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(54) **Actuation and/or locking device for household appliances having an improved actuation control system**

(57) The present invention relates to an actuation and/or locking device for use in a household appliance in connection with a control system for the same device (DB), wherein the device (DB) comprises:

- a body (FR), for being fastened to at least a part (SS) of the household appliance (F),
- first actuation means (TA,TA1), for commanding the actuation to be performed,
- second actuation and/or locking means (B), for exploiting the actuation produced by the first actuation means (TA,TA1),
- a kinematic system (C) associated with the first actuation means (TA,TA1) and the second actuation and/or locking means (B), for transferring the motion from the first actuation means (TA,TA1) to the second actuation and/or locking means (B),
- detection means (DR,C1A,C2A) for detecting the operation of the actuation and/or locking device (DB), comprising information transducer means (SO1,SO2),
- electric connection means (CS,SP,SPT), for connecting the detection means (DR,C1A,C2A) and/or the first actuation means (TA,TA1) to the control system of the household appliance (F) for receiving information generated and transmitted by the detection means (DR,C1A,C2A) as well as for commanding the actuation of the first actuation means (TA,TA1).

tric connection means (CS,SP,SPT) are integrated into a single module (DR) suitable for being mounted or assembled in association with the actuation and/or locking device (DB).

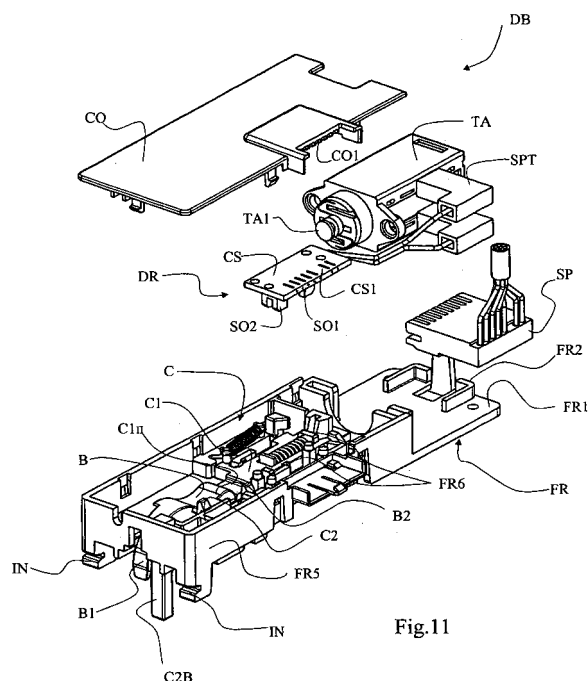


Fig.11

The peculiarity of the actuation and/or locking device consists in the fact that both the at least part of the transducer means (SO1,SO2) and at least a part of the elec-

Description

[0001] The present invention relates to an actuation and/or locking device for household appliances of a type as described in the preamble of the first claim, having a particular and improved system for controlling the actuation to be performed and the overall operation of the device, as well as to a method for assembling said actuation and/or locking device.

[0002] A device of such a type is for example known from the Italian Patent for Industrial Invention No. 1.314.176 in the name of the present Applicant, hereafter referred to as "first known solution" for simplicity sake, the equivalent foreign patent applications being the European Patent application. EP 1 041 186 and the USA application 09/479,289. In view of a close examination of the latters, the texts of the cited applications are provided as an integral part of the present description.

[0003] As a further example of a known device of the type described, we can cite the Italian Patent for Industrial Invention No. 1.303.102 in the name of the present Applicant, hereafter referred to as "second known solution", the foreign equivalents being the European Patent application. EP 0 977 104 and the USA Patent 6,255,934. In view of a close examination of the latters, the texts of the above applications are provided as an integral part of the present description.

[0004] A further example of known actuation means is provided by "direct action" actuators which, unlike the first and the second known solutions, do not have a real kinematic system associated with the actuation means. Therefore, such actuators incorporate at most connection elements whose movements necessarily follow those of the actuators. They can thus be seen merely as actuators having an improved constitution compared to simple monostable type actuators, e.g. thermo-actuators.

[0005] The known actuation devices of this latter type offer the possibility of integrating, on the outside of the actuator body, optical sensors suitable for detecting the position of the above-mentioned connection elements, whose actuation stroke is closely related to that of the actuators commanding the overall operation of the devices.

[0006] An example of such devices is given by the thermal-type actuation device described in the Italian Patent for Industrial Invention No. 1.281.117 in the name of the present Applicant, hereafter referred to as "third known solution", the foreign equivalents being the European Patent application EP 0 781 920 and the USA Patent 5,968,395. In view of a close examination of the latters, the texts of the above applications are provided as an integral part of the present description.

[0007] Although in the related patent documents the cited known solutions (first, second, and third) deal with different kinds of technical problems, within the scope of the technical problem at the basis of the present invention they exemplify and teach homologous characteristics, which can be summarized as follows:

- 1) either they perform the detection of elements of the internal kinematic system, related to the actuation and/or locking devices, through solutions (mechanically operated microswitches) which create a device assembly and operation mode that can be defined as "critical", as further explained hereafter (first and second known solutions);
- 2) or they perform a detection and subsequent transmission of information about the movement of elements which are closely associated with the operation of the actuators of the actuation and/or locking device, and therefore do not say anything about the actual functionality of any (external) kinematic system associated with and driven by the same actuation elements (third known solution).

[0008] In the present document, the term "critical", referred to the assembly and operation mode of an actuation and/or locking device, means:

- a) an operation that requires a high accuracy during the assembly of the elements for detecting the position of the kinematic system within the actuation device, in that even a small offset between the actual position and the design position of said elements may cause a detection error which would make the very presence of the detection means ineffective or even counterproductive (error signals in the absence of faults);
- b) the presence of high driving forces for the position detection elements, which require the presence of actuators having an adequate thrust capacity and need to be properly sized in order to withstand such necessary forces, as well as an unnecessary waste of energy;
- c) an assembly that involves high risks of rejection of the actuation device due to a faulty operation caused by an imperfect assembly of the position detection means, e.g. because of the precision with which the detection means must be positioned with respect to the remaining components of the device;
- d) a difficult and complex process for wiring the actuators and the detection means, which requires a careful and attentive manual intervention by an operator and which in conclusion is neither fast, reliable or high-quality.

[0009] With regard to the above points, it is necessary to underline how important it is nowadays the fabrication of

actuation and/or locking means for household appliances which meet all of the following requirements:

- overall assembly and operation quality and efficiency,
- reduced final production cost,
- space-saving solutions.

[0010] This is due to the need of providing said devices with an increasing number of functions to be performed. It becomes therefore necessary to make final products and production methods that allow to attain the above-mentioned aims through a simple, efficient and ultimately innovative designing.

[0011] The known solutions have the undoubted disadvantage of an irrational assembly as regards the technical problem of advantageously applying a number of substantially known sensors (such as magnetic sensors, optical sensors, or other types of sensors), and of connecting the actuator associated with the device in an efficient manner. It follows that the known solutions imply evident complications in the assembly of the devices and in the connection of the related wiring to the electronic control unit or, more in general, to the control system of the household appliance, suitable for managing the various functions that the actuation and/or locking devices must implement.

[0012] The industrial production reality has demonstrated that, besides long assembly times, the known devices are subject to concrete and high risks of defective operation due to wiring errors, which are difficult to avoid, given the necessity of many single connections that may easily be exchanged each others by mistake; the consequence is that the whole device will be rejected when it undergoes a quality check during the final production test.

[0013] This generally known situation causes therefore higher production costs, a difficult verification of the operation of assembled and non-assembled sensors, and ultimately a low overall efficiency of the final production process.

[0014] Another drawback of the known solutions is that they use actuation and/or locking devices having a system for controlling the actuation to be performed and the overall operation which cannot be easily protected from the action of particularly aggressive atmospheric agents, such as, for instance, the high level of humidity present within household appliances, like washing machines. For example, microswitches cannot be resinated or at least partially coated with protective materials, and are therefore easily attacked by oxidizing agents, with predictable consequences.

[0015] The present invention is based on the acknowledgment of the above facts and permits to overcome the highlighted drawbacks of the state of the art.

[0016] Within such a frame, the present invention mainly has the purpose of indicating an actuation and/or locking device for household appliances which is reliable, economical and easy to be assembled, and that therefore does not require any particularly careful manual intervention by an operator appointed to the assembly of household appliances.

[0017] A first aim of the invention is therefore to provide an actuation and/or locking device for household appliances having a particular and improved system for controlling the actuation to be performed and the overall operation; it is capable not only of detecting the actual and proper operation of the elements of the kinematic system associated with it, but also of performing its functions in a non-critical mode of assembly and operation, i.e. of implementing them with the maximum manufacturing efficiency and the minimum cost.

[0018] A further aim of the invention is that of indicating an actuation and/or locking device for household appliances which requires an assembly process easily feasible by using automatic production systems.

[0019] In other words, the device according to the invention is capable of controlling the state and the position of an internal or associated kinematic system/mechanism (and therefore not only the simple operation of the actuator or of the actuation elements closely associated with it), at the same time producing a much higher efficiency in terms of assembly, operation and reliability.

[0020] A further aim of the invention is that of indicating an actuation and/or locking device for household appliances which implies an assembly of the actuation device at low risk of rejection during a quality and reliability check carried out on the entire actuator. Such a rejection may be caused either by a defective operation of the means for the detection of the position of the kinematic system elements of said device, or by a wrong harness concerning the detection and actuation means.

[0021] A further aim of the invention is that of indicating an actuation and/or locking device for household appliances which allows to easily carry out testing procedures by means of automatic production systems.

[0022] A further aim of the invention is that of indicating an actuation and/or locking device for household appliances having a system for controlling the actuation to be performed and the overall operation which can be easily provided in a version with protected assembly, i.e. susceptible of efficiently operating in environments with particularly hard climatic conditions and/or a shock-proof location.

[0023] A further aim of the invention is then to provide an actuation and/or locking device with external dimensions as small as possible, for applications on household appliances having particular needs in terms of compactness and therefore of rationalization of the inner spaces.

[0024] A further aim of the invention is that of indicating an actuation and/or locking device for household appliances comprising a module providing at least part of the harness/connection of at least part of the sensor and/or the actuator.

[0025] Such aims are attained, according to the present invention, by an actuation and/or locking device for household appliances having an improved system for controlling the actuation to be performed and the overall operation, as well as by a method for controlling the actuation to be performed, having the features of the annexed claims, which form an integral part of the present description.

[0026] Further aims, features and advantages of the present invention will become apparent from the following detailed description and the annexed drawings of the invention embodiments, which are supplied by way of non-limiting examples, wherein:

- Fig. 1 shows an exploded perspective view of a first embodiment of an actuation device according to the present invention;
- Figs. 2 and 3 show two assembled perspective views of the actuation device of Fig. 1, wherein said device is shown complete and without a component, respectively, for a better representation of the parts of the internal kinematic system;
- Fig. 4 shows a plan view of the actuation device as shown in Fig. 3;
- Figs. 5 and 6 show an assembled perspective view of the device of Figs. 1-4 without some components, in a first and in a second operating condition, respectively;
- Figs. 7-10 show a plan view of the actuation device as shown in Fig. 4, in four distinct operating conditions, respectively;
- Fig. 11 represents a partially exploded perspective view of a second embodiment of a device according to the invention;
- Figs. 12 and 12/I respectively show a plan view and the longitudinal section along the A-A axis of the device of Fig. 11;
- Fig. 13 illustrates a perspective view from below of the device of Fig. 11;
- Figs. 14 and 15 illustrate a perspective view from above of the device of Fig. 11, without some elements for a better representation of a detail of said device;
- Figs. 16 and 16/I, 17 and 17/I, 18 and 18/I, 19 and 19/I, 20 and 20 /I illustrate some partially sectioned views from below and the related longitudinal sections (/I) taken along the B-B, C-C, D-D, E-E, F-F axes of the device of Fig. 11 in five distinct operating conditions, respectively;
- Fig. 21 shows a perspective view from above of a household appliance fitted with the device of Fig. 11;
- Fig. 22 shows the longitudinal section of the household appliance of Fig. 21 along a plane which is parallel to the side wall of the household appliance.

[0027] In particular, the device according to the invention is of a typology as described in the preamble of the first claim, which is considered as an integral part of the present description, i.e. of a type comprising at least an actuator and a kinematic system and/or actuation means; the actuation kinematic system allows the actuator to transfer at least a part of the motion it generates to the final actuation and/or locking elements. Besides, the invention fits any devices comprising a kinematic system suitable for producing an actuation and/or locking of parts of household appliances, and wherein it should be appropriate, for any reason, to monitor the proper functionality of said kinematic system.

