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## (54) Drive mechanism for medium voltage switch

(57) A drive mechanism for a Medium Voltage switch which comprises: a base plate 10 and a front plate 11 defining an internal space housing an operating shaft 2 and a power shaft 3, coaxially mounted on a first longitudinal axis, the power shaft 3 being operatively connectable to a kinematic chain of a Medium Voltage switch for opening/closing operation of said switch, the operating shaft 2 having a head 20 connectable to an operating handle for manual actuation of said shaft; a spring assembly 4 which comprises a spiral spring 41 having a first end 411 operatively coupled to said operating shaft 2 and a second end 412 operatively couplable to said power shaft 3, said spiral spring 41 being loaded by rotation of said operating shaft and actuating said power shaft when released. The operating shaft 2 is provided with release means 21 acting on said power shaft 3 by manual rotation of said operating shaft 2 and the spring assembly 4 is provided with adjusting means 40 for regulating the pre-load of said spiral spring 41.

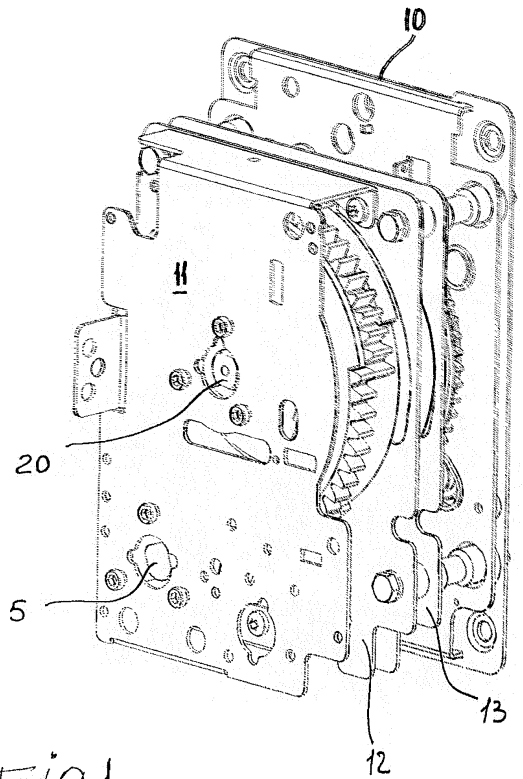


Fig.1

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## Description

**[0001]** The present invention relates to a drive mechanism for a Medium Voltage switch, in particular a drive mechanism for a Medium Voltage line switch, having improved features. For the purposes of the present application the term Medium Voltage is referred to applications in the range of between 1 and 52 kV.

**[0002]** Medium Voltage switches, in particular Medium Voltage line switches, are well known in the art and usually comprises a drive mechanism which is operatively connected to the kinematic chain of the switch and actuates it for opening and closing the contacts of the switch. Due to the speed needed for carrying out opening/closing operation, mechanical means are normally used to actuate the kinematic chain of the switch. In most cases, the drive mechanisms are based on springs which are loaded before carrying out the opening/closing operation; when the spring is released, the drive mechanism transmits the energy and the motion generated by the spring to the kinematic chain of the switch, thereby actuating the opening/closing operation with the required speed.

**[0003]** Even if the currently known drive mechanisms are certainly suitable to operate the opening/closing operation of a Medium Voltage switch, they are not totally satisfactory in terms of performances and/or manufacturing costs.

**[0004]** A problem that may occur during operation of a Medium Voltage switch derives from the increased frictional forces between the contact blades due to not-normal conditions in the plants. In such a case, the energy required to open the contacts (i.e. to "detach" the contact blades from each other) is greater than the energy required under normal conditions. As a consequence, over-dimensioning of the spring is often necessary in order to have proper operation under all conditions, with a consequent increase in manufacturing costs.

**[0005]** A further problem derives from the speed requirements of the opening/closing operation of the switch which involves an accurate dimensioning of the spring, as well as an accurate testing thereof.

**[0006]** Also, the characteristics of the spring may change during the operation life, thereby reducing also the speed characteristics of the associated switch under values that may no longer be acceptable.

**[0007]** It is therefore an object of the present invention to provide a drive mechanism for a Medium Voltage switch, in particular a drive mechanism for a Medium Voltage line switch, in which the above-mentioned drawbacks are avoided or at least reduced.

**[0008]** More in particular, it is an object of the present invention to provide a drive mechanism for a Medium Voltage switch which allows to operate also in case of increased frictional forces between the contact blades.

**[0009]** As a further object, the present invention is aimed at providing a drive mechanism for a Medium Voltage switch which does not require over-dimensioning of the spring.

**[0010]** A further object of the present invention is to provide a drive mechanism for a Medium Voltage switch which does not require an excessively accurate dimensioning and pre-testing of the spring.

**[0011]** Another object of the present invention is to provide a drive mechanism for a Medium Voltage switch which allows to tune the characteristics of the spring and adapt it to the application in an easy way.

**[0012]** Still another object of the present invention is to provide a drive mechanism for a Medium Voltage switch with reduced manufacturing, installation and maintenance costs.

**[0013]** Thus, the present invention relates to a drive mechanism for a Medium Voltage switch which is **characterized in that** it comprises:

- a base plate and a front plate which defines an internal space housing an operating shaft and a power shaft, coaxially mounted on a first longitudinal axis, the power shaft being operatively connectable to a kinematic chain of a Medium Voltage switch for opening/closing operation of said switch, the operating shaft having a head connectable to an operating handle for manual actuation of said shaft;
- a spring assembly which comprises a spiral spring having a first end operatively coupled to said operating shaft and a second end operatively couplable to said power shaft, said spiral spring being loaded by rotation of said operating shaft and actuating said power shaft when released;

**[0014]** In the drive mechanism for a Medium Voltage switch according to the invention, the operating shaft is provided with release means acting on said power shaft by manual rotation of said operating shaft, and the spring assembly is provided with adjusting means for regulating the pre-load of said spiral spring.

