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(72) Inventors:  
• **Monteleone, Mauro**  
**10092 Castiglione (TO) (IT)**  
• **Marcello, Burzi**  
**12059 La Morra (CN) (IT)**

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(74) Representative:  
**Fiammenghi-Domenighetti, Delfina**  
**Fiammenghi-Fiammenghi,**  
**Via San Gottardo 15**  
**6900 Lugano (CH)**

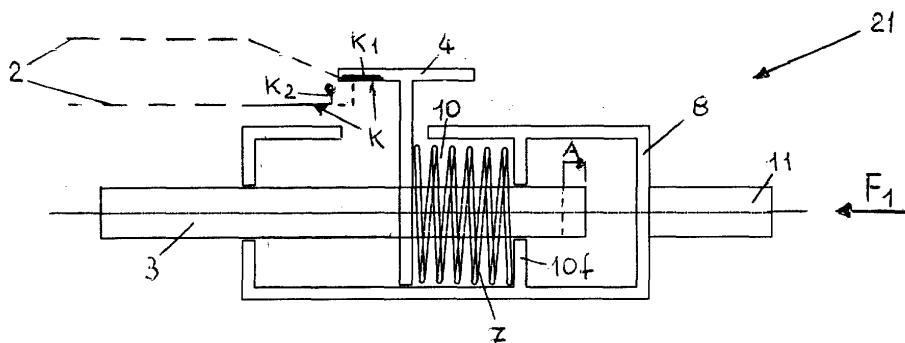
(71) Applicants:  
• **Monteleone, Mauro**  
**10092 Castiglione (TO) (IT)**  
• **Marcello, Burzi**  
**12059 La Morra (CN) (IT)**

(54) **Electrical switch device**

(57) A device (21) able to cause opening or closing of at least one contact (K) of an electric circuit (2) when an axial force ( $F_1$ ) of predefined value is exerted on a member (3) is described, in which, of the two terminals ( $K_1$ ,  $K_2$ ) forming this contact (K), one of them ( $K_1$ ) is integral with a part (4) of the member (3) and the other one is integral with a casing (8) on which the axial force ( $F_1$ ) is exerted and which contains inside it the said member (3) and is slidable with respect to the latter, between the said casing (8) and the said part (4) of the

member (3) there being arranged at least one resilient element (7) which offers an increasing resilient resistance to a relative linear displacement (A) of the member (3) with respect to the casing (8), the two terminals ( $K_1$ ,  $K_2$ ) of the contact (K) reaching a position which causes the opening or closing of the latter (K) when there is a relative linear displacement (A) of the member (3) with respect to the casing (8) which results in reaching of a predefined value of the resilient resistance offered by at least one resilient element (6, 7) and therefore also of the axial force ( $F_1$ ,  $F_2$ ) exerted on the member (3).

**FIG.2**



## Description

**[0001]** The present invention relates to the sector of devices able to activate or, more frequently, deactivate an electric circuit when a predefined force is exerted on a member.

**[0002]** A typical example of these applications consists of the safety devices, for gates or lift doors, which must intervene, interrupting the electric circuit of the apparatus which moves the gates or doors, when they encounter a foreign body along their path.

**[0003]** When this occurs, the moving part of the gate or the door exerts a force on the said foreign body which therefore reacts with a force equal and opposite to that directed towards it. The devices in question have the function of detecting this force and deactivating the system of the electrical apparatus which moves that part when this force reaches a predefined value. This is done in order to avoid possible accidents which may result in injury or damage to persons and objects.

**[0004]** The devices currently used are of various types and use in most cases load sensors of the piezometric or other type which, when a situation such as that described above occurs, send a signal to an electronic control unit which, by means of its logic, causes interruption or reversal of the current supplying the apparatus which performs closure, locking the door and the gate or reversing the direction of movement thereof.

**[0005]** The devices of this kind have, however, certain drawbacks, such as the high cost, a relatively complicated design and the near impossibility of performing adjustment of the limit value of the force at which said devices must intervene.

