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(54) **Adapter module with compensation springs for tubular motors suitable for the moving of protection devices**

(57) The adapter module with compensation springs consists of an internal adapter module (1) splined to the drive shaft of the tubular motor and of an external adapter module (4) splined to the roller tube coupled to the internal adapter module by means of at least one spring (5). The internal adapter module (1) and the external adapter module (4) are constructed in such a way that some play is left between the two, thereby allowing their mutual rotation. The spring (5) acts in such a way as to generate a temporary difference between the angular velocity of the internal adapter module (1) and the angular velocity of the external adapter module (4) at the moment in which the weight force bearing down on the roller tube is cancelled out.

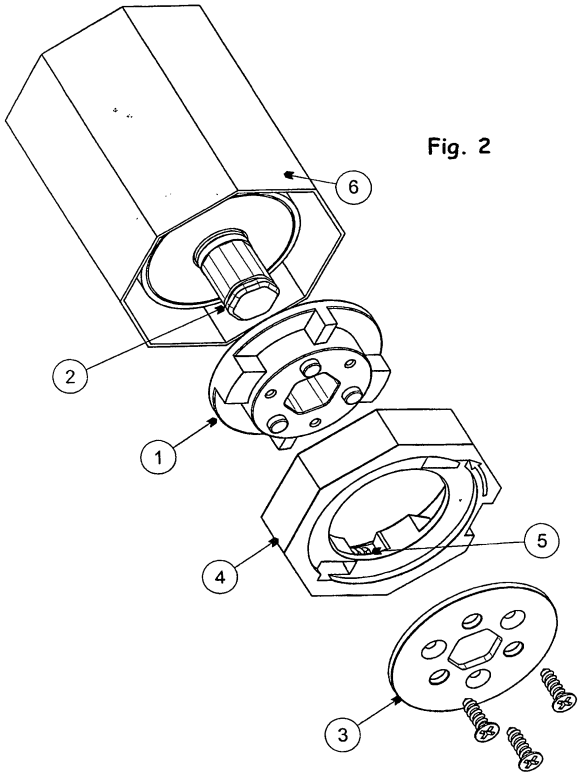

Fig. 2

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Description

[0001] The present invention concerns an adapter module for tubular motors equipped with electronic limit switches, used for the automation of environmental protection devices, especially awnings, rolling shutters or similar.

[0002] In household automation, the use of motors is becoming increasingly more frequent for the moving of environmental protection devices, especially awnings and rolling shutters. Normally these motors have a tubular shape and dimensions which allow them to be inserted in the roller tube to which the environmental protection device is attached. By means of an appropriate adapter, the drive shaft of the motor is splined to the roller tube so that to each rotational movement of the drive shaft corresponds an equal rotational movement of the roller tube and thus of the awning or roller shutter to which it is attached.

[0003] A fundamental part of any type of tubular motor for the moving of an awning or roller shutter is that known as the "limit switch unit". The function of the limit switch unit is to automatically stop the motor when the position of the awning or the roller shutter has reached one of the two points defined as end-of-travel limits. For example, in the case of a roller shutter, the upper end-of-travel limit (upper limit switch) corresponds to the situation in which the roller shutter is totally rolled around the roller tube, the lower end-of-travel limit (lower limit switch) corresponds to the situation in which the roller shutter totally closes the opening to which it has been applied.

[0004] Depending on the characteristics of the limit switch unit, the tubular motors may be divided into two categories: tubular motors with "mechanical limit switches" and those with "electronic limit switches".

[0005] In the tubular motors with the "mechanical limit switches", the limit switch unit comprises a mechanism that operates the microswitches. As soon as the motor reaches one of the limit switch positions, the relative microswitch comes into operation, thus stopping the motor. Tubular motors with "mechanical limit switches" embody the simplest type of motor, the only function they are able to perform being that of moving the environmental protection device in a certain direction, without any kind of control other than that of the reaching the limit switch positions.