[0028] Devices according to the present invention may also comprise some actuation kinematic systems suitable for assuming operating states which are independent from the operating state of the actuator that drives them. Said devices may therefore comprise the feature of having a plurality of stability positions and/or an autonomous operation and/or an improved working speed, and/or of implementing other specific functions; furthermore, they may comprise complex kinematic systems, or more simply they may command the articulated actuation of shafts, strikers, cams, foils, hooks, and the like.

[0029] In the present description, by "autonomous operation devices" we mean a category of devices suitable for carrying out all phases of their working cycle, i.e. all of the sequences of actuation and/or hooking/unhooking, independently from the fact of being mounted on household appliance or final apparatus and/or without necessarily having to co-operate with external means, such as kinematic systems or actuation elements belonging to the final apparatus; an extremely accurate assembly of said devices on the machine or final apparatus is therefore not strictly necessary.

[0030] Moreover, in the present description the term "kinematic system" means a set of elements or means which are susceptible of transmitting the action, e.g. a thrust, pull or rotation, etc. produced by an associated actuator and/or of transforming said action into a different motion. In some cases, the kinematic system is at least partially independent from the operation of the actuator, i.e. some parts of said kinematic system may not be integral with the actuator and therefore may not be subject to a motion constantly constrained to that of the actuator.

[0031] Before describing the invention, it is appropriate for clarity sake to take into account in more detail the above-mentioned known solutions, in particular the first one. The device described in the first known solution is applied in particular to a system for locking the drum of a laundry washing and/or drying machine in a certain position, hereafter referred to as drum lock. With special reference to Figs. 12-17 annexed to the patent application of the first known

solution, and recalling the various components by using the same numbers as those used in said patent, the following briefly summarizes the operation of the kinematic system present in the actuation device having improved working speed.

[0032] Fig. 12 of the first known solution shows the initial condition, or idle condition, of the device 20, comprising said characteristics of autonomous operation, wherein the actuator 1 is not electrically supplied and the slide 23 is in an advanced or extracted position with respect to the housing body, i.e. in the lock position in the given embodiment of use as a drum lock, wherein the appendix 23A is inserted in a suitable cavity or seat defined in the pulley 28. From the cited Fig. 12 it can be seen that, in said initial condition, the piston 8 of the electro-thermal actuator or thermo-actuator 7 and the shaft 3 are completely retracted, the hooking teeth 23E of the foils 23D are not engaged with the pins 21F, and the slider 26, constrained to the shaft 3 of the actuator 1, is in a first position completely retracted towards the actuator itself. In such a condition, the lateral appendix 23G of the slide 23 keeps the driving element 22A of the microswitch 22 pushed, e.g. keeping the machine motor supply circuits open.

[0033] The start of a wash cycle causes the electric supply of the thermo-actuator 7, with the consequent extension of the shaft 3. With reference to Fig. 13 of the first known solution, the thrust produced by the shaft 3 causes the displacement of the slide 23 and of the lateral appendix 23G, thereby freeing the driving element 22A of the microswitch 22. Moreover, the teeth 23E engage with the pins 21F, thereby locking the slide 23 in the retracted position of use, or unlock position; in such a condition, the appendix 23A of the slide 23 is in a retracted position within the body 21, and so it is behind the cavity of the pulley 28, thereby freeing it and allowing its rotation.

[0034] In this embodiment, the switching of the microswitch 22 is also used for closing the door lock supply circuit, thereby preventing the washing machine door from being opened.

[0035] In a subsequent phase, the electric supply of the actuator 1 is interrupted and the shaft 3 slowly returns to the initial position. The spring 24 tends to push the slide 23 toward the initial position. As it can be highlighted in Fig. 14, the return of the slide 23 is prevented by the hooking teeth 23E engaged with the pins 21F.

[0036] The microswitch 22 is kept in the door lock supply circuit closed position, thereby preventing the machine door from being opened. The shaft 3 is however free to continue its return stroke within the body 2 of the actuator 1; during said stroke, the return of the shaft 3 causes the retraction of the slider 26 (Fig. 15), and the lateral appendixes 26A slide onto the inclined reliefs 23F of the foils 23D; the result is therefore a reciprocal opening of the foils 23D until the slide 23 is released and returns toward its original position (Figs. 16, 17). The device 1 thus returns to the initial position (Fig. 12), i.e. the lock position.

[0037] After said last movement of the slide 23, also the switching of the microswitch 22 takes place, since the lateral appendix 23G presses again the actuation element 22A. The switching of the microswitch 22 causes the opening of the supply circuit of the electric motor that produces the drum revolution; it follows that the washing machine drum is locked in the desired position, the motor is stopped and the machine door can be opened.

[0038] In conclusion, the above described device of the first known solution uses a microswitch 22 which co-operates with a lateral appendix 23G constrained to the slide 23 in order to send an ON/OFF type signal to a logic of the control system of the machine on which the device is mounted, aiming at signaling whether or not the slide 23 is in the working extracted position, i.e. the lock position. The microswitch 22 is of mechanic type, and is suitable, as described above, for detecting the position of an element of the kinematic system for the actuation of the autonomous operation device.

[0039] A first requirement that such actuation devices, in particular drum locks and/or door locks for applications in household appliances, must meet is that of having external dimensions as small as possible, so that they can be housed even in particularly compact machines. From this viewpoint, we can preliminarily point out that the use of a microswitch, which is bulky by its very constitution, placed next to the kinematic system as in the first known solution, often takes much more room than the maximum width of the main body of such actuation devices will allow. Therefore, in the known drum locking devices, said contacts or microswitches are very difficult to be installed within the confined inner spaces available in the current household appliances.

[0040] On the whole, the use of microswitches or contacts in the aforesaid devices, and therefore in the particular harness configuration shown, presents a number of drawbacks which may be summarized and exemplified as follows:

- notoriously, microswitches need a certain actuation force for being activated, that must be taken away from the force of the actuation device intended to drive the actuation kinematic systems. It follows that said kinematic systems must be oversized just to allow for the driving of the contacts or microswitches;
- the use of microswitches, especially when more than one are installed, implies problems of positioning and wiring within the device body. In fact, they have large dimensions and must be positioned in a specific way in order to operate correctly and ensure a good reliability in time. It follows that the wiring of the related connectors can be quite complex, to great disadvantage for the production processes and the quality of the final product;
- the use of a preassembled type microswitches involves a higher device cost, thus contributing to increase the final cost of the whole device in which they are installed;
- the integration of electric contacts with other elements of the actuation and/or locking device, e.g. in drum locks,

involves a higher assembly cost and risks related to possible positioning errors. In this case, the difficult assembly may cause false contacts or defective electric switchings, thereof verification during the production process would imply the rejection of the entire drum locking device. In any case, in the presence of faulty assemblies there is the risk that the device may initially work, hiding a likely premature deterioration of the electric contacts due to inaccurate assembly and wiring operations. Such a risk of deterioration is even higher when the switching of the contacts is not enough rapid;

- microswitches are not suitable, during their assembly within the bodies of the devices where they must operate, for fast and high-quality electric and/or mechanic assembly operations.
- having a very short stroke and ON/OFF activation mechanisms which are not very accurate along their stroke, microswitches need to be assembled with the utmost precision, thus making the assembly process more complex.

[0041] Moreover, it has to be underlined the concept that an incorrect assembly and the resulting defective operation of the cited microswitches would cause the possible rejection of the entire device, thus leading to increase production costs.

[0042] Actuation devices of the above-mentioned type are also used as door locks for ovens, especially for household applications. Also for such devices related to the second known solution we can make some considerations concerning practical disadvantages.

[0043] Figures 4 and 9-11 related to the aforesaid document EP 781 920 illustrate an embodiment of an actuation device comprising a position sensor, indicated as a whole with 20, suitable for providing an electric signal as a function of the operating position of the appendix 7. In this embodiment, the sensor 20 is of an optical type and the related position signal is of digital binary type.

[0044] It is fundamental to underline that the first movable element 28 of the sensor 20 is integral with the appendix 7, whereas the second movable element 30 is integral with the support element 9, to which the second thermo-actuator 5 (Fig. 4) is rigidly constrained. Therefore, the sensor 20 is only capable of detecting the proper operation of the elements within the body 2 of the actuation device, but without being able to detect anything regarding an external kinematic system that may operate in association with the whole actuation device 1.

[0045] In the following there are the specifications of the present invention.

[0046] The first embodiment of the actuation device according to the present invention is illustrated in the annexed Figs. 1-10, and concerns an actuation and/or locking device having an inner kinematic system analogous to that represented in the first known solution, whose text is to be considered as an integral part of the present description, particularly as regards the constitution and the operation of the homologous parts.

[0047] Figs. 1-6 clearly highlight the parts making up the entire actuation and/or locking device, indicated as a whole with 50. It consists of a main body 51 substantially shaped as an open-top cradle, for instance made of a thermoplastic material, and having at its four ends many flanges 52 for fastening the same device 50 to a machine incorporating the same device 50 by means of known fastener means.

[0048] Laterally to the body 51 a seat 53 is provided, protruding or raised with respect to the same body 51, for housing and/or fastening a module 54, comprising sensor and transducer means which will be better detailed later, suitable for detecting at least some operating conditions of the device 50 and for transferring the corresponding signals to a control system, not shown here for simplicity sake, of the actuation and/or locking device 50. Said module 54 is suitable for providing at least a part of the related harness and/or electric connection among the parts of the same device 50 and to the above-mentioned control system; moreover, it is preferably a single module, such as, for instance, a printed circuit, and comprises at least one electronic device; on this matter, reference to Figs. 1, 6 and 7 is particularly made.

[0049] In said preferred solution, the module 54 comprises an electronic circuit 54A, mounted on a printed circuit, wherein at least on one side or an end there are electric connections forming a male connector element 54A1, suitable for being inserted into and/or connected to a respective external female connector 55. The female connector 55 may for example be in connection with the control system of a machine incorporating the actuation device 50 according to the invention, and therefore said connection allows for the above-mentioned electric connection between the module 54 and the control system. The module 54 is also electrically connected to a second connector 56, suitable for providing an electric connection to at least one actuator 1 of the device 50; aimed to this, the connector 56 is engaged onto the electric contacts of a thermo-actuator 1 housed in the actuation and/or locking device 50, in order to transmit the electric supply to a thermistor or PCT within the same thermo-actuator 1.

[0050] The electronic circuit 54A comprises a pair of optical sensors made up of one light emitter 54B and one light receiver 54C, represented by a LED diode and a phototransistor, respectively, mutually coupled, i.e. facing each other; if necessary, electronic components may be additionally present on the electronic circuit 54A, such as, for instance, resistances and capacitors, if necessary obtained with the SMD (surface mounted device) technique. According to known optoelectronic technologies, said module 54 allows to obtain electric signals, e.g. of binary type, depending on whether the receiver 54C receives or not a light signal produced by the emitter 54B.

[0051] The module 54, including the electronic circuit 54A, is mounted onto the seat 53 of the main body 51 through suitable known fastening and/or hooking elements, e.g. of the typology specified below.

[0052] In such a configuration, the male connector 54Al turns out to be easily accessible from the side of the body 51; at the top it is then covered by a part of the body, i.e. by a shell 54D (Fig.1), which preferably performs multiple functions; in fact, said shell 54D has the functions of covering and protecting the electronic circuit 54A as well as of driving the connection of the electronic circuit 54A onto the male element 54Al, i.e. it is suitable for determining univocally the polarization of the connector 55 during the connection to the electronic circuit 54A. As a matter of fact, the shell 54D has references 54E in the engagement area of the female connector 55, which in its turn has mating strikers 55E suitable for guiding its engagement into the male connector 54l. This way, it is univocally determined that only a particular female connector 55 is able to be connected to the sensor 54, with only one possible connection orientation.

[0053] In the housing identified by the seat 53 and the shell 54D, there are preferably hooking means suitable for retaining the connector 55 in the operating position; such hooking means, e.g. consisting of an elastic element, may be provided also within the shell 54D.

[0054] The thermo-actuator 1 is of a type analogous to that illustrated in the first known solution, and its operation is the same. Therefore these aspects are not to be detailed any further, since they are known and widely described in the cited patent text.

[0055] With particular reference to the exploded view of Fig. 1, the number 57 indicates a movable element or slide within the body 51, which at one end has a driving or locking element 57A, hereafter referred to simply as shaft 57A, protruding from an aperture 57G defined in one of the lengthwise ends of the body 51; the shaft 57A is suitable for representing the actuation and/or locking element for the actuated device 50.

[0056] The slide 57, once assembled to the body 51 along with a cover 58, creates a volume inside the device 50, wherein the thermo-actuator 1 is housed. The cover 58 is movable with respect to the body 51, and is a part of the kinematic system: it is of a typology as illustrated in Figs. 10 and 11 of the first known solution, i.e. it is suitable for engaging through its slider 58C with the final portion of the actuation element 3 of the thermo-actuator 1. The cover 58 is then moved by the actuation element 3 in both translation directions, in accordance with the activation state of the thermo-actuator 1. An elastic element 59, in particular a spiral spring, is rested between the slide 57 and the body 51, in front of the latter in the representations of Figs. 1 to 10.

