magnetic field with the function of attracting to the right (with reference to the figure) the disc 3, overcoming the thrust of the springs 5, so as to cause the series of teeth 3a and 1a (lower part of fig. 1) to mesh with each other.

[0028] In this last condition, at the perimeter area marked with P, the disc 3 and the stator 1 touch each other, ideally closing a magnetic field branch of solenoid E.

[0029] However, the Applicant has observed that the continuity of the magnetic flux with this design is not as effective.

[0030] As a matter of fact, the magnetic field is essentially toroidally-shaped around the solenoid. In the section shown in fig. 1, the magnetic flux is essentially circle-shaped around the solenoid E: hence it diffuses into the metallic material in a continuous way, except in the central area of the stator, i.e. at the teeth 1a and 3a, where - according to the prior art - a magnetic gap can be found (consisting of the clearance between the teeth) which significantly limits the effectiveness of the field.

[0031] On the other hand, identifying other surfaces that can come into contact in this position when the solenoid is energised is not considered feasible: this would in fact be incompatible with the need to allow free movement to the tapping tool used to manufacture the necessary bevelled toothing on the stator 1 and on the disc 3.

[0032] According to the inventive solution identified by the Applicant, a pair of contact surfaces are instead provided partially levelling off the respective toothing.

[0033] As can be gleaned from fig. 2, each tooth of the series 1a features a levelled-off area 1a', obtained radially outwards, which therefore creates a stubbling to the tooth 1a. Similarly, each tooth of the series 3a features a levelled-off area 3a', located radially inwards, which creates another stubbling. Preferably, then, undercutting grooves S are provided at the junction between the tooth relief and the levelled-off area.

[0034] In this way, during the solenoid energisation phase, the two series of teeth can be drawn nearer into each other, bringing the levelled-off area 1a' into contact with the levelled-off ridge 3a'' of the tooth 3a.

[0035] At the same time, as can be guessed, surfaces 1b' and 3b' are ground too to allow an adequate stroke increase.

[0036] Preferably, grinding of the surfaces 1b' and 3b' is carried out while grinding their respective toothing stubbling: by doing so, a perfect levelness is further achieved which guarantees optimal coupling.

[0037] A contact coupling has hence been obtained, both inwardly and outwardly, radially to the solenoid, establishing a perfectly continuous closure of the toroidal magnetic circuit and achieving the desired results.

[0038] Experimental tests have demonstrated the high effectiveness of this solution which, in all operating conditions, has always guaranteed release force values (i.e. of the force necessary to detach the stator from the disc) that are consistent and more than sufficient for the specific application.

[0039] Advantageously, with this solution, the bevelled toothing can be obtained still by conventional tapping; subsequently it is possible to create the levelled-off areas 1a' and 3a' by mechanical machining. If carried out properly, this subsequent machining, amongst other things, may simultaneously result in an improved planarity of the contact surfaces in P, removing possible manufacturing inaccuracies which would have inevitably caused a functioning fault.

[0040] As can be guessed, this method for obtaining the coupling according to the invention is applicable also to clutches already manufactured according to the prior art, thus achieving a further object of those detailed in the preamble.

[0041] According to another embodiment of the invention (not shown), the circumferential, perimeter portion of the teeth 1a on the stator 1 is removed by machining, for example by milling, obtaining a deep circumferential groove. Inside this groove, a ring is secured which represents an abutting surface against which the ridges 3a'' of the teeth 3a of the disc 3 are intended to engage, so as to achieve a similar closure of the magnetic circuit in the radially inner area. In this case too, the desired objects are fully achieved, although a different practical machining method is employed.

[0042] It is understood, however, that the invention is not limited to the specific embodiments illustrated above, which represent only non-limiting examples of the scope of the invention, but that a number of changes are possible, all within the reach of a person skilled in the field, without departing from the scope of the invention itself.

Claims

1. Slow-gear-selecting and pick-finding clutch in a weaving loom, of the type comprising a stator (1) fixed to the loom, and a flange (2) integral with a driven shaft, provided with opposing, flat, bevelled toothing (1a, 2b), between which a disc (3) is located rotatingly integral with a driving shaft (A), provided with corresponding flat, bevelled toothing (3b, 3a), translatable from a coupling position with said stator (1) to a coupling position with said flange (2), said disc being displaceable under the action of a magnetic force developed by a solenoid (E) integral with said stator (1), **characterised in that**, at the toothing (1a) of said stator (1) a flat circumferential surface (1a') is provided, so as to define, together with a flattened area (3a') in the corresponding toothing (3a) of said disc (3), at least a pair of flat coupling surfaces (1a', 3a'') intended to come into contact when the solenoid (E) is energised.