[0006] In tubular motors with "electronic limit switches", the limit switch unit generally comprises an electronic card containing a relay and microprocessor, an angular position detector and a sensor. The angular position detector is normally housed near the gear ring or next to a gear internal to the motor belonging to the reduction unit, in a fixed position, and its purpose is to create an alternation of physical characteristics (e.g. presence/absence of magnetic material or presence/absence of conductive material or presence/absence of light or other elements) that are angularly variable. The purpose of the sensor is to transform the alternation of physical characteristics into an electrical signal. Through the microprocessor, the purpose of the electronic card is to analyse the electrical signal, obtaining information from it on the operating status of the motor. The microprocessor processes the data acquired from the sensor and as soon as the motor has reached one of the two limit switch positions, the relative relay is opened, with consequent stopping of the motor. Tubular motors with "electronic limit switches" not only enable the management of limit switch positions but also the constant monitoring of the operation of the motor during the movement of the environmental protection device. For example, it is possible to monitor and change the speed of the motor, identify anomalous operating conditions or blocking of the motor due to the tripping of the thermal cutout etc.

[0007] An extremely important requirement for the household automation market is that of being able to operate awnings and rolling shutters with motors that have the capacity to detect the presence of obstacles which pose resistance to the movement of the motor, automatically stopping the manoeuvre in course. On the basis of the information provided above, only motors with "electronic limit switches" are able to provide a solution to this type of problem. Even in this case, however, the detection of an obstacle during the movement of the motor is not always easy. In fact, while the detection of an obstacle that poses resistance to the raising manoeuvre may be easily effected, it is not so easy to effect the detection of an obstacle that poses resistance to the lowering manoeuvre. With a view to clarifying the problem in question, figure 1 represents the typical time sequence of the electrical signals supplied by the sensor in the case of a roller shutter moving without encountering any obstacles (11), in the case of it encountering an obstacle during the raising phase (12) and in the case of it encountering an obstacle during the lowering phase (13).

[0008] As long as the roller shutter does not encounter obstacles, the roller tube rotates more or less at a constant rate; the electrical signal (11) generated by the sensor is therefore made up of an alternation of logical states and its period is just about constant.

[0009] When the roller shutter strikes an obstacle during the raising manoeuvre, the roller tube slows down until it stops, blocking the drive shaft of the motor; the electrical signal (12) supplied by the sensor will no longer consist of an alternation of logical states but of a stable logical state, since the magnet is no longer able to rotate and hence to generate the alternation of presence/absence of magnetism. This situation is easily detectable by the microprocessor which then takes appropriate action.

[0010] During the lowering manoeuvre, as long as the roller shutter does not encounter an obstacle, the roller tube in addition to being subjected to the downward force of the motor is further encumbered by the downward force of the roller shutter. When the roller shutter strikes an obstacle, its weight comes to rest on the obstacle and no longer on the roller tube; as a result, the roller tube is

subjected to a slight deceleration for a short time, proportional, among other things, to the weight of the roller shutter and to the play that always exists between the roller tube, the adapter and the drive shaft of the motor. The deceleration of the roller tube will be transmitted through the drive elements to the magnet, which will be subjected to a slight deceleration for a short time; the electrical signal (3) generated by the sensor will differ only slightly compared to the electrical signal (11) generated in the absence of an obstacle.

[0011] The latter situation is therefore difficult for the microprocessor to manage, given the negligible difference between the signal (11) generated by the sensor during movement in absence of obstacles and the signal (13) generated by the sensor when, during the lowering manoeuvre, an obstacle is encountered.

[0012] The solution currently adopted is that of increasing the play between the roller tube and the drive shaft by using a "loose adaptor". This type of adaptor is splined to the drive shaft of the motor, but the outer part of the adaptor is constructed in such a way that the adapter has a few angular degrees of free movement before impacting the roller tube when a manoeuvre is initiated. When the roller shutter encounters an obstacle, the greater the play between the roller tube and the drive shaft of the motor, the greater the deceleration effect transferred to the magnet. This type of approach is however unable to provide satisfying results inasmuch as the play artificially generated between the roller tube and the adapter is sometimes progressively cancelled out by the inevitable friction generated by the sliding of the roller shutter on the guides, by the friction between the roller shutter and the roller tube, by the settling movements of the motor fixing bracket.

[0013] It is an object of the innovation to eliminate such problems by realizing a tubular motor adapter equipped with compensation springs capable of amplifying the effect of the loss of the weight that bore down on the roller tube in order to allow the electronic card to unmistakably detect the presence of an obstacle during the motor's lowering manoeuvre.

[0014] This object and others that shall be observed from the description that follows have been achieved according to the invention with an adapter module with compensation springs for tubular motors suitable for moving awnings or roller shutters or similar, comprising at least one internal adapter module splined to the drive shaft of the motor, at least one external adapter module splined to the roller tube and coupled to the internal adapter module by at least one spring, the external adapter module and the internal adapter module being such that some play is left between the two so as to permit reciprocal rotation for at least five angular degrees, characterized by the fact that the spring acts in such a way as to generate a temporary difference between the angular velocity of the internal adapter module and the angular velocity of the external adapter module at the moment in which the weight force applied to the roller tube is cancelled out.