[0057] It can be noticed that the body 51 houses the thermo-actuator 1 resting on the relief 51C, which is susceptible of commanding in a known manner the actuation of the kinematic system of the actuation device 50, i.e. whether the related piston or actuation element 3 should extend or not depending on the supply or the interruption of the electric power to the inner PCT thermoresistor. The housing modes of the thermo-actuator 1 are also known, since they are identical to those illustrated and described in the embodiment showing the first known solution. Therefore, the thermo-actuator 1 has a substantially fixed position with respect to the body 51, thanks to the presence of a clamp 60 that retains it from the top; said clamp may be a suitably shaped metal band, which hooks onto catches that are not detailed any further here for simplicity sake.

[0058] In the exploded view of Fig. 1, it is clear that the slide 57 is configured so as to have an empty central area, whose dimensions are greater than those of the thermo-actuator 1 housed within, resting on the main body 51. The slide 57 is suitably shaped and/or provided with a side aperture fitted for allowing it to move notwithstanding the crossing and/or presence of some elements of the actuator 1, whose contacts always remain facing toward the outside part of the slide 57.

[0059] A first end of the slide 57, in the rear in Figs. 1-10, defines the already cited shaft 57A which, as said above, passes through an aperture 57G being present in one of the lengthwise ends of the main body 51 of the actuation device 50.

[0060] At the front end of the slide 57, on the opposite side of the shaft 57A, there is also a bridge 57B. Onto said bridge 57B the actuation element of the thermo-actuator 1 is adapted to perform its thrust action through the interposition of the slider 58C of the cover 58. At the center of the bridge 57B there is a constraint element 57C for the already cited spring 59; the other end of the spring 59 is constrained in a point 51A defined in the lengthwise wall of the body 51 opposed to the one from which the shaft 57A protrudes (Fig. 4).

[0061] The foils 57D depart from the bridge 57B, laterally with respect to the constraint element 57C, thereby providing hooking means for the slide 57. These foils 57D are flexible and have ends shaped for defining respective hooking teeth 57E, each having an inclined surface which ends with a step. In an intermediate point of the foils 57D, reliefs 57F are also defined, whose function will be described later; as it can be seen, each of the reliefs 57F has at least a lateral surface which is inclined or anyway shaped for allowing an easy sliding onto it of a surface of a further functional component of the actuation device 1, specifically the slider 58C of the cover 58. In fact, the slider 58C has appendixes 58l provided for, when the kinematic system is activated, sliding onto the reliefs 57F and setting apart the foils 57D.

[0062] The main body 51 also has hooking pins 51B integrated into the bottom wall and projecting into the body 51, located near the foils 57D at a distance that allows them to interact with the latter. The pins 51B are substantially positioned in correspondence with the cited inclined surface of the hooking teeth 57E. The surface of the pins 51B

facing the foils 57D is suitable for easing the sliding of the inclined surface of the teeth 57E, when these have to overcome the constraint being represented by the pins 51B. The teeth 57E of the slide 57 are also suitable for hooking onto the pins 51B of the body 51.

[0063] In proximity to the bridge 57B of the slide 57, on the same side of the seat 53 of the main body 51, an indicator 61 protrudes from the slide 57, preferably having a relief-like or bridge-like shape and integral or in one piece with the same slide 57. During its translational motion, said indicator 61 is susceptible of interacting with the module 54 associated with the main body 51. In particular, it is capable of sliding between the emitter 54B and the receiver 54C of the same module 54, thus interfering with the emitted light signal. Such a solution embodiment therefore permits to signal the position of the slide 57 with respect to the main body 51 of the actuation device 50.

[0064] This situation is clearly illustrated in the embodiments of Figs. 5 and 6, as well as in the following Figs. 7-10, wherein the actuation device is shown in projection and, for clarity reasons, without the following elements: cover 58 of the body 51, shell 54D of the module 54, and spring 59 (Figs. 5 and 6 only).

[0065] The slider 58C is bound to the cover 58, and is mechanically coupled in a known way with the actuation element or piston 3 of the thermo-actuator 1 (on this matter, see the description of the first known solution). The slider 58C therefore is not constrained to the main body 51, being able to slide longitudinally with respect to it, and can longitudinally return with respect to the slide 57. The same slider 58C also defines two appendixes 58I, which are substantially aligned with the inclined reliefs of the foils 57D; said appendixes 58I have the function of operating onto the inclined reliefs of the foils 57D in order to cause a bending during the opening action and therefore cause the hooking teeth 57E to be released from the pins 51B integral with the body 51 of the device 50.

[0066] The actuation and/or locking device 50 is suitable for being applied to a household appliance, for instance a laundry washing and/or drying machine provided with a safety drum locking function. Its operation is described below with particular reference to Figs. 7-10.

[0067] The above-mentioned figures show the actuation device 50 in plan view and without some exterior components, in order to facilitate the understanding of its operation; specifically, it is represented without the upper part of the cover 58 of the body 51, but with the slider 58C integral with the cover 58, and without the shell 54D of the module 54.

[0068] The cited figures also provide a schematic representation of a pulley 28 integral with the drum revolution shaft of a laundry washing machine; the other components of this machine are not shown and described hereafter for simplicity, since such components and their operation are known in the art.

[0069] Fig. 7 shows an operating condition of the actuation device 50, which can be considered as initial. The actuation device 50 is in the lock position, i.e. with the shaft 57A of the slide 57 at its maximum lengthwise stroke, inserted in a cavity defined in the pulley 28 for preventing the drum from turning. The spiral spring 59 is at its maximum extension, constrained between the constraint point 51A of the main body 51 and the constraint element 57C of the slide 57; the thermoactuator 1 is not electrically supplied, and therefore the related actuation element 3 is in retracted position.

[0070] In said initial or lock position, the hooking teeth 57E of the foils 57D are distant from the hooking pins 51B; the slider 58C of the cover 58, where the actuation element 3 of the thermoactuator 1 is constrained, is in fully retracted position.

[0071] Being interposed, the indicator 61 integral with the slide 57 interrupts the optical transmission between the emitter 54B and the receiver 54C. The module 54 transmits an electric signal to the machine control system, e.g. of ON type, thereby detecting the presence of the slide 57 and therefore of the related shaft 57A in the drum lock operating condition of the same machine, i.e. of maximum lengthwise extension.

[0072] The subsequent operating phase starts by supplying power to the thermoactuator 1, which displaces the actuation element or piston 3 in a known way, bringing it to an extracted position of use, e.g. within a time of a few tenths of seconds.

[0073] Fig. 8 highlights said second operating condition, according to which the actuation element 3 pushes the bridge 57B of the slide 57, against the opposed action of the spring 59. Therefore, the slide 57 translates to a retracted position of use together with its shaft 57A, thereby freeing the cavity of the pulley 28. The actuation device 50 is now in an actuation or unlock condition, and the drum of the laundry washing machine in which it is mounted is free to rotate.

[0074] The above-mentioned retraction of the slide 57 is readily signaled by the module 54, which sends corresponding information to the control logic of the laundry washing machine. In particular, the indicator 61 integral with the slide 57 is also in a retracted operating position, and therefore is far from the space defined between the emitter 54B and the receiver 54C of the module 54. The transmission of the optical signal between these items 54B and 54C is thus allowed, and this time the digital signal output from the module 54 is of OFF type.

[0075] The signal switching between ON and OFF, or any other suitable typology of signal (e.g. analogue, encoded, etc.), sent by the module 54 to the control system of the laundry washing machine may then suitably be used for implementing additional functions of a machine in which the actuation device 50 is installed, e.g. in order to close the supply circuit of a door lock associated with the actuation device 50, i.e. with the drum lock, thereby preventing the door of the laundry washing machine from being opened.

[0076] Fig. 8 also shows what happens on the other end of the slide 57, i.e. on the bridge 57B. The teeth 57E of the

foils 57D are now hooked on the hooking pins 51B of the main body 51. This because the actuation element 3 of the thermoactuator 1 produces a displacement of the slide 57 allowing the teeth 57E of the foils 57D to bend and open slightly in contact with the pins 51B. The opening takes place due to the shape of the inclined surface of the teeth 57E, which is capable of sliding onto the specially shaped surface of the pins 51B. When the entire inclined, or specially shaped, surface of the teeth 57E overcomes the inclined surfaces of the pins 51B, the elastic reaction of the foils 57D will realign them, with the foils 57D being hooked onto the pins 51B.

[0077] It should also be remembered that the slider 58C, integral with the cover 58 of the actuation device 50, now translates in the same direction as the slide 57.

[0078] The operating condition of Fig. 8, during which the thermo-actuator 1 is electrically supplied, lasts as long as the locking device is not to be engaged, in particular for locking the drum of a laundry washing machine.

[0079] The subsequent operating condition is implemented by the machine control system through the interruption of the electric supply to the thermoactuator 1, e.g. at the end of an entire wash program carried out by a laundry washing machine.

[0080] The thermoactuator 1 cools down and the actuation element 3 slowly goes back, returning to an initial or retracted operating position, being assisted by the action of the spring 59. This progressive retraction is shown clearly in Figs. 9 and 10, and ends with the actuation device 50 in the initial operating condition, i.e. in the lock position shown in Fig. 7.

[0081] The initial retraction movement of the slide 57 ceases when the steps of the hooking teeth 57E come in touch with the flat front surface of each pin 51B. At this point, the only element which is capable of going backward together with the actuation element 3 of the thermo-actuator 1 is the slider 58C in one piece with the cover 58.

[0082] The slider 58C is free to translate with respect to the main body 51 of the actuation device 50 and, in the hooked configuration of the teeth 57E, also with respect to the slide 57.

[0083] It should also be pointed out that the thermoactuator 1 is prevented from translating within the main body 51 by the presence of the relief 51C.

[0084] The retraction of the slider 58C allows the appendixes 58I of the slider 58C to come into contact with the inclined reliefs 57F of the foils 57D. Assisted by the thrust action of the spring 59 onto the bridge 57B, the appendixes 58I force the inclined reliefs 57F, thereby causing a progressive bending or opening of the foils 57D. This operating condition is clearly illustrated in Fig. 9.

[0085] Fig. 10 shows the moment when, at a certain bending or opening value of the foils 57D, the hooking teeth 57E free themselves from the pins 51B due to the disengagement of the respective surfaces, previously facing and touching each other. At this point, the slide 57 is released from the pins 51B, and the spring 59 pushes said slide 57 toward the initial or lock position of the actuation device 50. In the embodiment applied to laundry washing machines, the shaft 57A of the slide 57 therefore presses onto the pulley 28, with the spring 59 loaded.

[0086] The initial operating condition of Fig. 7 is achieved when the shaft 57A is free to reach its maximum extension; in this specific embodiment, when it enters the cavity of the pulley 28. After the return of the slide 57 to an initial position, another switching of the signal sent by the module 54 to the control system is obtained, this time from OFF to ON. In fact, the indicator 61 returns to occupy the space between the emitter 54B and the receiver 54C, and therefore the transmission of the optical signal is physically interrupted. Said switching can be used by the machine control system to implement various machine functions in a known manner.

[0087] It has to be underlined that the components of the kinematic system of the actuation device 50, and in particular the slide 57, the foils 57D and the respective teeth 57E and reliefs 57F, the pins 51B and the slider 58C with the respective appendixes 58I, are appropriately sized so that the teeth 57E unhook from the pins 51B when the actuation element 3 of the thermo-actuator 1 has almost fully returned to the retracted position of use. In the representation shown, the stroke of the slider 58C is longer than the working stroke of the foils 57D.

[0088] As regards said non-limiting embodiment of the present invention, it is appropriate to give full details of the following characteristics.

[0089] The device 50 has a module 54 which preferably consists in a single electronic operation module, i.e. the electronic circuit 54A, where a part of the connectors supplying power to the thermoactuator 1 as well as the transducer/sensor means 54B, 54C and the circuits for detecting the position of the indicator 61 of the slide 57, may be integrated. The cited electric connection means 54A, 55, 56 may be realized either according to specific requirements or in a known manner. In particular, at least two electric connections, for instance made up of different tracks of electrically conductive material and defined in the electronic circuit 54A, respectively lead to:

- 1) the thermoactuator 1, through some of the tracks in the same electronic circuit 54A connected to the second connector 56 by means of two electric wires, being the connector 56 engaged onto the contacts of the actuator 1;
- 2) the optical emitter 54B and receiver 54C.

[0090] In conclusion, the module 54 of the position of the slide 57 has an electronic circuit 54A wherein a plurality

of distinct electric connections are defined in a known and therefore not further detailed manner, which implement the above-mentioned connections 1) and 2) and allow for an easy connection, for instance by pressure, of the electronic circuit 54A onto the male element 54AI of the electronic circuit 54A. The electronic circuit 54A is in its turn electrically connected to the machine control system which, among other functions, also manages the actuation and/or locking of the actuation device 50.