2. Clutch as claimed in claim 1), wherein said flat circumferential surface (1a') consists of a flat/levelled-off portion of the toothing (1a) of the stator (1).

3. Clutch as claimed in claim 2), wherein said levelled-off area is obtained as an undercut of the toothing (1a) of the stator (1) by mechanical machining.

4. Clutch as claimed in claim 1), wherein said flat circumferential surface consists of the flat surface of an applied metallic ring.

5. Clutch as claimed in any of the preceding claims, wherein said flat circumferential surface (1a') at the toothing (1a) of the stator (1) is capable of coupling with the levelled-off ridge (3a'') of the toothing (3a) of said disc (3).

6. Manufacturing method for an improved clutch for slow-gear selection and pick-finding in a weaving loom, comprising the steps of

   supplying a clutch of the type comprising a stator (1) integral with the loom and a flange (2) integral with a driven shaft, provided with opposing, flat, bevelled toothing, between which a disc (3) is located rotatingly integral with a driving shaft (A) and provided with corresponding flat bevelled toothing, translatable from a coupling position to said stator (1) to a coupling position to said flange (2), said disc being displaceable under the action of a magnetic force developed by a solenoid (E) integral with said stator (1),

   wherein, furthermore, said flat bevelled toothing has been obtained by conventional tapping,

   characterised by the steps of

   obtaining a pair of coupling surfaces at said toothing by undercutting at least part of at least one of said toothing by mechanical machining.

7. Method as claimed in claim 6), wherein

   the toothing of said disc (3) is at least partially undercut by mechanical machining and,

   the toothing of said stator is partially removed by mechanical machining, producing at the same time a housing groove into which a metallic ring is subsequently applied capable of representing one of said coupling surfaces.

8. Method as claimed in claim 6) or 7), wherein said coupling surfaces are ground together with other abutting surfaces (1b', 3b') of the disc and of the stator, radially opposite to the toothing with respect to the solenoid (E).