**[0015]** Thanks to the presence of the release means, the drive mechanism for a Medium Voltage switch according to the invention allows to operate also in case of increased frictional forces between the contact blades, as better explained hereinafter. Thue, over-dimensioning of the spring with respect to the speed requirements of the switch is no longer necessary.

**[0016]** Also, the presence of the adjusting means allows to fine tune the characteristics of the spring when already installed in the drive mechanism, without requiring an excessively accurate dimensioning and pre-testing of it.

**[0017]** A Medium Voltage switch comprising a drive mechanism as described above is also part of the present invention.

**[0018]** Further characteristics and advantages of the invention will emerge from the description of preferred, but not exclusive embodiments of a drive mechanism for a Medium Voltage switch according to the invention, non-limiting examples of which are provided in the attached drawings, wherein:

Figure 1 is a perspective view of a possible embodiment of a drive mechanism according to the invention;

Figure 2 is front view of the interior of a drive mechanism according to the invention, showing some key components thereof;

Figure 3 is a perspective view of an embodiment of the operating shaft, power shaft and spring assemblies used in a drive mechanism according to the invention;

Figure 4 is an exploded view of the assemblies of figure 3;

Figure 5 is front view of the assemblies of figure 3, shown in a first operating position;

Figure 6 is front view of the assemblies of figure 3, shown in a second operating position;

Figure 7 is a partial perspective view of a drive mechanism according to the invention, shown in the operating condition of figure 6;

Figure 8 is a partial perspective view of a drive mechanism according to the invention, shown in a third operating position.

**[0019]** With reference to the attached figures, a drive mechanism for a Medium Voltage switch according to the invention, globally designated with the reference numeral 1, generally comprises a base plate 10 and a front plate 11 that define an internal space. Additional plates, e.g. plates 12 and 13, can also be present between the front 11 and base 10 plate. The drive mechanism also comprises a number of components for its connection to a Medium Voltage switch that can be of conventional type and that will not described in details.

**[0020]** An operating shaft 2 and a power shaft 3 are housed in said internal space and are coaxially mounted along a first longitudinal axis, the power shaft 3 being operatively connectable to a kinematic chain of a Medium Voltage switch through conventional linking system to actuate the opening/closing operation of said switch. The operating shaft 2 has a head 20 connectable to an operating handle for manual actuation of said operating shaft, through a hole positioned on the front plate 11 of the drive mechanism 1.

**[0021]** The drive mechanism 1 of the invention further comprises a spring assembly 4 which comprises a spiral spring 41, also positioned in the internal space between the base plate 10 and the front plate 11.

**[0022]** The spiral spring 41 has a first end 411 which is operatively coupled to said operating shaft 2 and a second end 412 operatively couplable to said power shaft 3. In this way, the spiral spring 41 can be loaded by rotation of said operating shaft 2 and than actuates said power shaft 3 when released. In practice, the closing operation is carried out by rotating clockwise the operating shaft 2, through an operating handle acting on the head 20 of the operating shaft 2; during said rotation, the spiral spring 41 is loaded until when a release point is reached, at which point the spring is release transmitting motion and energy to the power shaft 3 which, being connected to the kinematic chain of the switch, actuates the closing operation of said switch. Similarly, the opening operation is carried out by rotating counterclockwise the operating shaft 2; during said rotation, the spiral spring 41 is loaded until when a release point is reached, at which point the spring is release transmitting motion to the power shaft 3 in the opposite direction with respect to the closing operation, thereby actuating the opening operation of the switch.

**[0023]** One of the characterizing features of the drive mechanism 1 according to the invention resides in that the operating shaft 2 is provided with release means 21 acting on said power shaft 3 by manual rotation of said operating shaft 2. As better explained hereinafter, this allow to act on the power shaft 3, and consequently also on the contact assembly of the switch, applying additional forces to the force exerted by the spring 41, thereby allowing to detach from each other the contact blades of the switch even in case of increase frictional forces between the contact blades.

**[0024]** Further, in the drive mechanism 1 according to the invention, the spring assembly 4 is conveniently provided with adjusting means 40 for regulating the pre-load of said spiral spring 41. In this way the speed characteristics of the spring 41 can be changed, or at least fine-tuned, according to needs, thereby allowing accurate calibration of the speed characteristics of the drive mechanism and/or compensating variations due to, e.g., aging of the spring itself or other mechanical components of the drive mechanism and/or of the switch.

**[0025]** With reference to figure 2-4, according to a preferred embodiment of the drive mechanism 1 of the invention the operating shaft 2 comprises a disk 22 of substantially circular shape which is mounted perpendicularly to the longitudinal axis of the operating shaft 2 (i.e., perpendicular to the first longitudinal axis). A first plate element 23 protrudes perpendicularly from the disk 22 in the direction of the head 20 of said operating shaft 2 and is operatively couplable to the second end 412 of said spiral spring.

**[0026]** Preferably, the power shaft 3 comprises a first L shaped lever 30 having a flat base 31 with a first end 311 which rotationally mounted along said first longitudinal axis; a second plate element 32 protruding from a second end 312 of said flat base 31, perpendicular to the flat base 31 and parallel to said first longitudinal axis, in the direction of the head 20 of said operating shaft 2, said second plate element 32 being operatively couplable with the second end 412 of the spiral spring 41.

**[0027]** In practice, the first 23 and second 32 plate elements protrudes respectively from the disk 22 and the flat base 31 along parallel directions. Also, said second plate element 32 is positioned at a distance from said first longitudinal axis which is greater than the distance of said first plate element 23 from said first longitudinal axis; in other words, the length of the flat base 31 is greater than the diameter of the disk 22. Preferably, as shown

in figure 3, the length of the second plate element 32 is greater than the length of said first plate element 23.

**[0028]** In details, the spring assembly 4 preferably comprises a second lever 42 which has a base 43 coaxially mounted on said operating shaft 2 in correspondence of the disk 22. The base 43 is provided with fixing means for the first end 411 of the spiral spring 41; for instance, the fixing means can be a groove 430 in which the first end 411 of said spiral spring 41 is secured.