**[0006]** All these drawbacks are also substantially more significant in the case of "double-acting" devices, i.e. devices which must intervene when a force of predefined magnitude is exerted in any one of the two directions on the member controlled by them.

**[0007]** The inventors of the present invention have devised a device for the abovementioned purposes, the main parts of which are purely mechanical and which is therefore very low-cost and simple to construct and adjust.

**[0008]** The device according to the invention, moreover, in view of its constructional characteristics, is also much more reliable and has an operating life which is much longer.

**[0009]** The device devised by the inventors in fact makes use of the resilient reaction of one or more resilient elements (usually ordinary flexural or torsional springs) arranged between a casing mounted on the member to be moved (for example the thrust spindle for an automatically opened gate) and the said member.

**[0010]** This casing may slide relative to the said member, so that when it is subject to a force or a couple of forces which tends to stop its movement, being integral during movement with respect to the said gate or door, it slides with respect to the said member, compressing

or in any case deforming the abovementioned resilient elements and transmitting this force or couple to the abovementioned member depending on the coefficient of rigidity of the abovementioned resilient elements. A predefined linear travel movement of the casing with respect to the member occurs when a predefined force is applied to the said casing.

**[0011]** With the continuation in the movement of the member and therefore the door or gate moved by it by means of the casing, the sliding movement of the latter relative thereto increases, resulting in an increase also in the resilient yielding action of the abovementioned resilient means and causing a corresponding displacement of a terminal of the electrical system of the apparatus which moves the member, which is mounted on the outside of the casing and which makes sliding contact with another terminal of the said system, which is fixed on a suitably arranged part of the said member. As will be seen more clearly below, by conveniently positioning and suitably designing these terminals with dimensions, it is possible to produce, when the resilient elements have yielded by an amount corresponding to a force of predetermined magnitude applied to the casing and transmitted by it to the abovementioned member, opening (or closing) of the contact formed by these terminals, thereby opening (or closing) a branch of the circuit of the apparatus which performs movement of the said door or the said gate by means of the abovementioned member.

**[0012]** It is thus possible to stop the door or the gate before the force exerted by them on a foreign object reaches a predefined value.

**[0013]** Depending on the degree of performance which the device must provide, an inverter may be inserted into the said circuit, said inverter, when opening or closing of the said contact occurs, causing reversal of the movement of the abovementioned member and therefore of the door or the gate connected thereto.

**[0014]** As will be explained below, using several resilient elements suitably mounted and two contacts of the type described above, it is also possible to obtain opening or closing of the said contact when forces in both directions are applied to the abovementioned casing.

**[0015]** The subject of the present invention is therefore a device able to cause opening or closing of at least one contact of an electric circuit as described in the accompanying Claim 1.

**[0016]** A more detailed description of two preferred examples of embodiment of the device according to the invention will now be provided, with reference also to the accompanying drawings in which:

- Figure 1 shows a longitudinal section through a first device in which the said member moves in a linear manner when no resistive force is applied to the associated casing;
- Figure 2 shows the same cross-section as in Figure 1, when a predefined force is applied to the casing

and a contact is opened as a result of application of a resistive force of a predefined magnitude to the casing;

- Figure 3 shows a longitudinal section through a second device according to the invention of a type which is similar to that of Figures 1, 2, in which two contacts are opened respectively when a force is applied to the casing in one of the two directions; the figure shows the situation in which this force is zero;
- Figure 4 shows the same cross-section as in Figure 3 when one of the two contacts is opened as a result of the application of an axial pulling force to the casing;
- Figure 5 shows the same cross-section as in Figure 3 when the other of the two contacts is opened as a result of the application of a force directed axially towards the casing.

**[0017]** Figure 1 shows a "single-acting" design of the device 21 according to the invention: a member, consisting of a spindle 3, performs the movement of an automatically opened gate (not shown) which is connected thereto by means of a casing 8 which is mounted externally and coaxially around the end of the spindle 3 so as to be able to slide with respect thereto: if the gate in question does not encounter along its path any object which causes it to stop, the situation is that described in the abovementioned Figure 1: a helical spring 7 which is wound coaxially around the spindle 3 is housed inside a compartment 10 formed inside the casing 8 and is arranged, without being subject to any particular stress, between an end wall 10f of the said compartment and a perpendicularly projecting part 4 of the said spindle 3.