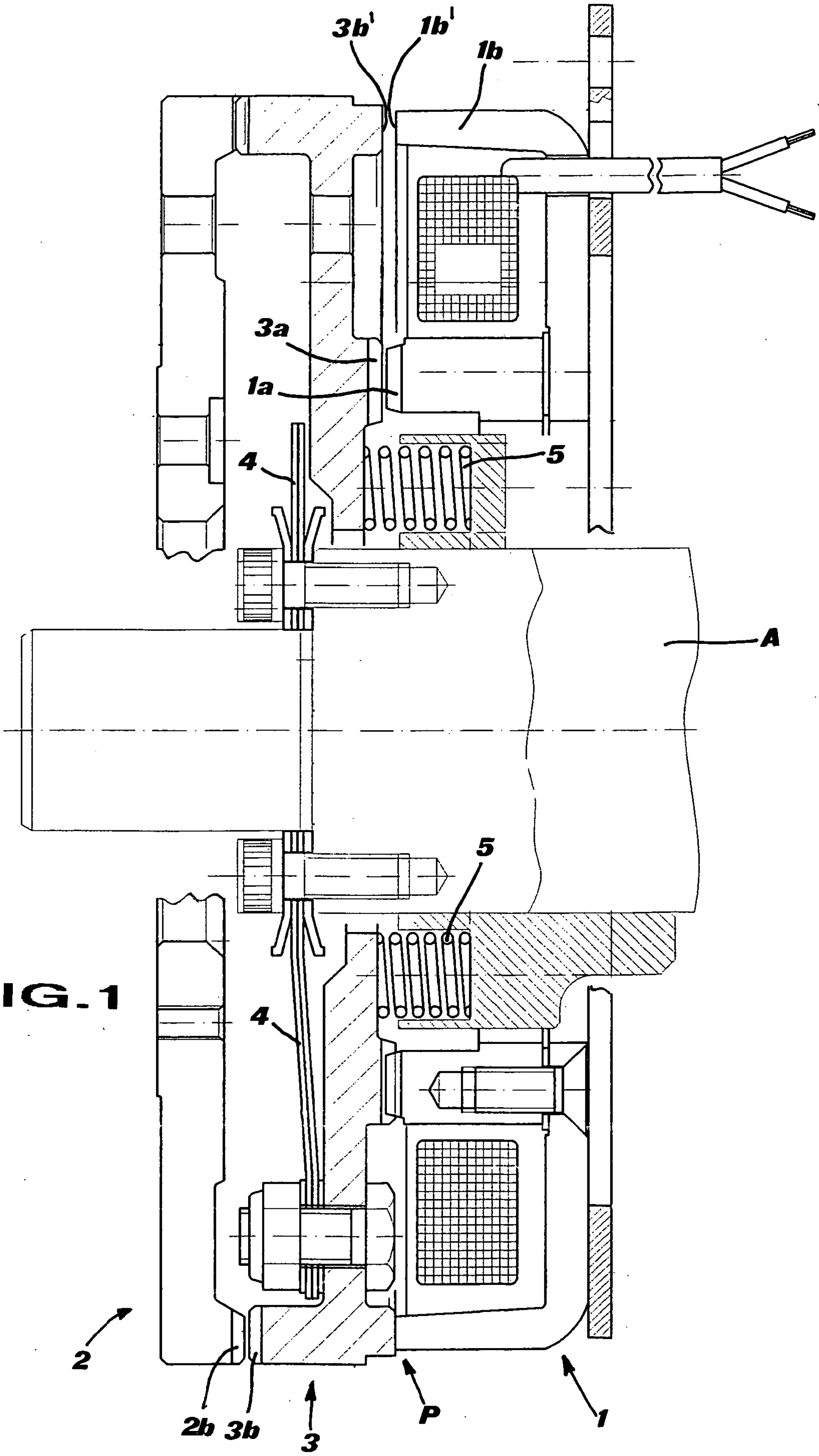

FIG.1

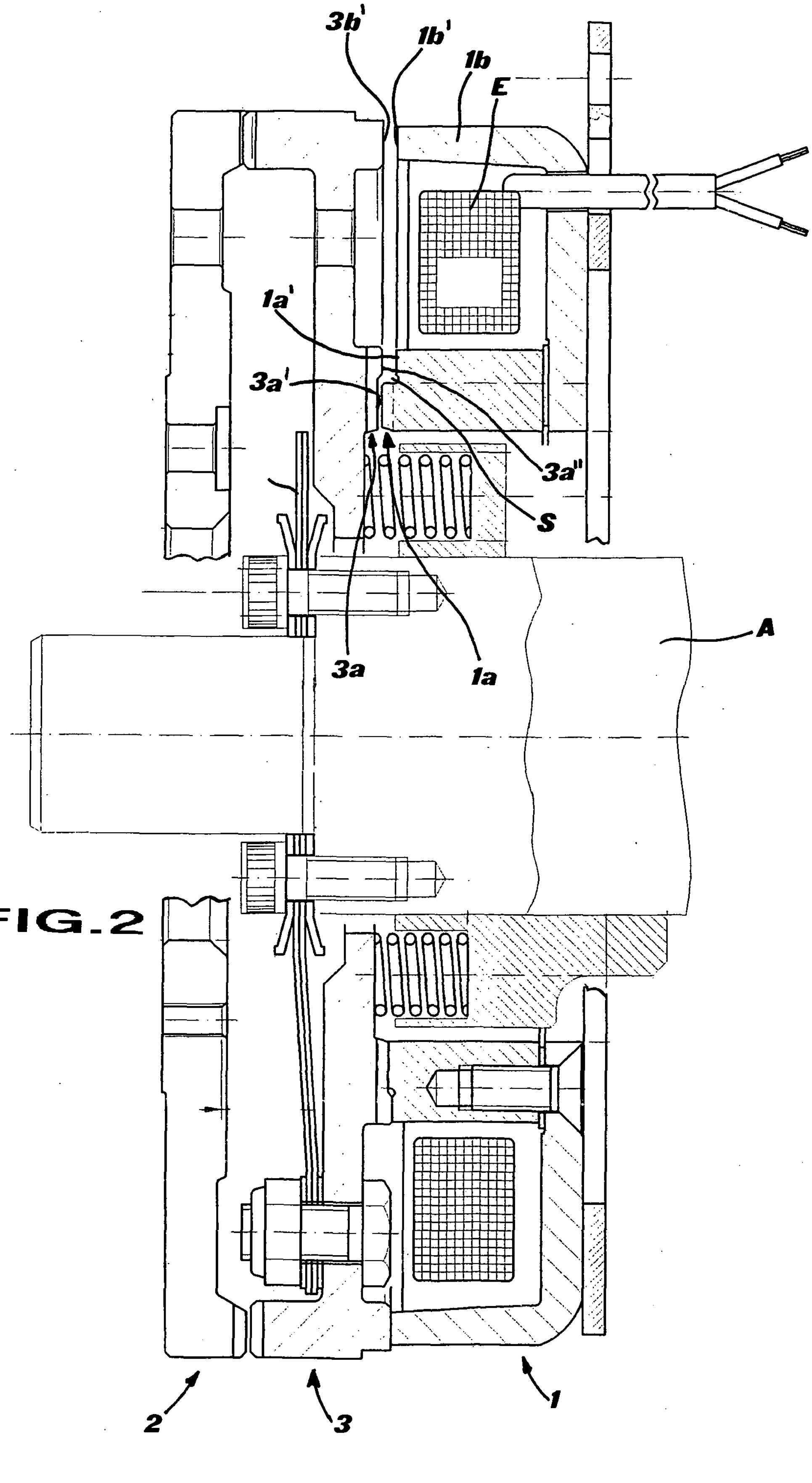