**[0029]** Further, the second lever 42 has a distal end portion 44 onto which said adjusting means 40 are positioned. Preferably, the adjusting means 40 are positioned so as to cooperate with said first plate element 23 of said operating shaft 2. In practice, according to this embodiment, the adjusting means 40 allow to rotate the second lever 40 (onto which the first end 411 of the spiral spring is fixed, with respect to the disk 22 of the operating shaft 2, thereby changing the pre-load of the spiral spring 41 and consequently also its speed characteristics.

**[0030]** As an example, said adjusting means 40 can comprise a hole 47, preferably a threaded hole, positioned on the distal end portion 44 of said second lever 42 and screw means 45 inserted in said hole 47 and abutting against the first plate element 23 of said operating shaft 2. Thus, by rotating the screw 45, the second lever 42 can be rotated to a more or less great extent with respect to the operating shaft 2, consequently changing the pre-load applied to the spiral spring 41.

**[0031]** In a particularly preferred embodiment of the drive mechanism 1 according to the invention, said release means 21 comprises a protrusion 210 which is keyed on the disk 22 of said operating shaft 2. Said protrusion 210 has an edge 211 which is capable to interact with the second plate element 32 of said power shaft 3.

**[0032]** For instance, the protrusion 210 can be a part of a circular ring, keyed on the disk 22, having an edge 211 radially protruding from said disk 22. The length of the edge 211 is such that it can intercept the second plate element 32 of the power shaft 3, by rotating the operating shaft 2 with respect to the power shaft 3. In other words, the edge 211 of the protrusion 210 can be brought into contact with the second plate element 32 of said power shaft 3 by manual rotation of said operating shaft 2.

**[0033]** In details, the functioning will be explained with reference to figures 5-8.

**[0034]** Figure 5 shows the positions of the operating shaft 2 and power shaft 3 in correspondence of a situation in which the contacts of an associated switch are closed. In such a situation, the spiral spring 41 is not loaded (excluding the pre-load applied by the adjusting means 40).

**[0035]** The opening operation starts with the loading of the spring 41, which is carried out by acting on the head 20 of the operating shaft 2 and rotating it counterclockwise, till the position of figure 6 is reached. Once the spiral spring 41 is loaded and is in the position of figure 6, it is released and snaps; energy is thus transmitted to the power shaft 3 through the second end 412 of the spring 41 which acts on the second plate element 32 of the power shaft 3. If the contacts of the switch are free (i.e. the frictional forces are within the design limits), the power shaft 3 is rotated thereby opening the contacts of the switch. However, in case of increased frictional forces between the contact blades of the switch, the energy of the spiral spring can not be sufficient to detach them from each other and allow the opening operation.

**[0036]** In such a case, the release means 21 of the drive mechanism of the invention, acts on the power shaft 3 and applies additional forces thereon, thus allowing detaching of the contact. In practice, with reference to figures 7 and 8, in the situation of figure 7 (corresponding to the one in figure 6), the edge 211 of the protrusion 210 is into contact with the second plate element 32 and the force applied to the operating shaft 2 can thus be transferred to the power shaft 3 and consequently to the contacts of the switch.

**[0037]** In this situation, the rotation of the operating shaft 2 is not stopped, but an extra stroke of it is allowed (see figure 8). Thus, in case of increased frictional forces between the contact blades, the whole force applied to the operating shaft 2 is transferred to the power shaft 3 and, together with the force exerted by the spiral spring 41 on the power shaft 3 (through the second end 412 of the spring 41 acting on the second plate element 32), is transferred to the contact system of the switch associated to the drive mechanism, thereby allowing detaching of the contact blades.

**[0038]** In this way it is possible to dimension the spiral spring 41 according to the minimal force required for the opening operation under normal conditions. As explained above, in case of increased frictional forces between the contact blades of the switch, the additional forces applied to the power shaft 3 by the release means 21 will allow to detach the contact blades and carry out the opening operation.

**[0039]** In a particularly preferred embodiment of the drive mechanism 1 according to the invention, a second operating shaft 5 is also present. The second operating shaft 5 is preferably mounted on a second longitudinal axis parallel to said first longitudinal axis and can be advantageously used to carry out the earthing operation of the switch acting on a shaft which is independent from the first (main) operating shaft 2 which is used for the opening and closing operation.

**[0040]** As it can be seen from the above description, the drive mechanism 1 for a Medium Voltage switch, in particular for a Medium Voltage line switch, of the present invention has a number of advantages with respect to the Medium Voltage switches equipped with conventional drive mechanisms.

**[0041]** In particular, the presence of the release means 21 allow to minimize the energy requirements of the spiral spring 41, with a consequent saving of costs. Even more important, the presence of said release means 21 allows to detach the contact blades in case of excessive frictional forces between them, with a consequent substantial increase of the safety for the switch associated to the

drive mechanism as well as of the plant in which it is used.

**[0042]** Also, the presence of the adjusting means 40 does not require an excessively accurate dimensioning and pre-testing of the spiral spring 41, since the speed characteristics of the spring can be calibrated and fine-tuned after assembling. Moreover, the adjusting means 40 allow adjusting the speed characteristics of the spiral spring 41, in case of variation over the time of the characteristics of the spring itself and/or of the associated mechanical components.

**[0043]** It is worth noting that the above mentioned functionalities (i.e., releasing means and adjusting means) can be implemented in a relatively easy manner, with a reduced number of components of relatively simple structure. Thus, the drive mechanism of the invention is also effective from an economical standpoint.

**[0044]** In general, the structure of the drive mechanism of the invention is very compact and can be adapted, with only a few modification, to a number of different Medium Voltage applications.

**[0045]** The drive mechanism for a Medium Voltage switch of the invention can also comprise further components and functionalities that have not been described in details as they can be of conventional kind.

**[0046]** The drive mechanism for a Medium Voltage switch thus conceived may undergo numerous modifications and come in several variants, all coming within the scope of the inventive concept. Moreover, all the component parts described herein may be substituted by other, technically equivalent elements. In practice, the component materials and dimensions of the device may be of any nature, according to need and the state of the art.