[0015] The present invention is further clarified below in its preferred embodiment of practical realization shown purely by way of non-limiting example with reference to the annexed figures:

figure 2 represents a form of practical realization of the adapter module with compensation springs;
figure 3 shows a cross-section of the adapter module with compensation springs during the lowering manoeuvre in absence of obstacles and a representation of the electrical signal generated by the sensor;
figure 4 shows a cross-section of the adapter module with compensation springs at the moment in which the roller shutter encounters the obstacle during the lowering phase and a representation of the electrical signal generated by the sensor;
figure 5 shows a cross-section of the adapter module with compensation springs at the end of the spring's thrust action and a representation of the electrical signal generated by the sensor.

[0016] Figure 2 represents a form of practical realization of the adapter module with compensation springs. It consists of an internal adapter module (1) splined to the drive shaft (2) of the tubular motor, an external adapter module (4) splined to the roller tube (6), a plate (3) and a spring (5). The internal adapter module (1) is lodged in the external adapter module (4); the internal (1) and external (4) adapter modules are constructed in such a way as to produce a play of 20 angular degrees; this play enables the internal adapter module (1) and the external adapter module (4) to rotate, one with respect to the other, for a maximum of 20 angular degrees.

[0017] The internal adapter module (1) is coupled to the external adapter module (4) by means of a spring (5) in such a way that the application of a weight force on the roller tube compresses the spring (5). The plate (3) is attached to the internal adapter module (1) for the sole purpose of preventing the internal adapter module (1) from sliding out of the external adapter module (4).

[0018] Figure 3 shows a cross-section of the adapter module with compensation springs during a lowering manoeuvre before the roller shutter encounters an obstacle. The weight force (38) of the roller shutter applied to the roller tube and hence to the external adapter module (34) is such that it compresses the spring (35); up to the point in which the roller shutter encounters the obstacle (36) the drive shaft of the tubular motor, the internal adapter module (31), the external adapter module (34) and the roller tube move in an integral manner. The electrical signal (37) generated by the sensor consists of an alternation of logical states and the period of the signal is just about constant.

[0019] Figure 4 shows a cross-section of the adapter module with compensation spring when, during the lowering manoeuvre, the obstacle is encountered (46). When the roller shutter encounters the obstacle (46) the weight force (48) of the roller shutter comes to rest on

the obstacle (46) and no longer on the roller tube, the spring (45) tends to return to its rest condition applying to the external adapter module (44) and hence to the roller tube a thrust in the opposite direction to that in which the motor drive shaft is rotating, thereby reducing the angular velocity of the roller tube. Through the gear ring which moves integrally with the roller tube, the deceleration of the roller tube is transmitted to the reduction unit and hence to the position detector. The electrical signal (47) generated by the sensor indicates the deceleration with a substantial increase in the period of the signal.

[0020] Figure 5 shows a cross-section of the adapter module with compensation spring at the end of the spring's thrust action (55). When the spring (55) has completed its thrust action on the external adapter module (54) cancelling out the play of 20 angular degrees between the external adapter module (54) and the internal adapter module (51), the drive shaft, the internal adapter module (51), the external adapter module (54) and the roller tube start moving again in an integral manner. The electrical signal (57) generated by the sensor returns to being an alternation of logical states and with a period that is just about constant.

[0021] From the above, it may be clearly observed that the adapter with compensation springs presents numerous advantages, among which:

- in the event of the presence of an obstacle during the lowering phase, it enables the sensor to supply to the microprocessor an electrical signal that differs substantially from that generated in the absence of obstacles, thereby placing the microprocessor in the condition to intercept in a safe and timely manner the presence of the obstacle during the lowering phase.
- It cancels out the negative effects on the system's performance of the inevitable, if minor, structural friction that may be created during the movement of the awning or roller shutter or similar.
- It can be easily adapted to make it compatible with roller tubes of any shape and tubular motors of any kind equipped with electronic limit switches with position sensors applied near to the gear ring or to the parts of the reduction unit.