[0091] As previously stated, the module 54 may also contain other electronic components necessary for the operation of the actuation device, such as, for instance, additional position sensors and/or electronic circuits needed for their operation which, being known, are not detailed here.

[0092] The operation of the transducer 54B-54C, integrated into the electronic circuit 54A, can be easily tested in a known manner before being assembled into the main body 51, since it is contained in the described integrated electronic module 54: testing can therefore be performed through electronic diagnostic methods, and such operation can be carried out easily, in a known and therefore not detailed manner, within automatic production systems.

[0093] A variation of the actuation device 50 provides a module 54 of a type which may be defined as "protected assembly". Said assembly implies the execution of a resin finishing process or, more in general, of a partial or total coating and/or protection and/or waterproofing process on the electronic circuit 54A and/or the module 54, by using a suitable resin or thermoplastic material. Said process may be carried out in a known manner through a material applied by spraying, casting, immersion, molding or injection, or else obtained through any suitable method, which in particular must be performed by using automatic methods and/or along a production line.

[0094] The above variation advantageously permits to install the actuation device 50 in household appliances operating in particularly heavy conditions, e.g. in the presence of a high level of humidity, which in the long term would cause the oxidation of the connectors. It follows a higher reliability in time of the actuation control system and therefore of the overall operation of the actuation device 50.

[0095] From the previous description of the kinematic system/mechanism concerning the actuation device 50 applied to household appliances, in particular to a laundry washing machine, we can basically identify two different systems of forces/displacements that characterize it.

[0096] With reference to Figs. 1-10, it is stated first that:

- the thermoactuator 1 constitutes a first actuation means suitable for commanding the actuation to be performed;
- the shaft 57A of the slide 57 constitutes a second actuation and/or locking means suitable for transferring toward the outside at least a part of the actuation of the thermoactuator 1;
- the main body 51, with its substantially cradle-like shape comprising the hooking pins 51B, the slide 57 inclusive of the bridge 57B and of the indicator 61, the slider 58C of the cover 58, and the spring 59, in assembled form constitutes the kinematic system associated with said first actuation means and second actuation and/or locking means for transferring the motion from a configuration of a first system of forces/displacements related to said kinematic system to another configuration of a different second system of forces/displacements;
- the thermoactuator 1 is substantially integral with the main body 51 in the assembled condition of the actuation device 50.

[0097] The first system of forces/displacements is identified by the situation illustrated and described in Figs. 7 and 10, whereas the second system of forces/displacements is substantially represented in Figs. 8 and 9.

[0098] In particular, in the first system of forces/displacements the forces acting on the kinematic system essentially consist in that exerted by the actuation element 3 of the thermoactuator 1, which is equal and opposite to the elastic force exerted by the spiral spring 59; differently, the second system of forces/displacements presents, in addition to the first, the constraint reaction that the hooking pins 51 exert onto the hooking teeth 57E of the foils 57D of the slide 57. In conclusion, these two different systems of forces/displacements make the actuation device 50 become of a type with two different stability positions, i.e. bistable, and having improved working speed.

[0099] In other words, the kinematic system of the actuation device 50 (i.e. of the actuation and/or locking device according to the invention) is suitable for transferring the motion from the first actuation means, i.e. the thermoactuator 1, to the second actuation and/or locking means, i.e. the shaft 57A of the slide 57, so as to convert the motion produced by the first actuation means into a second motion different from the first one.

[0100] It is also stated first that:

- the unit consisting of the emitter 54B and the receiver 54C on the electronic circuit 54A, facing each other for the transmission of an optical-type signal, makes up a transducer which is susceptible of co-operating with the indicator 61 of the slide 57 in order to detect the position of said indicator 61 and therefore the presence of the slide 57 in a certain position (in particular, the position of maximum extension of the slide 57, corresponding to the lock position of the actuation device 51);
- the module 54 as a whole, i.e. including the connectors 55 and 56, by co-operating with the indicator 61 of the

slide 57 and by exchanging binary information with a control system of the machine where the entire actuation device 50 is installed, form a system for controlling the actuation to be performed and the overall operation, i.e. the position of the kinematic system related to the actuation device 50;

the transducer/sensor 54B, 54C and the module 54 as a whole, with its electronic circuit 54A, are elements of a type which is neither assembly-critical nor operation-critical, in co-operation with the indicator 61 of the slide 57 (the adjective "critical" has the meaning as already specified above in the present description).

[0101] In fact, the size of the indicator 61 can be well greater than the light it must obscure when the sensor is ON, so that any production tolerances can be easily controlled and made non-influential.

[0102] Advantageously, the described actuation and/or locking device 50 provides, as illustrated, a system for controlling the internal kinematic system of the device and for commanding the thermo-actuator 1 with a "non-critical" mode of assembly and operation. The adopted solution, i.e. the use of the optical module 54, solves the above-mentioned criticality in a brilliant and original way.

[0103] Advantageously, the actuation and/or locking device for household appliances according to the present invention has an actuation control system which is reliable, economical and easy to assemble.

[0104] In fact, the device 50 has a single module 54 having a single electronic circuit 54A integrating the transducer/sensor means 54B and 54C, the conductive tracks and the second connector 56 supplying power to the thermo-actuator 1, as well as the conductive tracks suitable for connecting electrically to the external connector 55, finally transmitting the signal concerning the position of the indicator 61 of the slide 57 to the control system of the actuation and/or locking device 50.

[0105] Furthermore, the electric wiring is extremely easy to be implemented, by connecting the external connector 55 with a slight pressure onto the male connector element 54AI of the electronic circuit 54A; the same process is required for the connection of the second connector 56 to the contacts of the thermoactuator 1.

[0106] It follows the further advantage that the electronic circuit 54A, integrating the transducer/sensor 54B and 54C, the operation of which can be easily tested before its assembly onto the main body 51, is at low risk of being rejected during a quality check carried out on the entire actuation device. Moreover, testing can be easily performed by using automatic production systems, to great advantage for the quality of the final product.

[0107] Advantageously, the actuation control system may also be easily provided in a version with protected assembly, as previously described, so as to operate efficiently in particular heavy conditions thanks to the perfect operation of the electric contacts.

[0108] A further advantage is given by the external dimensions of the actuation device 50, which are particularly reduced. As a matter of fact, the optical-type module 54, once assembled, protrudes just a little bit from the overall shape of the main body 51 (which is substantially defined by the rectangle comprising the flanges 52 of the body 51).

[0109] The optical-type module 54 also offers the advantage of an extremely low weight, thus contributing to the reduction of the overall weight of the entire device 50.

[0110] In conclusion, the inventive idea at the basis of the present invention consists in proposing an actuation device having a system for controlling the actuation and/or locking and the overall operation, which is neither assembly-critical nor operation-critical. Said feature is obtained through the use of a sensor having a single module, in particular an electronic one, integrating the functions for the connection to the actuation means of the device as well as the means for detecting/transducing the position of an element of the kinematic system associated with said actuation means.

[0111] Conceptually, the above invention revolutionizes the approach to the manufacture and production of actuation and/or locking devices for household appliances, teaching to apply the sensors for detecting the position of an element of the kinematic system (and therefore of the actual operating state of the device itself) within a single module, in particular an electronic one, integrated with connections to the actuator. In this way, the assembly, production and final use of the entire device are made highly reliable and efficient.

[0112] It is clear that many variations to the device described in the above embodiment may be made by a person skilled in the art without departing from the novelty principles contained in the inventive idea.

[0113] The described control system uses an optical transducer/sensor; it could however also be achieved with other known systems having a non-critical mode of assembly and operation, i.e. being integrated into a module, in particular an electronic one, together with the connectors of the actuation means.

[0114] For instance, the receiver element of an inductive or Hall-effect magnetic sensor could be integrated into a similar electronic module as a technical equivalent of the optical sensors. The magnetic sensor would therefore need the insertion of a ferromagnetic material in a certain position of the slide 57, in particular laterally, in the area corresponding to and as a substitute for the indicator 61. In such a manner, the presence of the slide in a certain position would equally be detected through the development of an induced current in the magnetic sensor.

[0115] In order to further clarify the inventive idea at the basis of the present invention, the following provides a description of a further embodiment of the actuation and/or locking device for household appliances having an improved actuation control system according to the present invention. This embodiment is also supplied by way of an explanatory

and non-limiting example.

[0116] In particular, it concerns a locking device to be applied onto the door of a household appliance, e.g. an oven door lock, indicated as a whole with DB.

[0117] Below the elements making up the locking device DB are schematically described, with particular reference to the annexed figures 11-26:

- a frame or body FR, which has a first end FR1, e.g. provided with a flange for its application or mounting (by using known fasteners) to a part of a household appliance, and shaped in such a way as to define a first striker FR2 and a second striker FR3 in order to support a thermoactuator TA, so that it rests in a substantially fixed position with respect to the frame or body FR;
- the thermoactuator TA that, resting on the strikers FR2 and FR3 of the body FR, is capable of transmitting a thrust in the lengthwise direction through a shaft or pushing element TA1;
- a hooking element B, which is free to rotate at least partially about a fulcrum FR4 located at a second end FR5 of the body FR, where there is a first return spring M1 being suitable for operating between the hooking element B and the body FR in order to bring the hooking element B back to a hooked operating condition. The hooking element is shaped in such a way as to have at one end a first profile or hook B1 suitable for being housed in a specific seat of the element to be locked, and at the other end a second eccentric profile or cam B2 suitable for sliding along the inclined surface of the slider C;
- a kinematic system, indicated as a whole with C, housed within the body FR. The kinematic system C comprises a first slider C1 with a first end C1I facing toward the pushing element TA1 of the thermoactuator TA, and with a second end C1II terminating with an inclined plane, suitable for co-operating to the thrust action against the cam B2 of the hooking element B, thereby allowing the hooking element B to rotate and engage. In particular, said inclined end C1II is suitable for slipping or wedging between the body FR and the end B2 of the hooking element B, thus raising and turning the end B2 of the hook with the resulting rotation of the opposite end or hook B1 of the hooking element B, which therefore is brought to the hooked position;
- a second slider C2, wholly free from constraining to the kinematic system C, which can slide onto or within the body FR, in opposition to a second spring M2. The second slider C2 is one piece with a downward-protruding ledge C2B, which works as a detector of the presence of the household appliance part to be locked (clearly visible in Fig. 13), specifically an oven door (Figs. 27-28);
- a detection device, fastened to a staked support FR6 of the body FR, indicated as a whole with DR.

[0118] A peculiarity of this detection device DR consists in having a first SO1 and a second SO2 pair of optical sensors plugged into a printed circuit CS supporting them, sensors thereof being made up of an emitter element and a receiver element facing each other, such as, for instance, a LED photodiode and a phototransistor mutually coupled; the pairs of optical sensors SO1 and SO2 are preferably aligned according to a common lengthwise direction.

[0119] The detection device DR is assembled in the actuation device DB with the printed circuit CS resting on the staked support FR6 of the body FR and the sensor pairs SO1 and SO2 toward the inside of the body FR. This way, the first sensor pair SO1 is capable of interacting with a first appendix C1A of the first slider C1, whereas the second pair SO2 can interact with a second appendix C2A of the second slider C2. This configuration is clearly visible in Fig. 13 and in Figs. 15 to 20.

[0120] The printed circuit CS, as well as the entire detection device DR, is of the same type as the 54A one related to the sensor 54 of the first representative solution embodiment shown in Figs. 1-10; the arrangement of the electric connections is also the same.

[0121] In short, the detection device DR has:

- a connection edge or connector CS1 of the printed circuit CS, wherein a respective electric connector or plug SP is plugged to connect the detection device DR electrically to the control system of the household appliance wherein the locking device DB is installed, being the connector CS1 suitable for transferring signals from the sensors SO1, SO2 to said control system;
- a jack plug SPT, which in assembled condition is engaged onto the terminals or contacts of the thermo-actuator TA and in its turn is electrically connected to the printed circuit CS, preferably through simple electric wires or cables;
- the sensor pairs SO1 and SO2, suitable for transmitting the respective electric signals to the control system, e.g. ON/OFF type signals, depending on whether the first appendix C1A of the first slider C1 and the second appendix C2A of the second slider C2, respectively, interfere or not with the optical transmission between emitter and receiver of each pair SO1, SO2.

[0122] In conclusion, the printed circuit CS is crossed by the electric signals indicating the position of the sliders C1 and C2, as well as by the supply signals for the thermo-actuator TA. Therefore, the detection device DR integrates into

an electronically working single module the printed circuit CS, the functions for detecting the position of the sliders C1 and C2, and those for the connection to the thermoactuator TA.

[0123] The body FR has a cover CO on top, movable with respect to the body FR, which covers the whole housing for the kinematic system C, the second slider C2 and the hooking element B, leaving free only the thermoactuator TA, which thus can be easily replaced by accessing the locking device DB from above.