## Claims

**1.** A drive mechanism (1) for a Medium Voltage switch **characterized in that** it comprises:

- a base plate (10) and a front plate (11) defining an internal space housing an operating shaft (2) and a power shaft (3), coaxially mounted on a first longitudinal axis, the power shaft (3) being operatively connectable to a kinematic chain of a Medium Voltage switch for opening/closing operation of said switch, the operating shaft (2) having a head (20) connectable to an operating handle for manual actuation of said shaft;
- a spring assembly (4) which comprises a spiral spring (41) having a first end (411) operatively coupled to said operating shaft (2) and a second end (412) operatively couplable to said power shaft (3), said spiral spring (41) being loaded by rotation of said operating shaft (2) and actuating said power shaft (3) when released;
- the operating shaft (2) being provided with release means (21) acting on said power shaft (3) by manual rotation of said operating shaft (2);
- the spring assembly (4) being provided with adjusting means (40) for regulating the pre-load of said spiral spring (41).

**2.** The drive mechanism (1) according to claim 1, **characterized in that** said operating shaft (2) comprises a disk (22) of substantially circular shape perpendicularly mounted to said first longitudinal axis, and a first plate element (23) which protrudes perpendicularly from said disk (22) in the direction of the head (20) of said operating shaft (2), said first plate element (23) being operatively couplable to the second end (412) of said spiral spring.

**3.** The drive mechanism (1) according to claim 2, **characterized in that** said power shaft (3) comprises a first L shaped lever (30) having a flat base (31) with a first end (311) rotationally mounted along said longitudinal axis and a second plate element (32) protruding from a second end (312) of said flat base (31), perpendicular to the flat base (31) and parallel to said longitudinal axis, in the direction of the head (20) of said operating shaft (2), said second plate element (32) being at a distance from said first longitudinal axis which is greater than the distance of said first plate element (23) from said first longitudinal axis and being operatively couplable with the second end (412) of said spiral spring (41).

**4.** The drive mechanism (1) according to one or more of the preceding claims, **characterized in that** said spring assembly (4) comprises a second lever (42) having a base (43) coaxially mounted on said operating shaft (2) and a distal end portion (44), said base (43) having a groove (430) in which the first end (411) of said spiral spring (41) is secured, said adjusting means (40) being positioned on said distal end (44) portion of said second lever (42).

**5.** The drive mechanism (1) according to claims 2 and 4, **characterized in that** said adjusting means (40) cooperate with said first plate element (23) of said operating shaft (2).

**6.** The drive mechanism (1) according to claim 5, **characterized in that** said adjusting means (40) comprises a hole (47) positioned on the distal end portion (44) of said second lever (42) and screw means (45) inserted in said hole (47) and abutting against said first plate element (23) of said operating shaft (2).

**7.** The drive mechanism (1) according to one or more of the preceding claims, **characterized in that** said release means (21) comprises a protrusion (210) keyed on said disk (22) of said operating shaft (2).

**8.** The drive mechanism (1) according to claims 3 and 7, **characterized in that** said protrusion (210) has

an edge (211) capable to interact with said second plate element (32) of said power shaft (3).

**9.** The drive mechanism (1) according to claim 5, **characterized in that** the edge (211) of said protrusion (210) is brought into contact with the second plate element (32) of said power shaft (3) by manual rotation of said operating shaft (2).

**10.** The drive mechanism (1) according to one or more of the preceding claims, **characterized in that** it comprises a second operating shaft (5) mounted on a second longitudinal axis parallel to said first longitudinal axis.

**11.** A Medium Voltage switch **characterized in that** it comprises a drive mechanism (1) according to one or more of the preceding claims.