**[0018]** When the gate encounters an obstacle which tends to stop it, the casing 8 which is also integrally joined thereto by means of the end 11 slows down its movement and the spindle 3 performs a linear sliding movement A with respect thereto, compressing the spring 7 inside the compartment 10. The two terminals  $K_1$ ,  $K_2$  are fixed on the outside of the casing 8 and on the said projecting part 4 of the spindle, said terminals forming a contact K by means of which the electric circuit 2 (only schematically shown in the drawing) is closed, said circuit supplying power to the apparatus which moves the spindle 3.

**[0019]** This contact K is of the known sliding type and its terminals  $K_1$ ,  $K_2$  are positioned and designed with dimensions such that, when the spindle 3 has compressed the spring 7 with a predefined force  $F_1$  (equal and opposite to the reaction exerted on the casing 8 by the foreign body 8 encountered by the gate), performing the said relative sliding movement A, the contact K opens, interrupting the electric circuit 2 and the movement of the gate.

**[0020]** It is therefore avoided that the spindle 3, by means of the casing 8 integral with the gate, exerts a potentially damaging force on the foreign body (object

or person) against which the gate exerts a pressure.

**[0021]** Figure 3 on the other hand shows a device 1 according to the invention of the "double-acting" type in the sense that this device causes opening of the electric circuit 12 described above in all those situations in which a force  $F_1$ ,  $F_2$  directed in any one of the two directions is exerted on the end 11 of the casing 8 and therefore on the spindle 3.

**[0022]** Whereas Figure 3 shows the situation where no reactive force is applied by the casing 8 on the spindle 3, Figures 4 and 5 show the situations where this reaction  $F_1$ ,  $F_2$  is oriented respectively in the opposite or same direction as that of the movement of the spindle.

**[0023]** Operation of this "double-acting" device is entirely similar to that of the "single-acting" device 21 described above but, in order to achieve the desired object, two compartments 9, 10 have been formed in the casing 8, each compartment housing a helical spring 6, 7, and two contacts K are provided, the terminals  $K_1$ ,  $K_2$  of which are fixed as explained on the outside of the casing 8 and the projecting part 4 of the spindle 3. These contacts K, as well as the springs 6, 7 and the associated compartments 9, 10, are arranged on opposite sides of the said projecting part 4 so that, when one of the two springs is compressed between the latter and the end wall 9f, 10f of its compartment 9, 10, the spindle performs a linear sliding movement A or B such as to cause opening of one of the two said contacts K.

**[0024]** As already mentioned it is possible to insert, into the electric circuit 12, a device of the inverter type which, when the said contacts are opened (or where appropriate closed), causes reversal in the direction of movement of the door or the gate.

**[0025]** It is obvious that, if it is required that a given relative sliding movement of the member 3 with respect to the casing 8 must cause closing, instead of opening of an electric circuit, the terminals of the sliding contacts must be positioned and have dimensions such that, instead of moving away from each other, they are brought into contact at the end of the relative sliding movement of the abovementioned elements.

**[0026]** It is considered that persons skilled in the art do not require further explanations in order to adapt a device according to the invention to this type of "reversed" operation.

**[0027]** It should be noted that the terminals  $K_2$  have been deliberately shown slightly spaced from the casing 8 in order to indicate that they must be only integral during movement with respect thereto. These terminals  $K_2$  may therefore be fixed directly on the outside of the casing 8 or on any element of the gate or the door which is integral with the said casing 8.