[0124] Preferably, the cover CO has the peculiarity of being provided with teeth or references CO1 in the area corresponding to the housing of the detection device DR, which is at least partially covered, thereby guiding the pressure connection of the plug SP to the respective connector CS1.

[0125] Said references CO1 are suitable for determining the direction of insertion of the connector or plug SP during its connection to the respective connector CS1, thus preventing connection mistakes. Said references CO1, as well as the references 54E of Fig. 1 related to the first embodiment of the invention, therefore provide encoding means for the connector or plug SP (or for the female connector 55, referring to Fig. 1), since it is possible to connect only that type of plug SP (or female connector 55 in Fig. 1) having a female interface (55E in Fig. 1) exactly matching the teeth or references CO1 (54E in Fig. 1).

[0126] Figs. 15 and 16-20 show the locking device DB in a plan view without the cover CO; in particular, Figs. 16-20 show the detection device DR without the printed circuit CS in order to highlight the sensor pairs SO1 and SO2.

[0127] The following provides a detailed description of the kinematic system C, with particular reference to Figs. 13 to 16, which has the following components:

- the first slider C1, having an inner seat C1S against which rests a third spring M3. Said spring M3 in its turn rests against a relief or retainer FE of the body FR, so as to push onto the first slider C1 and oppose its advancing. In particular, the third spring M3 causes the return of the slider C1 once the pushing element TA1 has returned inside the body of the thermoactuator TA due to the interruption of the electric supply;
- a pivoting element EB, performing the function of hooking the slider C1, with shape and operation very similar to those illustrated in the second known solution, the description thereof should be referred to for details.

[0128] During the operation of the kinematic system C, the pivoting element EB co-operates in a known manner (see the description of the second known solution) in association with the inner walls of the body FR adjacent to the same element BE and with a specially shaped relief C1R sideways from the first slider C; the element EB also co-operates with a fourth spring M4, binding itself to the first slider C1.

[0129] The peculiar structural features of the pivoting element EB are the following:

- a head EB4 (Fig. 17-23), suitable for hooking itself onto an inclined surface of the relief C1R of the first slider C1,
- a first and a second protrusion or appendix, indicated with EB1 and EB2, respectively, having a shape suitable for engaging the respective seats within the body FR, i.e. suitable for interacting with the inner wall of the body FR close to said appendixes EB1 and EB2,
- a third protrusion EB3, suitable for interacting with a seat present in a second retainer or relief FE2 integral with the frame FR, the third protrusion EB3 being obtained on the side opposite to that of the two cited protrusions EB1 and EB2, i.e. on the same side of the head EB4.

[0130] This particular conformation of the pivoting element EB, substantially having four fulcrum points represented by the three cited protrusions and the head, indicated with the symbols EB1-EB4, gives the same element its particular pivoting motion; said particular motion is induced by the respective positions taken from time to time, combined by the pull exerted by the fourth spring M4 on a point near the head EB4, the action being generated when the first slider C1 advancing under the thrust action of the pushing element TA1 of the thermoactuator TA.

[0131] The following describes the overall operation of the locking device DB, with particular reference to Figs. 16 to 20. It should be remembered that the operation of the kinematic system C is known, e.g. as illustrated in the second known solution often referred to in the present description.

[0132] Figs. 16 and 16/I show the locking device DB in idle or not active configuration, i.e. with the hooking element B1 in retracted unlock position and deactivated thermoactuator TA. The second slider C2 is in extracted position, the latter meaning that the element to be locked of the household appliance, an oven door (PF in Fig. 28) in this embodiment, is not closed, i.e. does not interfere with the ledge C2B of the second slider C2. This condition does not imply any interruption of the transmission of the optical signal between emitter and receiver of the optical sensor pairs SO1 and SO2; the appendixes C1A and C2A do not interpose themselves between emitter and receiver of said sensors. Such a condition is therefore recognized by the regulating device DR and signaled to the control system of the household appliance.

[0133] The subsequent closing of the oven door (PF in Figs. 21 and 22), shown in Figs. 17 and 17/I, causes the retraction of the ledge C2B integral with the second slider C2; the second appendix C2A interrupts the optical trans-

mission between emitter and receiver of the second sensor pair SO2, which switches its state, e.g. to the ON position, and sends the corresponding signal to the control system.

[0134] The next phase implemented by the control system is locking, i.e. the actuation of the locking device DB, as shown in Figs. 18 and 18/I. The control system supplies the thermoactuator TA, so that its pushing element TA1 makes the first slider C1 move forward, which in its turn acts upon the hooking element B as previously described. The hooking element B rotates about the fulcrum FR4, so that the hook B1 is extracted in a lock position. The rotation of the hooking element B is caused by the thrust exerted in co-operation by the inclined plane of the second end C1II of the first slider C1 and by the second profile or cam B2 of the element B itself.

[0135] According to a known method, during the elongation of the pushing element TA1, the first slider C1 moves in the same direction, thereby causing the relief C1R to slide onto the lateral surface; the pivoting element EB therefore slides onto the relief C1R of the first slider C1 until overcoming it and bringing its own head EB4 in engagement with the relief C1R, under the action of the fourth spring M4; the second appendix EB2 remains engaged in the provided seat within the body FR.

[0136] During said phase, the first appendix C1A also gets to interfere with the first sensor pair SO1, thereby interrupting the optical signal between emitter and receiver and switching the state of the signal sent to the control system, e.g. to ON; at this stage, therefore, both sensor pairs SO1 and SO2 send an ON signal to the control system.

[0137] The subsequent return of the pushing element TA1, commanded by the control system through the interruption of the power supply to the thermoactuator TA, causes the head EB4 of the pivoting element EB to hook onto the shaped relief C1R. Under the action of the fourth spring M4, the pivoting element part EB moves to a different position, where the second appendix EB2 protrudes from its seat within the body FR, while the third appendix EB3 enters a seat or slot obtained in the second retainer FE2 of the body FR.

[0138] As described, during said phase the pivoting element EB therefore performs an swinging or angular movement about a fulcrum point located in the area corresponding to the inclined surface of the relief C1R of the first slider C1; the fourth spring M4 takes a position which is substantially parallel to the sliding axis of the first slider C1.

[0139] The above configuration does not allow the first slider C1 to go back under the thrust of the third spring M3, and therefore the locking device DB remains in the lock position, as clearly shown in Fig. 19, even in the absence of electric supply to the thermoactuator TA.

[0140] In order that the locking device DB switches itself to an unlock operating condition, it is necessary that the control system supplies power to the thermo-actuator TA again, thereby causing a new extraction of the pushing element TA1 to exert a thrust against the first end C1I of the first slider C1.

[0141] The advancing of the first slider C1 causes the pivoting element EB to be released from the relief C1R; due to the unstable condition determined by the pull of the fourth spring M4, the head EB4 moves away from the condition of hooking with the relief C1R, with the first appendix EB1 moving toward the body FR. The operating situation where the pivoting element EB is released from the relief C1R is shown in Figs. 20, 20/I.

[0142] At the subsequent interruption of the power supply to the thermoactuator TA, the first slider C1 tends to go back under the action of the third spring M3, until it causes the third appendix EB3 to come out from the seat EB3 of the second retainer FE2.

[0143] The retraction of the pushing element TA1 therefore causes the first slider C1 to follow the same element TA1, since the pivoting element EB is fully adhering to the inner surface of the body FR. This condition allows the hooking element B to rotate about the fulcrum FR4 again under the action of the first spring M1, thus reaching a release operating condition. This restores the configuration wherein the first sensor pair SO1 sends an OFF signal to the control system, whereas the second sensor pair SO2 sends an ON signal (Fig. 17, 17/I).

[0144] The subsequent opening of the oven door (PF in Figs. 21 and 22) causes the second slider C2 to advance under the thrust of the second spring M2, and the second sensor pair SO2 switches the signal to OFF. The locking device DB is then again in the configuration of Figs. 16, 16/I.

[0145] From the operation described above, we can summarize in the following table the configurations that the locking device DB may assume in its operating conditions, with particular reference to the ON/OFF signals that the detection device DR sends to the control system through its integrated electronic module, i.e. the printed circuit CS, and the electric connection provided by the fast-coupling connector SP.

Operating configuration of locking device DB	Power supply to thermo-actuator TA	Switching of pair SO1	Switching of pair SO2	Reference figures
DB in unlock position, oven door PF open	OFF	OFF	OFF	16, 16/I

(continued)

Operating configuration of locking device DB	Power supply to thermo-actuator TA	Switching of pair SO1	Switching of pair SO2	Reference figures
DB in unlock position, oven door PF closed	OFF	OFF	ON	17, 17/I
DB locking, oven door PF closed	first ON and then OFF	ON	ON	18, 18/I, 19, 19/I
DB unlocking, oven door PF closed	first ON and then OFF	first ON and then OFF	ON	20, 20/I

[0146] Fig. 21 shows a perspective view from above of the locking device DB assembled to a household appliance F, in particular an oven, working as a door lock for a door PF, e.g. an angularly movable or pivoting door.

[0147] Fig. 22 shows an enlarged lengthwise section of a detail of the oven F, i.e. the upper area, according to a plane parallel to the lateral surface of the oven F and very close to said surface.

[0148] The device DB is positioned with the second end FR5 of the body FR, i.e. the end where the hooking element B is located, close to the upper surface of the oven F in the area corresponding to the oven door PF. In particular, such end FR5 has hooking seats IN, clearly visible in Figs. 11 and 13, which rest or hook onto the lower edge SS1 of an open-box structure SS representing the exterior enclosure of said upper area of the oven F. On the contrary, the first flanged end FR1 of the body FR, i.e. the one corresponding to the area where the thermoactuator TA is housed, protrudes inside said upper area of the oven F, where the device DB is fastened.

[0149] In the detail shown, the locking device DB is in the lock operating position, as can be noticed from the extracted position of the hooking element B, whose hook B1 is engaged in a seat SP of the door PF in order to prevent it from opening.

[0150] From the description concerning the constitution, the operation and the application of the locking device DB as a second embodiment for the present invention, the advantages already explained for the first embodiment become even clearer. In short, these advantages are:

- the described locking device DB comprises a system for controlling the actuation and the operation of the same, in particular of the kinematic system C and of the open or closed condition of the door PF, which is of a "non-critical" mode in terms of assembly and operation thanks to the presence of a detection device DR provided in a single module integrating the connectors leading to the thermoactuator TA;
- the locking device DB has an actuation and operation control system which is simple, reliable, economical and easy to assemble;
- the printed circuit CS, together with the related connectors and electronic components present on it, i.e. the entire detection device DR which also performs, as already described, functions of connection to the thermoactuator TA, is susceptible of being easily and accurately checked or tested before being mounted to the frame FR; it is suitable for a fully automatic assembly process along production lines. It follows a minimum risk of rejection of the entire locking device DB during a quality check due to a faulty operation of the detection device DR. Testing of the same can therefore be carried out through automatic production systems, to great advantage for the quality of the final product;
- the detection device DR may advantageously be provided in a version with protected assembly, as previously explained, in order to protect the elements making up the same device DR against environmental factors as high humidity, water seepage or dirt;
- the external dimensions of the locking device DB are particularly small, thus facilitating its assembly and saving space inside the household appliance.

[0151] In particular, from the illustrations of the locking device DB shown in Figs. 11-20 it is immediately clear how simple it is to provide the wiring to the control system of the household appliance in which the device has to operate, in particular the oven F. The wiring operations turn out to be extremely fast, safe and reliable, thus minimizing the risk of errors.

[0152] Given the extreme simplicity of the above operations, the wiring can advantageously be provided automatically during the assembly of the household appliance in which the locking device has to operate; it follows a rationalization, a higher speed and a better overall efficiency of the production processes for household appliances using the locking

device according to the present invention.

[0153] All the observations and remarks made regarding to the first embodiment apply also to the cited second embodiment: it is easy to deduce the two distinct systems of forces/displacements for said second embodiment.

[0154] It is also clear that many variations to the device described by way of example may be made by a person skilled in the art without departing from the novelty principles contained in the inventive idea.

[0155] For instance, the hooking element and the kinematic system could be provided in a known manner through a single element, consisting in a number of linked parts susceptible of performing the functions previously described. In this variation, it is clear that the sensor means could be actuated by an element integral with the hooking and/or locking means, i.e. with the second actuation and/or locking means, instead of being integral with the kinematic system.

[0156] Advantageously, this solution implies a higher versatility in the realization of the design architecture of the entire actuation and/or locking device, offering the additional possibility of locating the integrated single module in proximity of the second actuation and/or locking means.