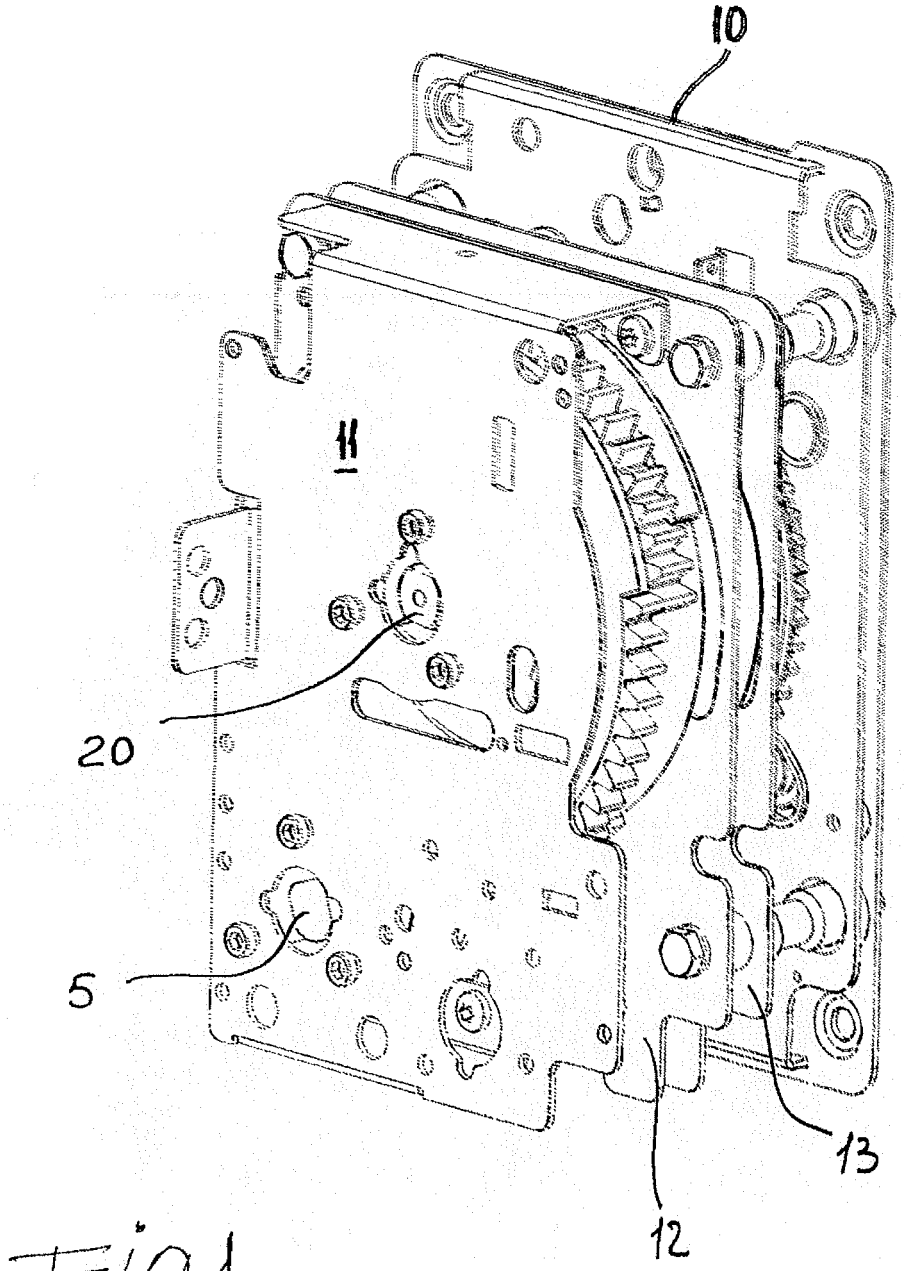


Fig.1

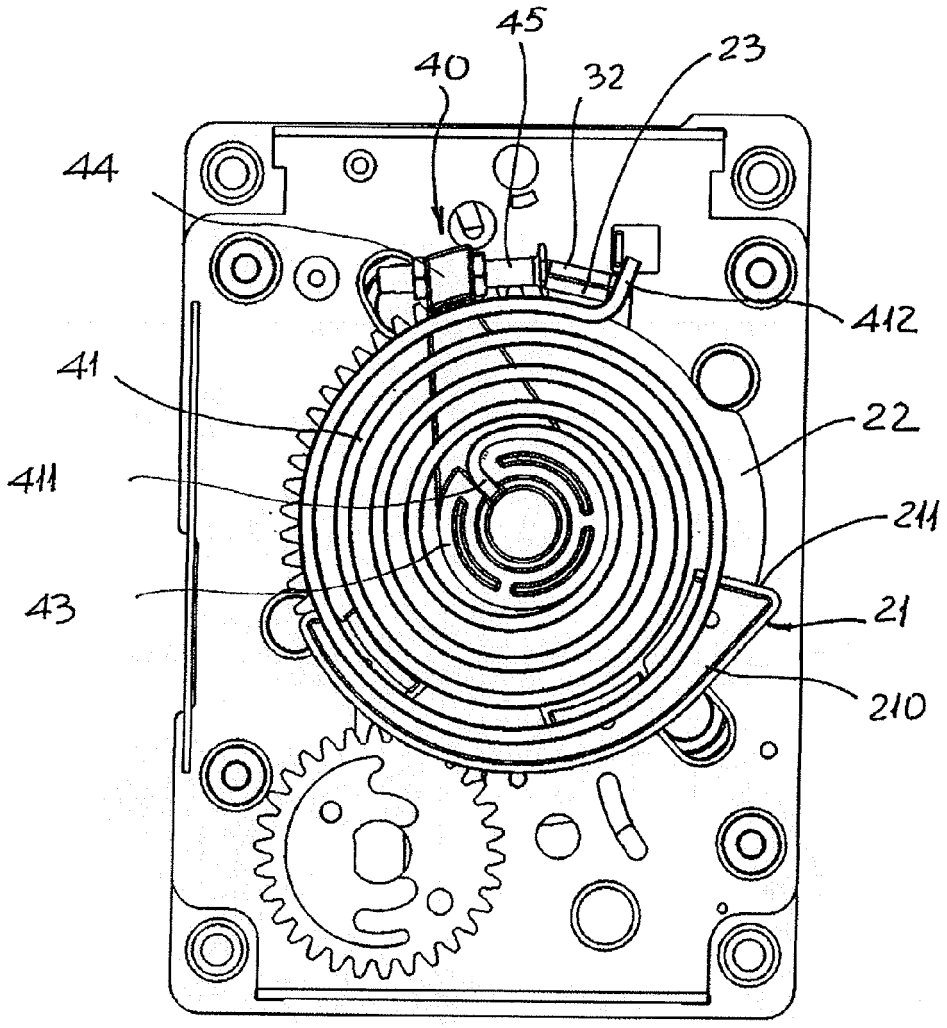


Fig. 2

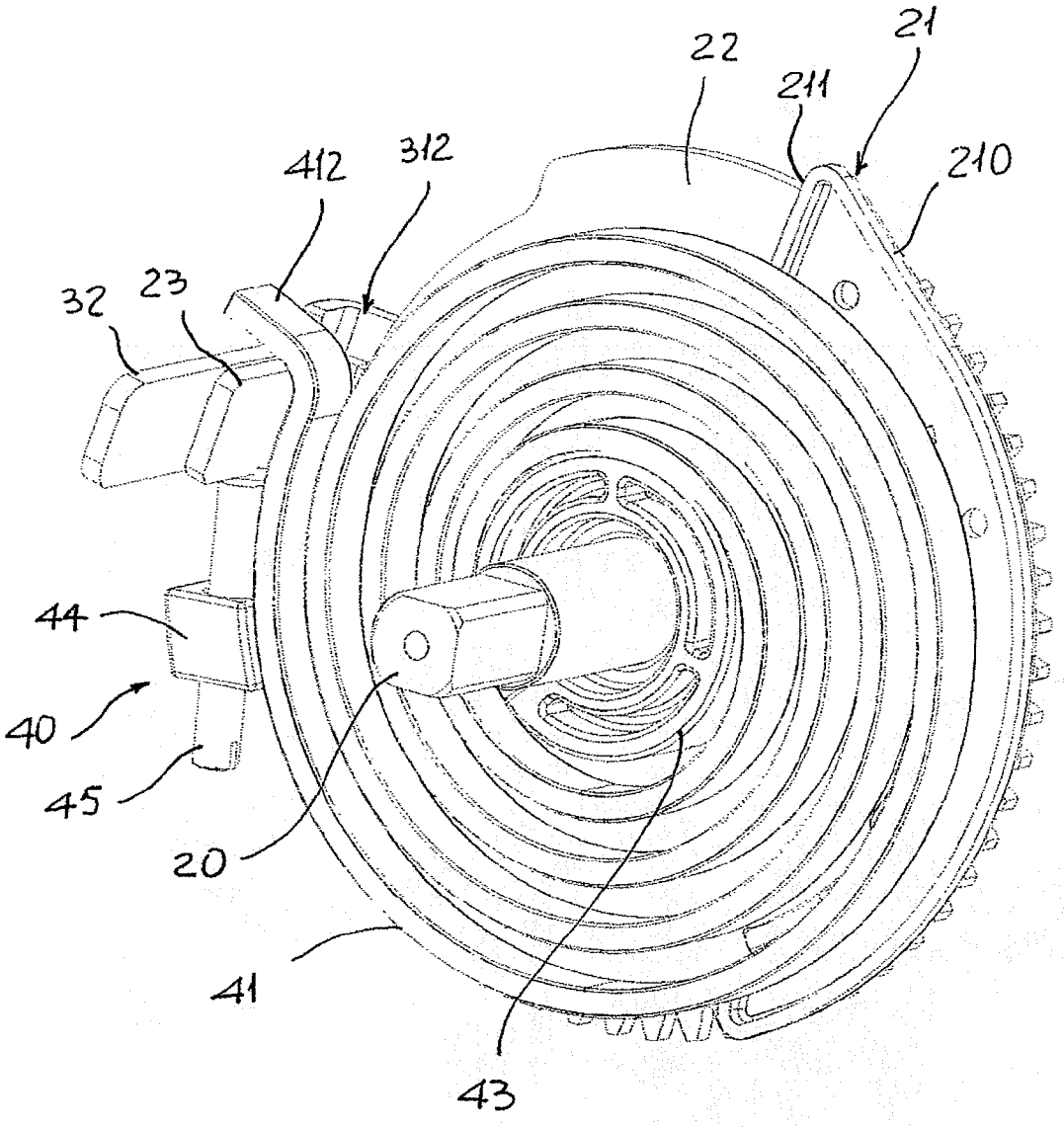


Fig.3

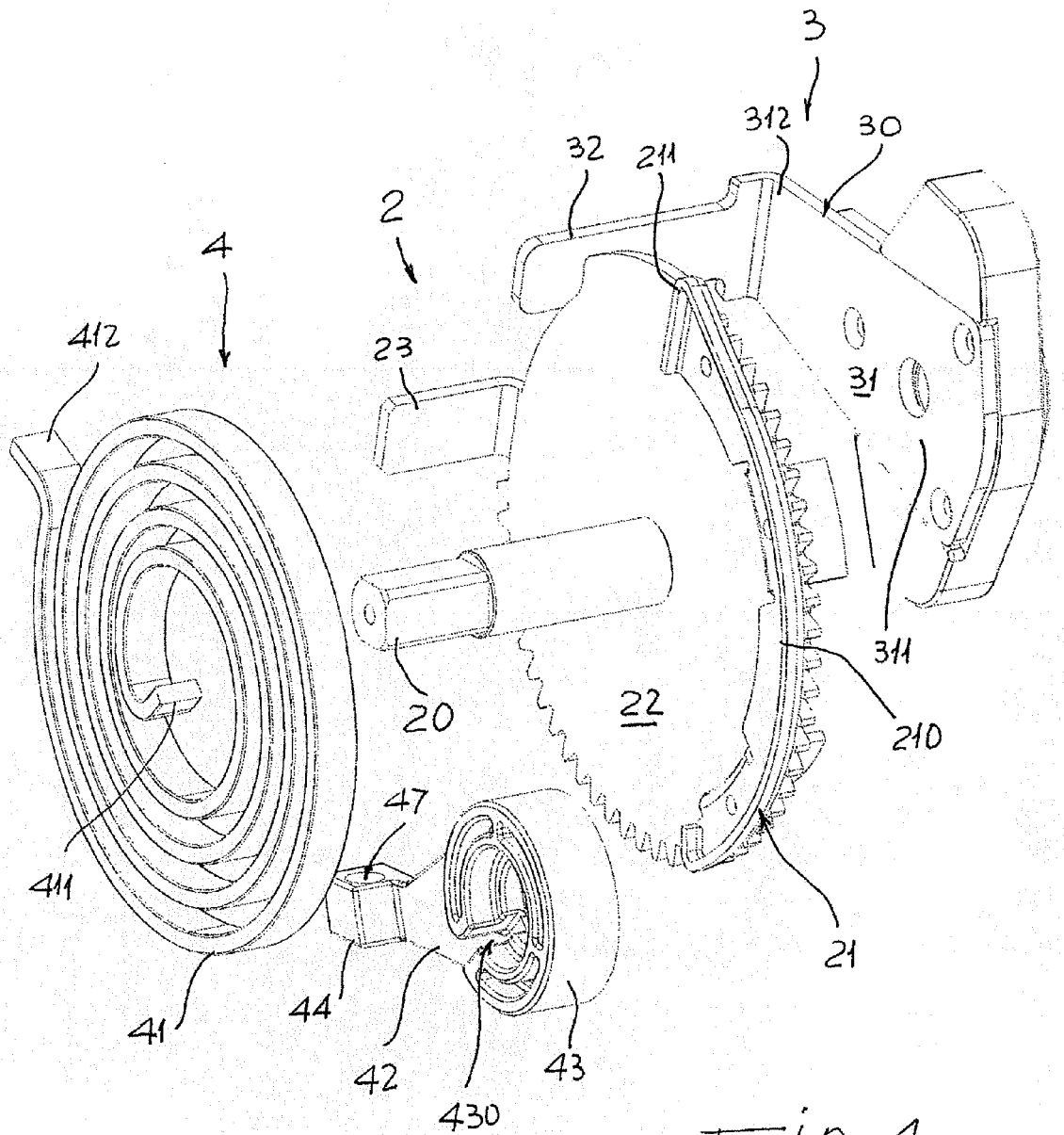


Fig.4

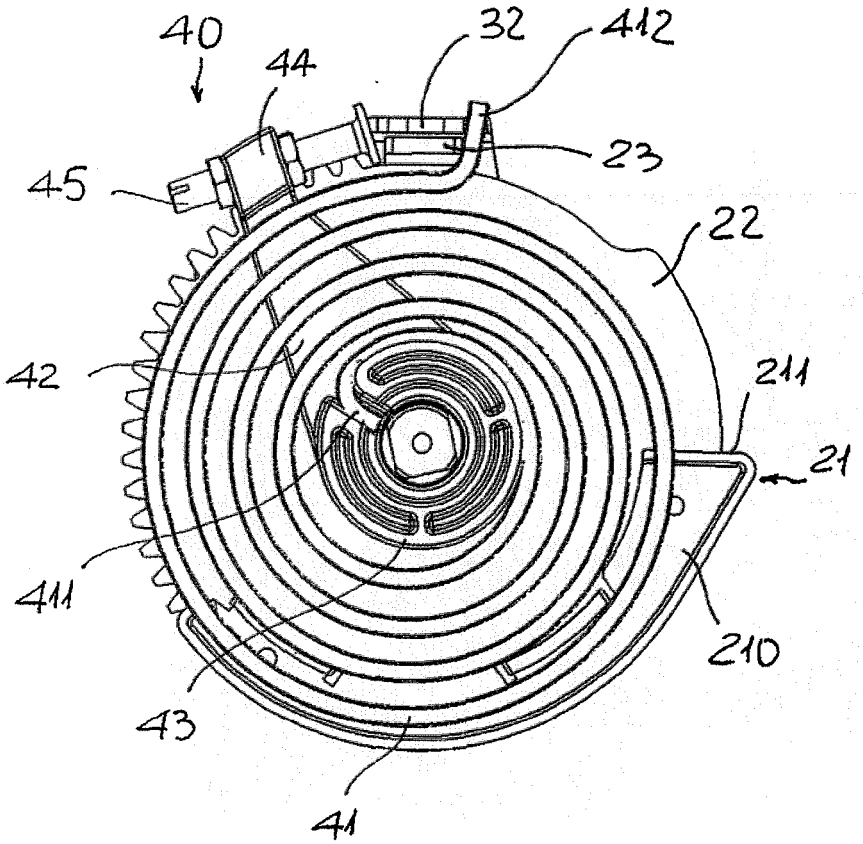