## Claims

1. Device (1, 21) able to cause opening or closing of at least one contact (K) of an electric circuit (2, 12)

when an axial force ( $F_1$ ,  $F_2$ ) of predefined value is exerted on a member (3), **characterized in that**, of the two terminals ( $K_1$ ,  $K_2$ ) forming this contact (K), one of them ( $K_1$ ) is integral with a part (4) of the member (3, 13) and the other one is integral with a casing (8) on which the said axial force ( $F_1$ ,  $F_2$ ) is exerted and which contains inside it the said member (3) and is slidable with respect to the latter, between the said casing (8) and the said part (4) of the member (3) there being arranged at least one resilient element (6, 7) which offers an increasing resilient resistance to a relative linear displacement (A, B) of the member (3) with respect to the casing (8), the two said terminals ( $K_1$ ,  $K_2$ ) of the contact (K) reaching a position which causes the opening or closing of the latter (K) when there is a relative linear displacement (A, B) of the member (3) with respect to the casing (8) which results in reaching of a predefined value of the said resilient resistance offered by at least one resilient element (6, 7) and therefore also of the axial force ( $F_1$ ,  $F_2$ ) exerted on the member (3).

2. Device according to Claim 1, in which the contact (K) is of the sliding type, connection or separation of the two terminals ( $K_1$ ,  $K_2$ ) which form it occurring when the terminal ( $K_1$ ) integral with the said part (4) of the member (3, 13) has performed a displacement due to a predefined relative linear sliding movement (A, B) of the member (3) with respect to the casing (8).

3. Device according to one of the preceding claims, provided with one or more pairs of resilient elements (6, 7), in which one (6) of the resilient elements which forms a pair offers a resilient resistance having a direction opposite to that offered by the other element during relative linear displacements (A, B) of the member (3) with respect to the said casing (8), the two resilient elements (6, 7) which form a pair being mounted so that only one of them offers the said resilient resistance to the relative displacement of the member (3) depending on the direction of the latter.

4. Device according to Claim 3, in which the said member is a spindle (3), **characterized in that** it comprises:

- a) a part (4) projecting from the said spindle (3), on the opposite sides of which two terminals ( $K_1$ ) forming two contacts (K) of an electric circuit (2) are mounted;
- b) a casing (8) slidably and coaxially fixed to the said spindle (3) and having two compartments (9, 10) coaxial with the said spindle (3) and each housing a helical spring (6, 7) arranged between one of the end walls (9f, 10f)

of the respective compartment and the said projecting part (4) of the spindle (3);

the other two terminals ( $K_2$ ) forming the said two contacts (K) being fixed on the outside of the casing (8) or on a body integral therewith.