FIG.2

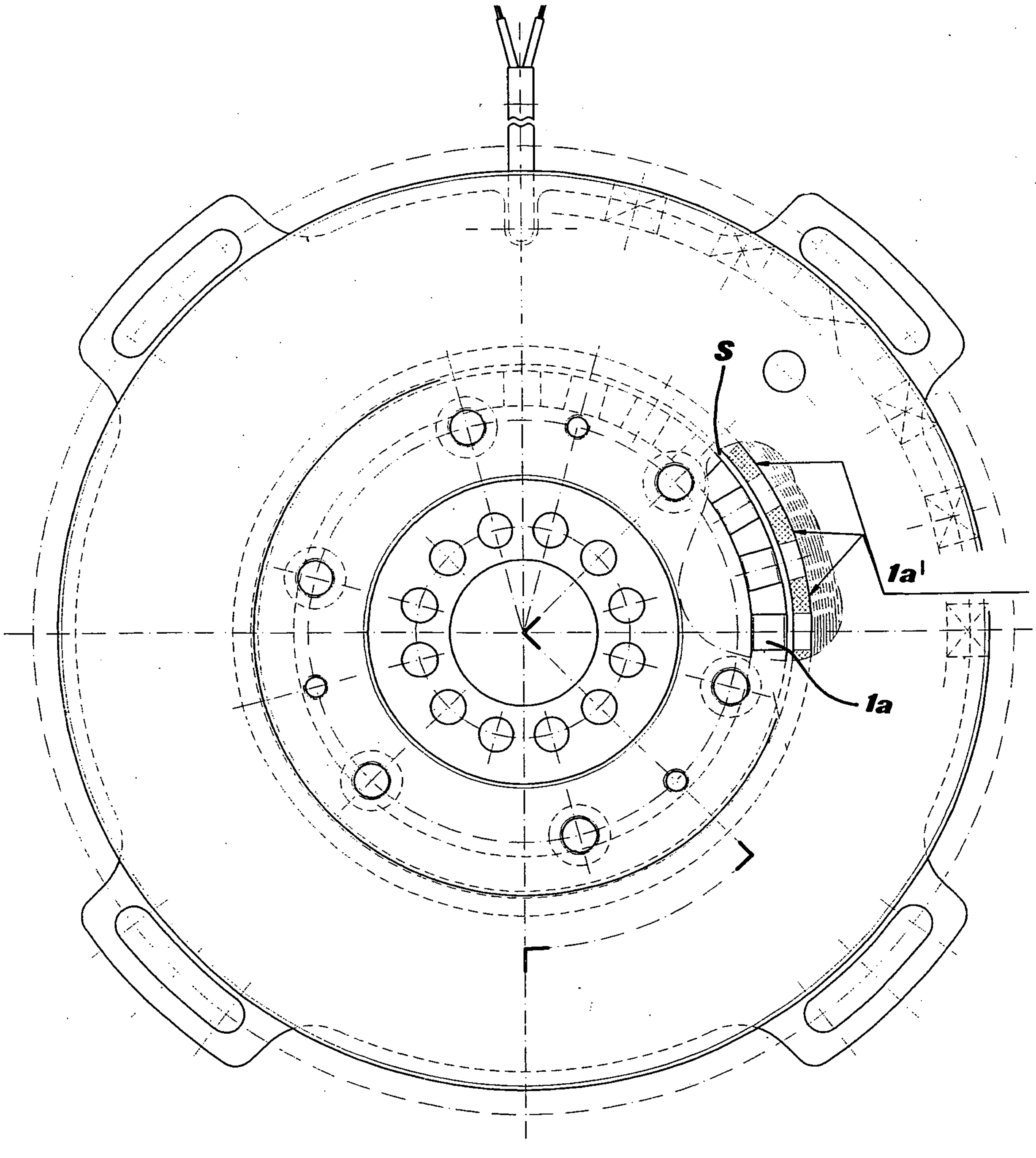

FIG.3