Fig.5

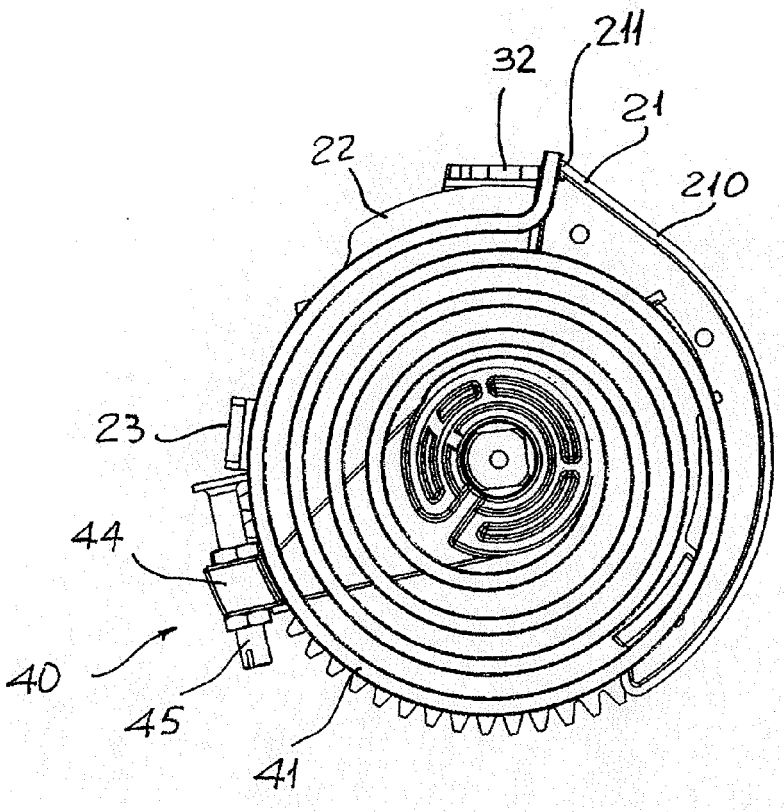


Fig.6

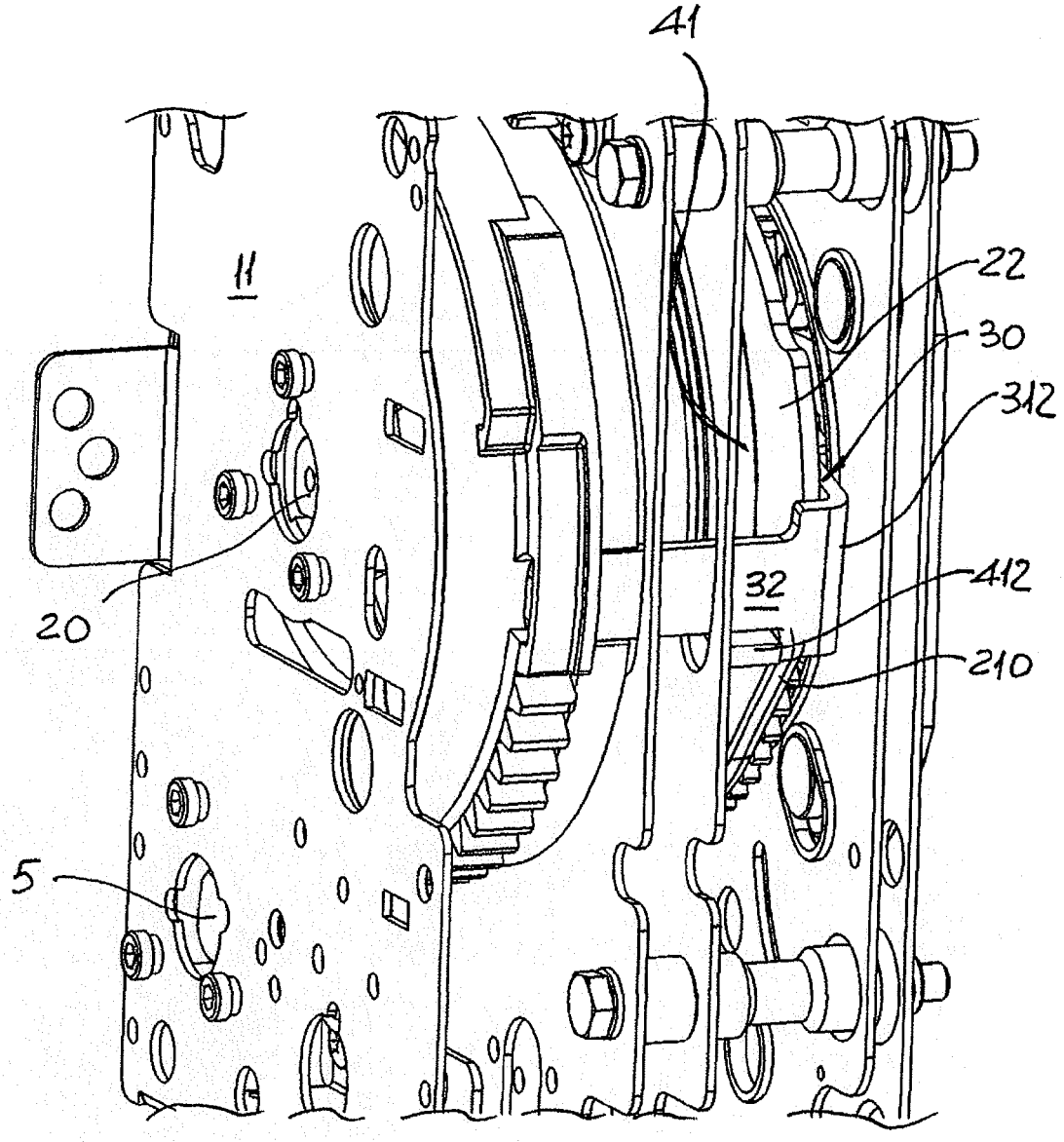


Fig.7

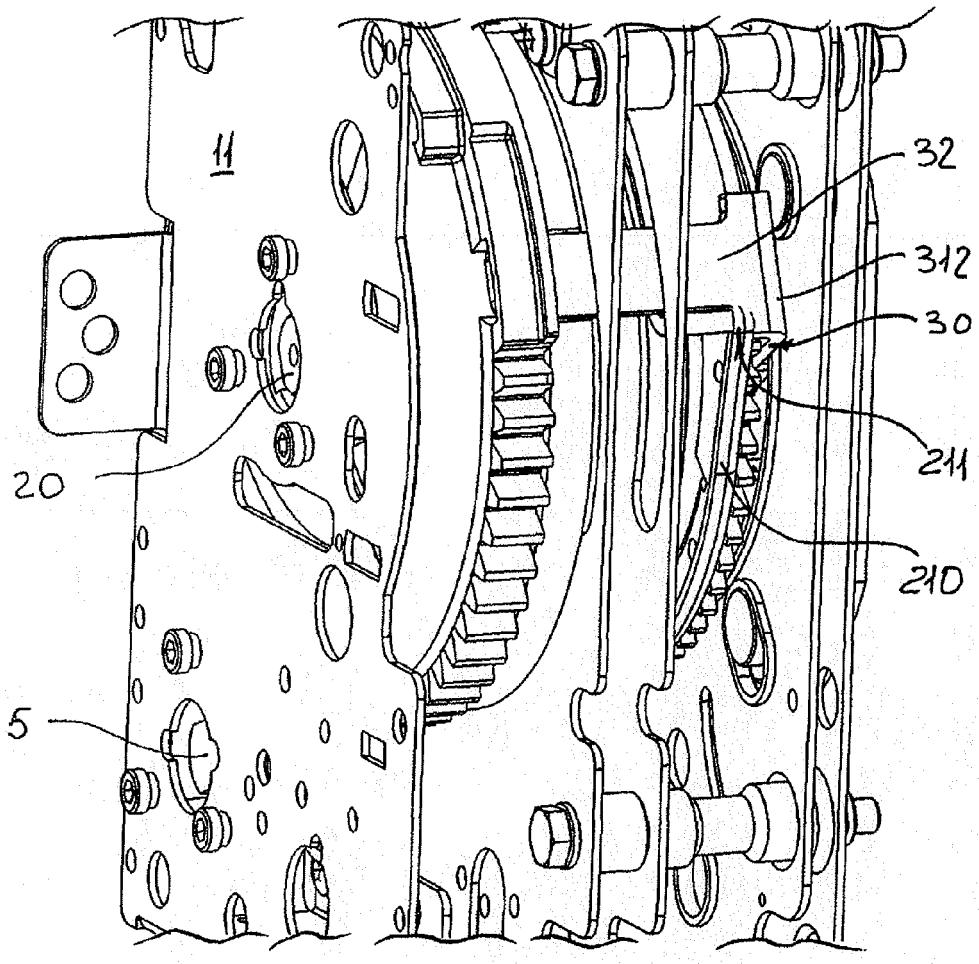


Fig.8

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# EUROPEAN SEARCH REPORT

Application Number
EP 09 15 9297

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
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TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
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| Munich | 24 September 2009 | Simonini, Stefano |

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24-09-2009

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