Claims

1. Actuation and/or locking device for use in a household appliance in connection with a control system for the same device (50; DB), the device (50; DB) comprising:

- a body (51; FR), suitable for being fastened to at least a part (SS) of said household appliance (F),
- first actuation means (1, 3; TA, TA1), suitable for commanding the actuation to be performed,
- second actuation and/or locking means (57A; B), suitable for exploiting the actuation produced by said first actuation means (1, 3; TA, TA1),
- a kinematic system (51B, 57-59; C) associated with said first actuation means (1, 3; TA, TA1) and said second actuation and/or locking means (57A; B), for transferring the motion from said first actuation means (1, 3; TA, TA1) to said second actuation and/or locking means (57A; B),
- detection means (54, 61; DR, C1A, C2A) for detecting the operation of said actuation and/or locking device (50; DB), comprising information transducer means (54B, 54C; SO1, SO2),
- electric connection means (54A, 55, 56; CS, SP, SPT) for connecting said detection means (54, 61; DR, C1A, C2A) and/or said first actuation means (1, 3; TA, TA1) to said control system of the household appliance (F), which is suitable for receiving information generated and transmitted by said detection means (54, 61; DR, C1A, C2A), as well as for commanding the actuation of said first actuation means (1, 3; TA, TA1) i.e. of the actuation and/or locking device (50; DB),

wherein at least a part of said transducer means (54B, 54C; SO1, SO2) belonging to said detection means (54, 61; DR, C1A, C2A) is susceptible of being coupled to and/or co-operating with at least a first element (61; C1A) of said kinematic system (51B, 57-59; C) and/or of said second actuation and/or locking means (57A; B) in order to transmit information to said control system of the household appliance (F),

characterized in that both said at least part of said transducer means (54B, 54C; SO1, SO2) and at least a part of said electric connection means (54A, 55, 56; CS, SP, SPT) are integrated into a single module (54; DR) suitable for being mounted or assembled in association with the actuation and/or locking device (50; DB).

2. Device, according to claim 1, **characterized in that** said module (54; DR) comprises a connection or interface element (54A1; CS1) suitable for being assembled to a single connector (55; SP) electrically connected to said control system of the household appliance (F).

3. Device, according to claim 1 or 2, **characterized in that** said module (54; DR) is of a substantially electrically working type.

4. Device, according to the previous claim, **characterized in that** said transducer means (54B, 54C; SO1, SO2) belonging to said detection means (54, 61; DR, C1A, C2A) and integrated in said module (54; DR) are at least partially of an electronic type.

5. Device, according to claim 3 or 4, **characterized in that** said transducer means comprise sensor means (54B, 54C; SO1, SO2) associated with said detection means (54, 61; DR, C1A, C2A), being in particular implemented at least partially through a pair of optical sensors.

6. Device, according to the previous claim, **characterized in that** said pair of optical sensors of said transducer

means (54B, 54C; SO1, SO2) belonging to said detection means (54, 61; DR, C1A, C2A) comprise a light emitter (54B) and a light receiver (54C), being in particular carried out through a LED diode and a phototransistor or photodiode.

- 5 **7.** Device, according to one or more of the previous claims, **characterized in that** said first element (61; C1A) of said kinematic system (51B, 57-59; C) and/or of said second actuation and/or locking means (57A; B) is suitable for interfering or interacting with said detection means (54, 61; DR, C1A, C2A) for detecting the operation of said actuation and/or locking device (50; DB), so that said transducer means (54B, 54C; SO1, SO2) transmit a corresponding signal or piece of information to said control system of the household appliance (F).
- 10 **8.** Device, according to claims 6 and 7, **characterized in that** said first element (61; C1A) is suitable for interrupting the optical signal between said pair of optical sensors (54B, 54C; SO1, SO2), in particular between said light emitter (54B) and light receiver (54C) belonging to each pair of optical sensors (54B, 54C; SO1, SO2).
- 15 **9.** Device, according to one or more of the previous claims, **characterized in that** said part of said electric connection means (54A, 56; CS, SPT) integrated in said module (54; DR) comprises at least one connector (56; SPT) electrically connected to said first actuation means (1, 3; TA, TA1).
- 20 **10.** Device, according to one or more of the previous claims, **characterized in that** said part of said electric connection means (54A, 56; CS, SPT) integrated in said module (54; DR) comprises at least one additional connector (54AI; CS1), in particular a male connector element, electrically connected to said control system of the household appliance (F), in particular through a mating female connector (55; SP).
- 25 **11.** Device, according to one or more of the previous claims, **characterized in that** said device (50, DB) or said module (54; DR) comprises encoding means (54E; CO1) suitable for determining univocally the connection of external connection means (55; SP) of said electric connection means (54A, 55, 56; CS, SP, SPT) onto said module (54; DR).
- 30 **12.** Device, according to the previous claim, **characterized in that** said encoding means of said module (54; DR) comprise references (54E; CO1), being in particular represented by teeth, belonging to an external element (54D; CO) of said module (54; DR), in particular a cover, wherein said references (54E; CO1) represent a particular encoding for the connection of said external connection means (55; SP) onto said module (54; DR).
- 35 **13.** Device, according to one or more of the previous claims, **characterized in that** said body (51; FR) comprises means for a stable housing (53; FR6) of said module (54; DR) with respect to said body (51; FR).
- 40 **14.** Device, according to the previous claim, **characterized in that** said means for a stable housing of said module (54) comprise at least one seat or housing (53) of said body (51), being in particular at least partially protruding or raised with respect to the same body (51).
- 45 **15.** Device, according to claim 13, **characterized in that** said means for the stable housing of said module (DR) comprise bearing means or supports (FR6), in particular staked supports, suitable for supporting and/or fastening said module (DR) with respect to said body (FR) in a univocal and accurate way.
- 50 **16.** Device, according to claim 3, **characterized in that** said transducer means of said detection means comprise a magnetic sensor, in particular of inductive or Hall-effect type, co-operating with a ferromagnetic-type element inserted in said kinematic system.
- 55 **17.** Device, according to one or more of the previous claims, **characterized in that** said module of said actuation and/or locking device (50; DB) comprises a printed circuit (54A; CS), wherein at least a part of said electric connection means (54A, 55, 56; CS, SP, SPT) is provided.
- 18.** Device, according to the previous claim and to claim 2, **characterized in that** said connection or interface element of said module (54; DR) comprises a male element (54AI; CS1) obtained on one edge of said printed circuit (54A; CS).
- 19.** Device, according to one or more of the previous claims, **characterized in that** said module (54; DR) of said actuation and/or locking device (50; DB) is of a protected type, i.e. comprises protection means provided externally by a protective coating or enclosure.

20. Device, according to one or more of the previous claims, **characterized in that** said module (54; DR) is at least partially coated and/or protected by insulating material, in particular against humidity and/or dirt and/or atmospheric agents.
- 5 21. Device, according to claim 19 or 20, **characterized in that** said module (54; DR) is at least partially coated and/or protected by a resin or thermoplastic material.
22. Device, according to claim 19 or 20 or 21, **characterized in that** said module (54; DR) is at least partially coated and/or protected by a material applied by spraying, casting, immersion, molding or injection.
- 10 23. Device, according to claim 17 and one or more of the previous claims, **characterized in that** said module (54; DR) comprises a part of said electric connection means (54, 56; CS, SPT) made up of electric wires and another part made up of electric connections or tracks integrated in said printed circuit (54A; CS) of said module (54; DR).
- 15 24. Device, according to one or more of the previous claims, **characterized in that** said first actuation means (1, 3; TA, TA1) of said actuation and/or locking device (50; DB) are of a monostable typology.
- 25 25. Device, according to the previous claim, **characterized in that** said first actuation means of said actuation and/or locking device (50; DB) comprise a thermo-actuator (1; TA) or thermoelectric actuator.
- 20 26. Device, according to one or more of the previous claims, **characterized in that** said second actuation means of said actuation and/or locking device (50) comprise a tooth or shaft (57A) defined at one end of a slide (57), being said slide (57) movably associated with said body (51) and operated by an actuation element (3) of said first actuation means (1, 3), the slide (57) belonging to said kinematic system (51B, 57-59) of said actuation and/or locking device (50; DB).
- 25 27. Device, according to the previous claim and to claim 5, **characterized in that** said element (61) of said kinematic system (51B, 57-59), which is susceptible of coupling and/or co-operating with said transducer means (54B, 54C) belonging to said detection means (54) of said actuation and/or locking device (50), comprises a relief (61) integral with the slide (57) and suitable for interacting with said sensor means (54B, 54C) of said detection means (54) in an operating position of said actuation and/or locking device (50), in particular in an extracted lock position.
- 30 28. Device, according to one or more of the previous claims, **characterized in that** said second actuation means of said actuation and/or locking device (DB) comprise a hook-shaped element (B1) suitable for rotating or moving angularly, whose hooking action is actuated by a movement of a first slider (C1) driven by an actuation element (TA1) of said first actuation means (TA, TA1); being said hook-shaped element (B; B1) pivoted in a point (FR4) of said body (FR) and being said first slider (C1) sliding with respect to said body (FR).
- 35 29. Device, according to the previous claim and to claim 5, **characterized in that** said first element (61) of said kinematic system (C), which is susceptible of coupling and/or co-operating with at least a part (SO1) of said transducer means (SO1, SO2) belonging to said detection means (DR, C2) of said actuation and/or locking device (DB), comprises a first appendix (C1A) of said first slider (C1) suitable for interfering with an optical signal emitted by said sensor pair (SO1) of said detection means (DR, C2) in an operating position of said actuation and/or locking device (DB), in particular a position where the hook-shaped element (B1) is in an extracted lock position.
- 40 30. Device, according to one or more of the previous claims, **characterized in that** the means for detecting the operation of said actuation and/or locking device (DB) comprise further detection means (DR, C2) for detecting the position of at least one element (PF) of the household appliance (F).
- 45 31. Device, according to the previous claims, **characterized in that** said further detection means (DR, C2) comprise an element or a ledge (C2B) co-operating or integral with a second slider (C2) which is sliding or movable with respect to said body (FR).
- 50 32. Device, according to the previous claim and to claim 5, **characterized in that** said second slider (C2) of said further detection means (DR, C2) comprises signal activation means (C2A), in particular a second appendix (C2A) suitable for interfering with a signal emitted by said transducer means in order to signal to and inform the control system of said actuation and/or locking device (50; DB).
- 55

33. Device, according to the previous claim, **characterized in that** said second slider (C2) of said further detection means (DR, C2) comprises a second appendix (C2A) suitable for interfering with an optical signal emitted by said sensor pair (SO2) of said transducer means (SO1, SO2) belonging to said detection means (DR, C2) in an operating position of said second slider (C2), in particular when said ledge (C2B) of said second slider (C2) is retracted under the action of said element (PF) of the household appliance (F)

34. Device, according to the previous claim, **characterized in that** said element of the household appliance (F) comprises at least a portion of a door (PF), in particular the door (PF) of an oven (F).

35. Actuation and/or locking device for use in household appliances, of a typology comprising:

- a body (51; FR), suitable for being fastened to at least a part (SS) of said household appliances (F),
- first actuation means (1, 3; TA, TA1), suitable for commanding the actuation to be performed,
- second actuation and/or locking means (57A; B), suitable for exploiting the actuation produced by said first actuation means (1, 3; TA, TA1),
- a kinematic system (51B, 57-59; C), associated with said first actuation means (1, 3; TA, TA1) and said second actuation and/or locking means (57A; B), for transferring the motion from a configuration of a first system of forces/displacements related to said actuation and/or locking device (50; DB) to another configuration of a second system of forces/displacements, different from the first system of forces/displacements and still related to said actuation and/or locking device (50; DB),
- detection means (54, 61; DR, C1A, C2A) for detecting the operation of said actuation and/or locking device (50; DB), comprising information transducer means (54B, 54C; SO1, SO2),
- electric connection means (54A, 55, 56; CS, SP, SPT) for connecting said detection means (54, 61; DR, C1A, C2A) and/or said first actuation means (1, 3; TA, TA1) to a control system of the household appliance (F), being the control system susceptible of processing information received from said detection means (54, 61; DR, C1A, C2A) and of commanding the actuation of said first actuation means (1, 3; TA, TA1) and of said actuation and/or locking device (50; DB),

wherein at least a part of said transducer means (54B, 54C; SO1) belonging to said detection means (54, 61; DR, C1A, C2A) is susceptible of being coupled to and/or co-operating with at least one element (61; C1A) of said kinematic system (51B, 57-59; C) and/or of said second actuation and/or locking means (57A; B) in order to transmit information to said control system of the household appliance (F);

characterized in that both said transducer means (54B, 54C; SO1, SO2) and said electric connection means (54A, 55, 56; CS, SP, SPT) are at least partially integrated into a single module (54; DR) suitable for being mounted or assembled in association with the actuation and/or locking device (50; DB).

36. Device, according to the previous claim and to one or more of claims from 2 to 34.

37. Household appliance incorporating an actuation and/or locking device according to one or more of claims 1 to 36.

38. Household appliance according to the previous claim, **characterized in that** it incorporates a control system for the actuation and/or locking device (50; DB).