Claims

1. Adapter module with compensation springs for tubular motors suitable for moving awnings or roller shutters or similar, comprising at least one internal adapter module (1) splined to the drive shaft (2) of the motor, at least one external adapter module (4) splined to the roller tube (6) and coupled to the internal adapter module (1) by at least one spring (5), the external adapter module (4) and the internal adapter module (1) being such that some play is left between the two so as to permit reciprocal rotation for at least five angular degrees, **characterized by** the fact that the spring (5) acts in such a way as to generate a temporary difference between the angular velocity of the internal adapter module (1) and the angular velocity of the external adapter module (4) at the moment in which the weight force applied to the roller tube (6) is cancelled out.

2. Adapter module with compensation springs for tubular motors suitable for moving awnings or roller shutters or similar as claimed in Claim 1 **characterized by** the fact that at least one of the springs is a torsion spring.

3. Adapter module with compensation springs for tubular motors suitable for moving awnings or roller shutters or similar as claimed in Claim 1 **characterized by** the fact that at least one of the springs is a compression spring.

4. Adapter module with compensation springs for tubular motors suitable for moving awnings or roller shutters or similar as claimed in Claim 1 **characterized by** the fact that at least one of the springs is an extension spring.

5. Adapter module for tubular motors suitable for moving awnings or roller shutters or similar as claimed in Claims from 1 to 4 and substantially as herein illustrated and described.

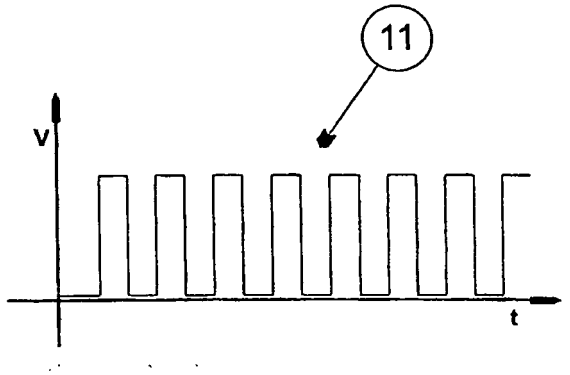
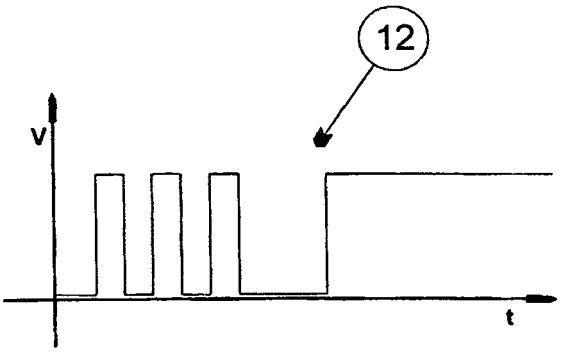
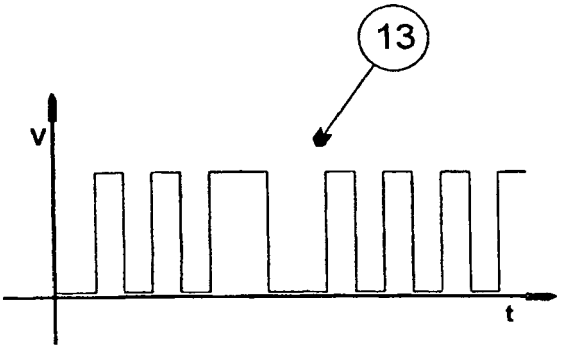