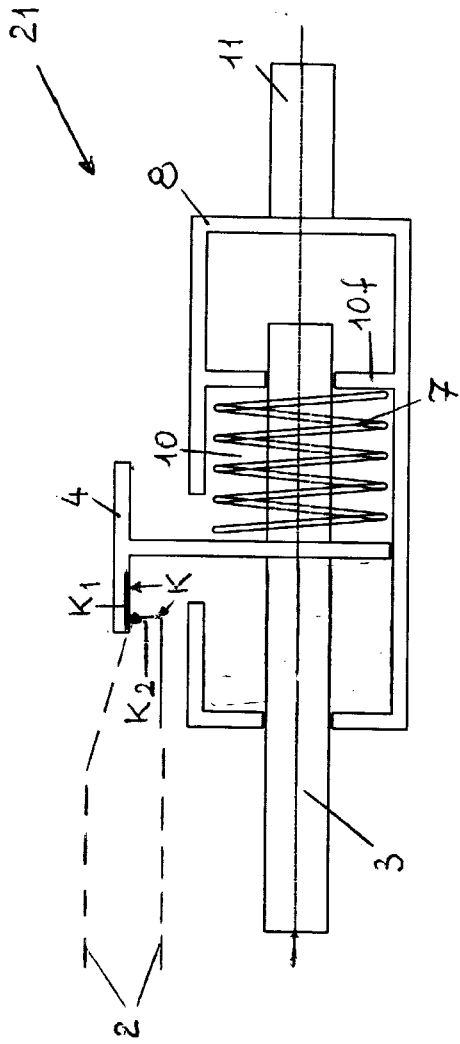


FIG. 1

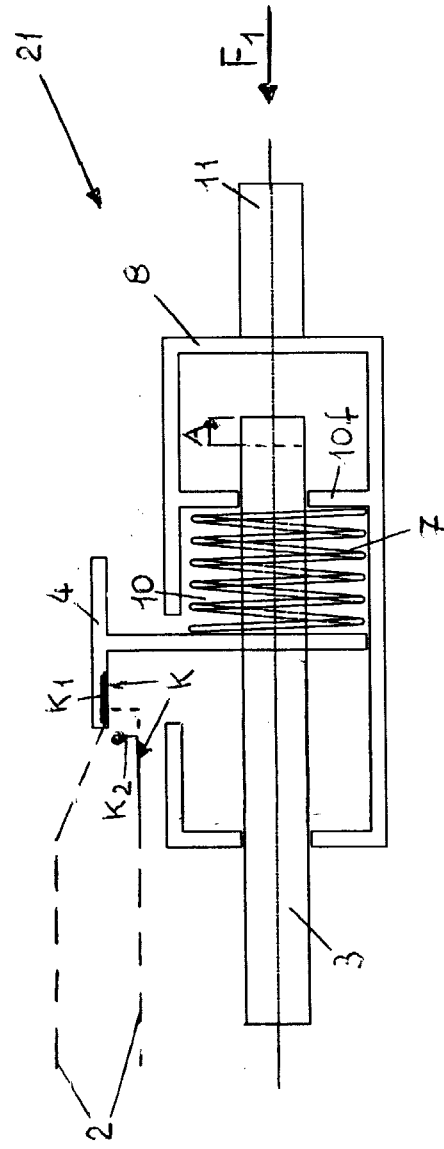


FIG. 2

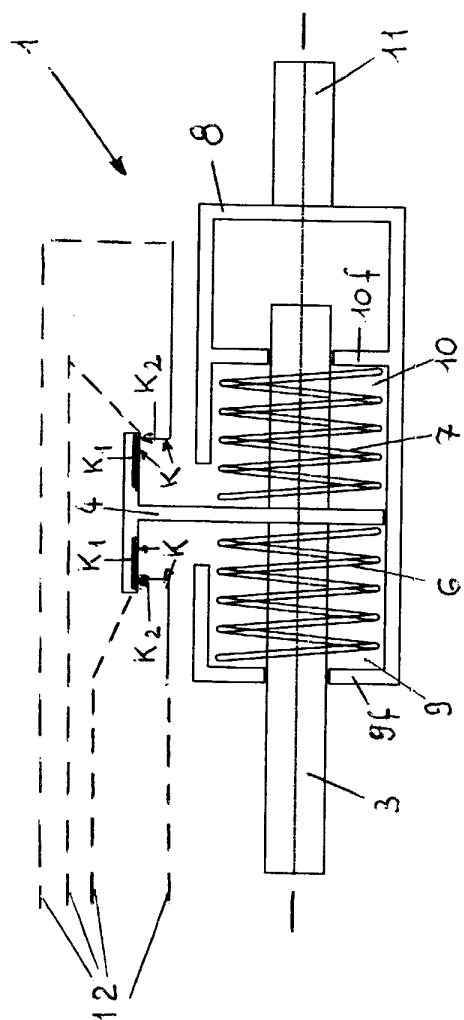


FIG. 3

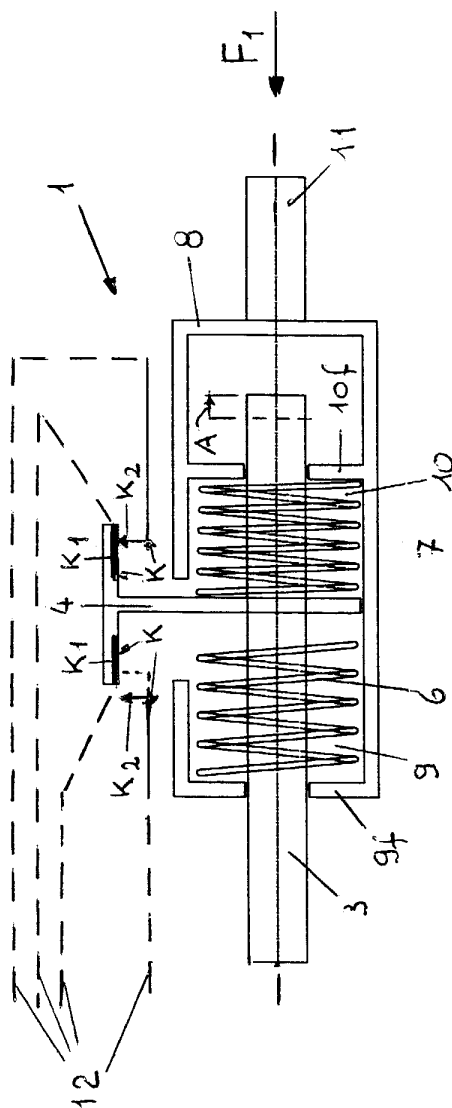


FIG. 4

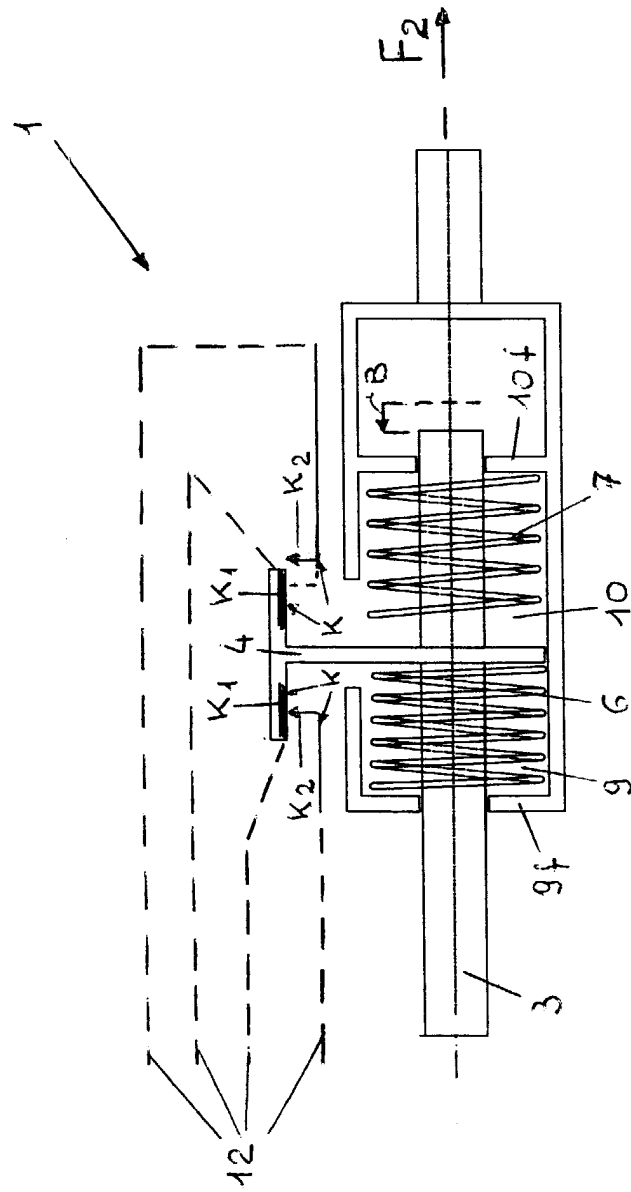


FIG. 5



European Patent  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                               |                                  |                                              |
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| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/> Y : particularly relevant if combined with another document of the same category<br/> A : technological background<br/> O : non-written disclosure<br/> P : intermediate document</p> <p>T : theory or principle underlying the invention<br/> E : earlier patent document, but published on, or after the filing date<br/> D : document cited in the application<br/> L : document cited for other reasons</p> <p>&amp; : member of the same patent family, corresponding document</p> |                                                                               |                                  |                                              |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 03 07 7117

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