39. Household appliance, according to claim 37 or 38, **characterized in that** it is a washing machine.

40. Method for controlling the operation of an actuation and/or locking device for use in household appliances, of a type as described in the preamble of claim 1, comprising:

- a first operation, consisting in detecting the operating conditions of the actuation and/or locking device (50; DR) through detection means (54, 61; DR, C1A, C2A),
- a second operation, wherein transducer means (54B, 54C; SO1, SO2) convert the information obtained from said detection means into an electric signal and transmit it to the control system of the household appliance (F) incorporating the actuation and/or locking device (50; DR),
- a third operation, consisting in the transmission of the command signals sent by the control system of the household appliance (F) to the first actuation means (1, 3; TA, TA1) for the actuation of the actuation and/or locking device (50; DR),

wherein said first operation comprises a step for detecting the positions taken by the kinematic system (51B, 57-59;

C) through the coupling of and/or the co-operation between said detection means (54, 61; DR, C1A, C2A) and a first element (61; C1A, C2A) of said kinematic system (51B, 57-59; C) and/or said second actuation and/or locking means (57A; B);

characterized in that said operations are at least partially implemented by using a single module (54; DR) operating at least as a detection, transduction and connection element with respect to said control system of the household appliance (F).

41. Method, according to the previous claim, **characterized in that** said first operation comprises a further step for detecting the position of at least a part (PF) of the household appliance (F), which is implemented through the displacement of an element (C2B) of the actuation and/or locking device (50; DR) suitable for signaling the position of said part (PF) of the household appliance (F).

42. Method for assembling an actuation and/or locking device to a household appliance, being said actuation and/or locking device (50; DB) of a type as described in the preamble of claim 1, comprising the following steps:

- fastening of the body (51; FR) of the actuation and/or locking device (50; DB) to at least a part (SS) of the household appliance (F),
- wiring of the first actuation means (1, 3; TA, TA1) and operation detection means (54, 61; DR, C1A, C2A) to said control system of the household appliance (F),

characterized in that at least a part of said wiring is implemented through the assembly, in association with the body (51; FR) of the actuation and/or locking device (50; DB), of a module (54; DR) suitable for performing at least detection, transduction and connection functions with respect to said control system of the household appliance (F).

43. Method, according to the previous claim, **characterized in that** it comprises the testing of said module (54; DR), being in particular performed by using at least partially automatic methods along a production line.

44. Method, according to the previous claim, **characterized in that** said testing of said module (54; DR) is carried out before said module (54; DR) is assembled into the actuation and/or locking device (50; DB), being in particular performed by using at least partially automatic methods and/or along a production line.

45. Method, according to claim 42, **characterized in that** it comprises a protection and/or coating and/or waterproofing operation carried out on said module (54; DR), being in particular performed by using at least partially automatic methods along a production line and/or before the module (54; DR) is assembled into the actuation and/or locking device (50; DB).

46. Method, according to one or more of claims 42 to 45, **characterized in that** at least a part of said wiring of the actuation and/or locking device (50; DB) is implemented through the assembly operation of said module (54; DR) into said actuation and/or locking device (50; DB).

47. Method, according to one or more of claims 42-46, **characterized in that** said wiring is implemented through a single operation by plugging a connector (55; SP), which is electrically connected to the control system of the household appliance, into said module (54; DR) of said actuation and/or locking device (50; DB).

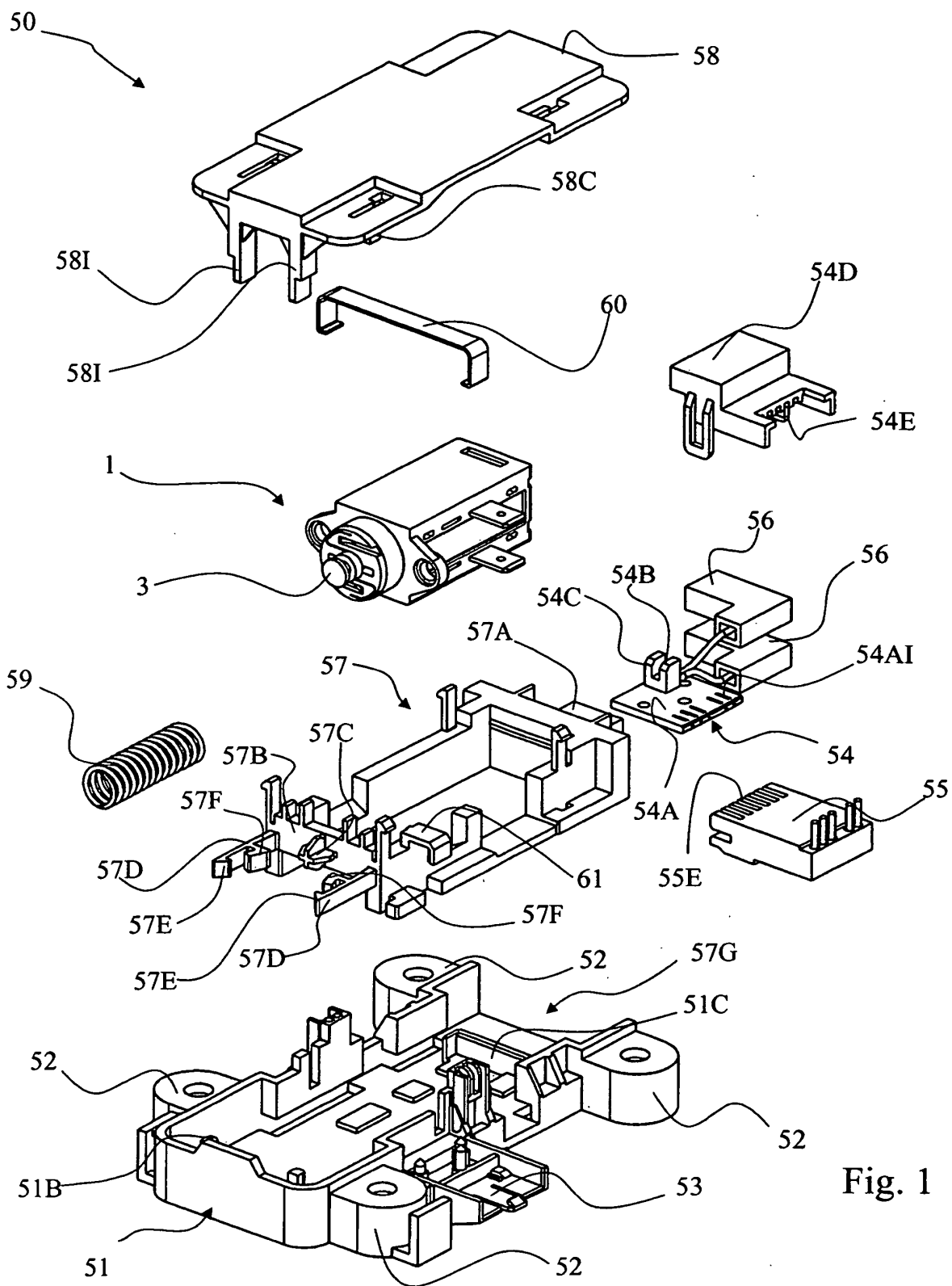
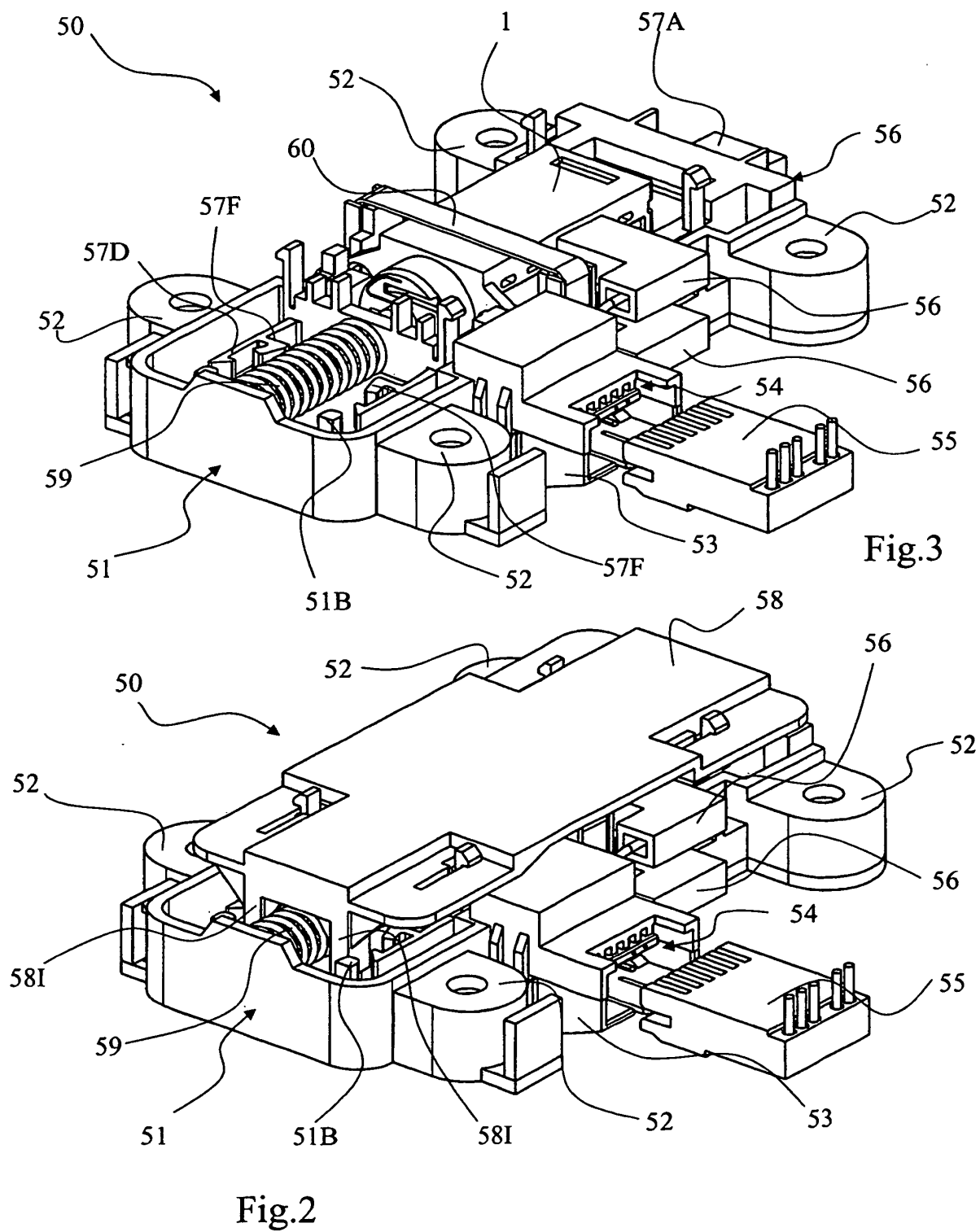