Fig. 1





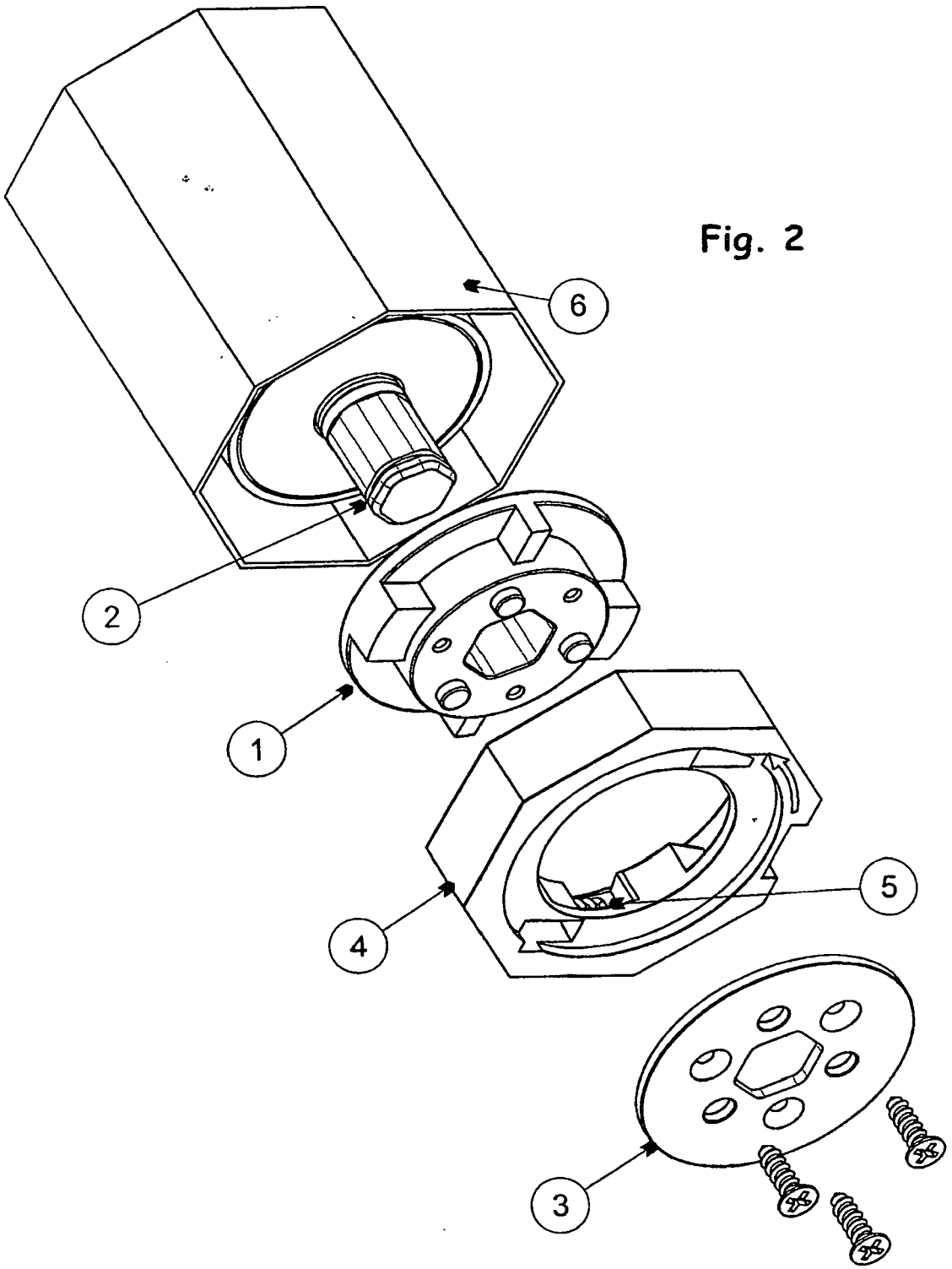


Fig. 2

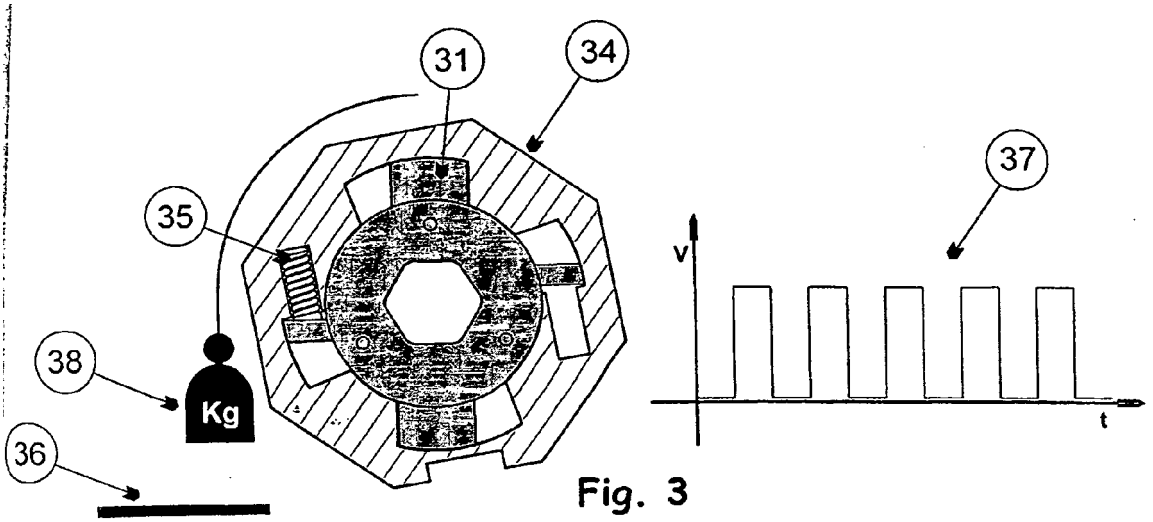


Fig. 3

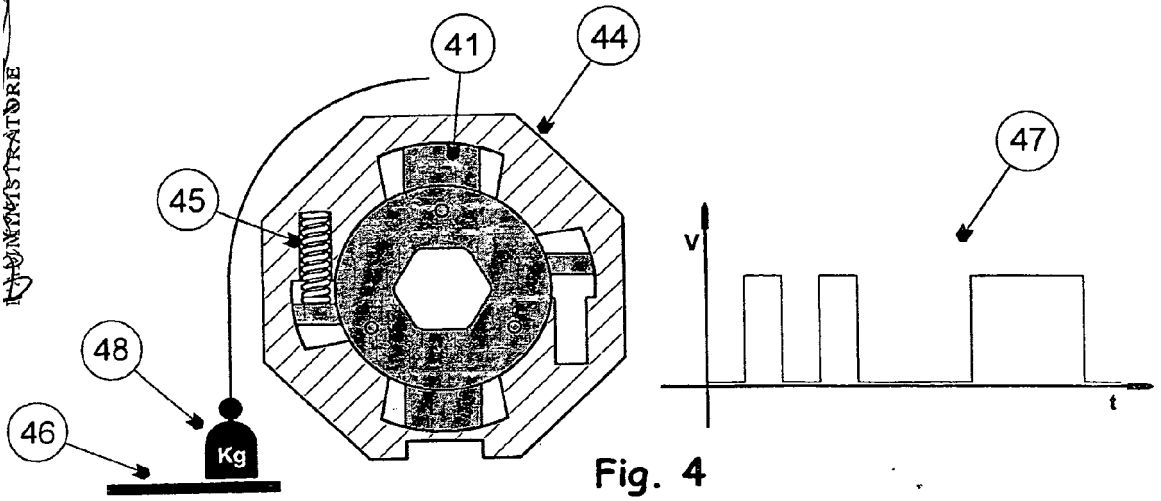


Fig. 4

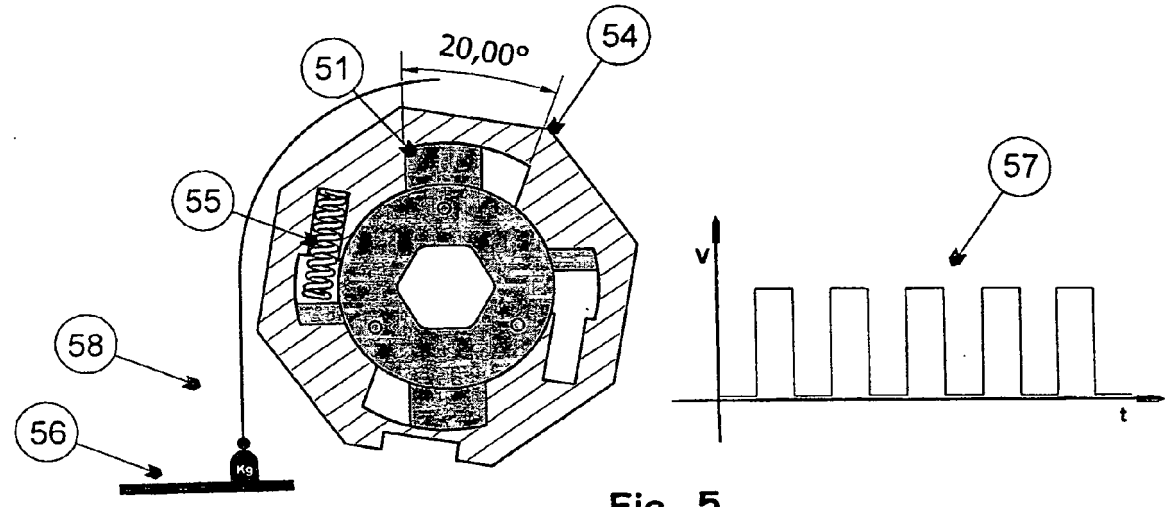


Fig. 5