Fig. 1



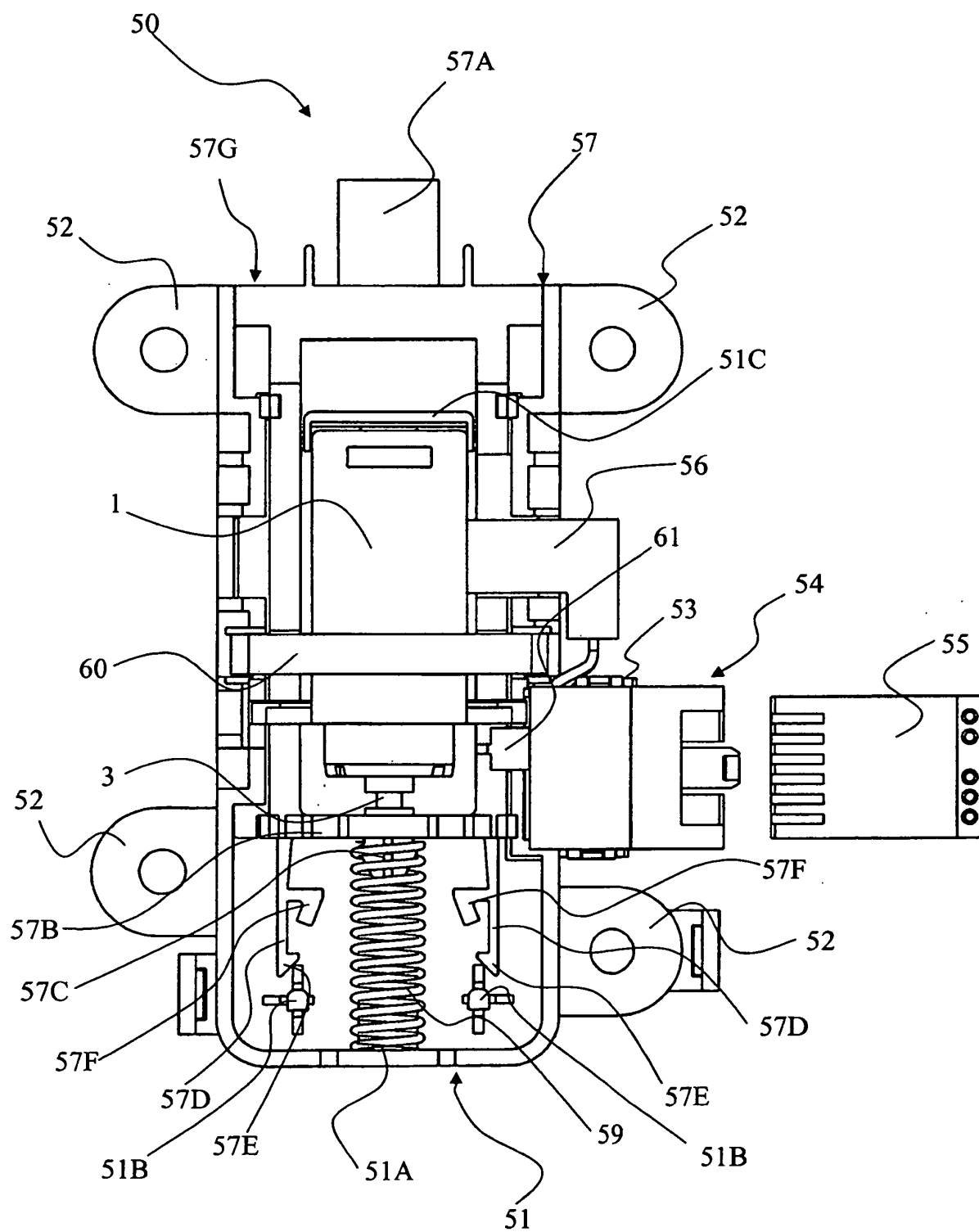
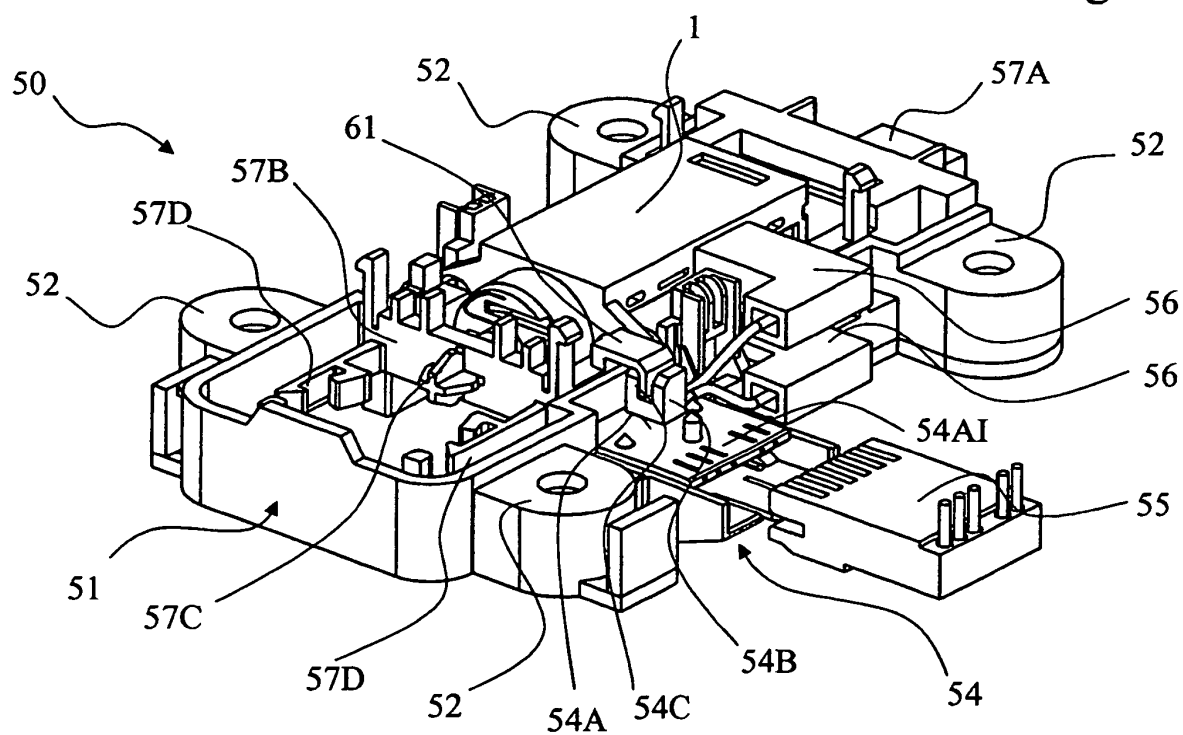
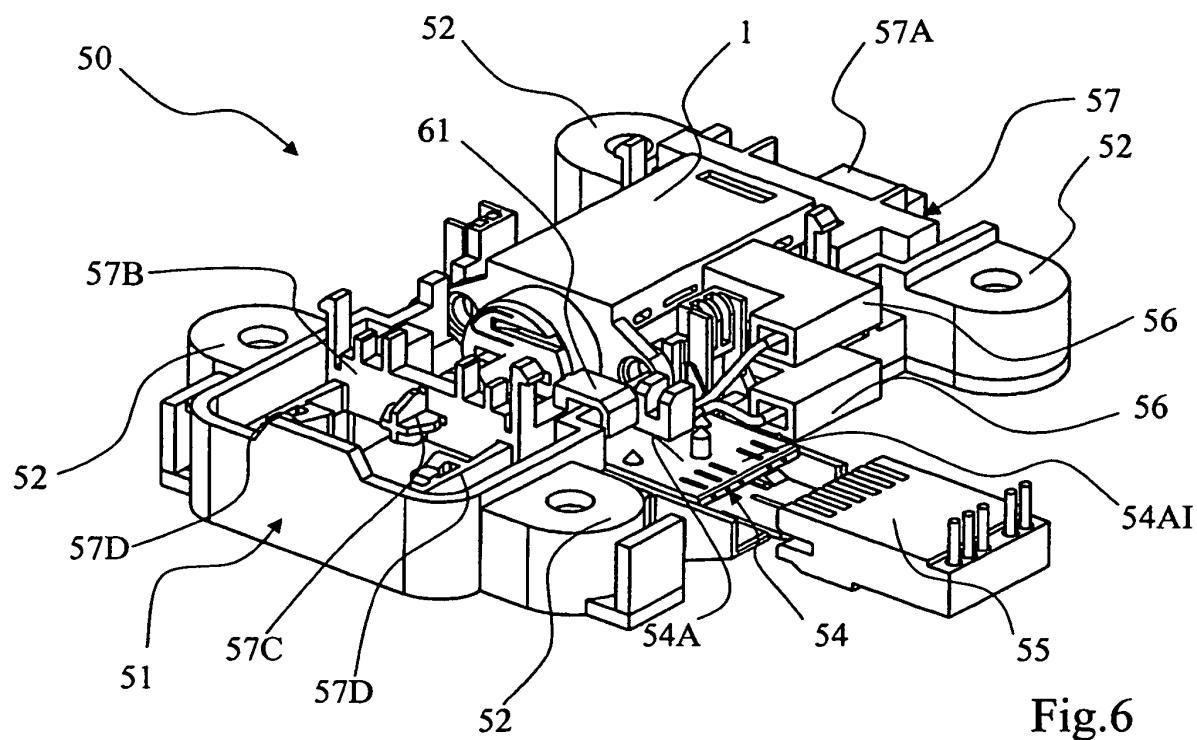


Fig.4



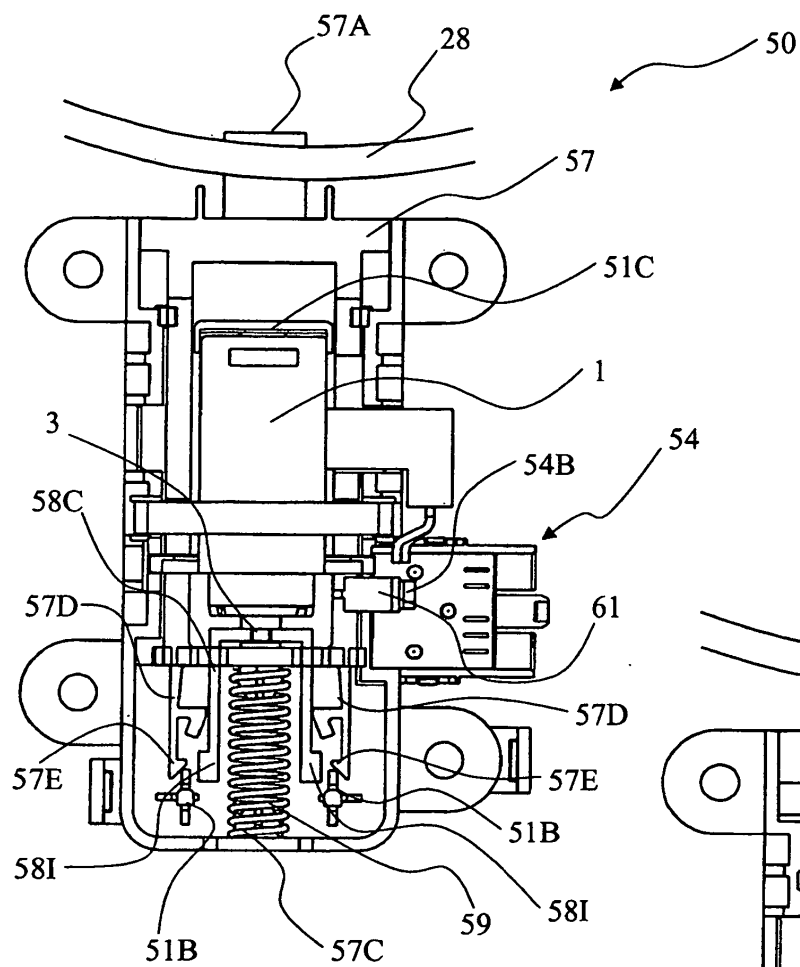


Fig.7

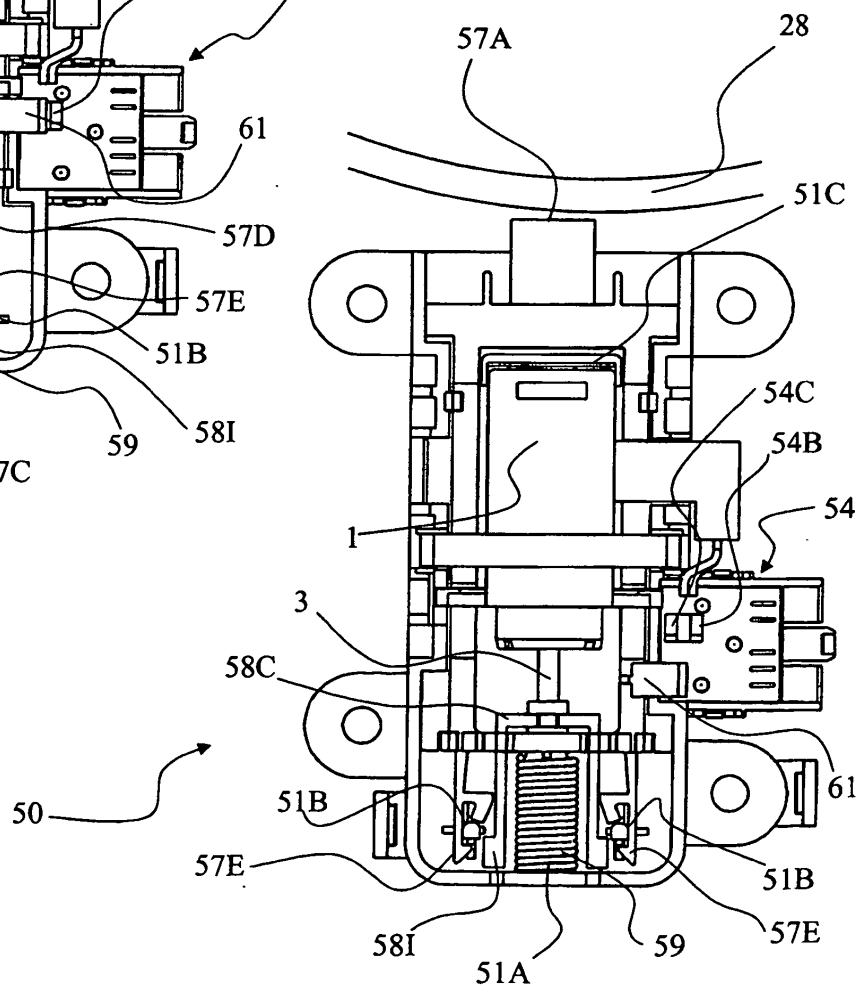


Fig.8

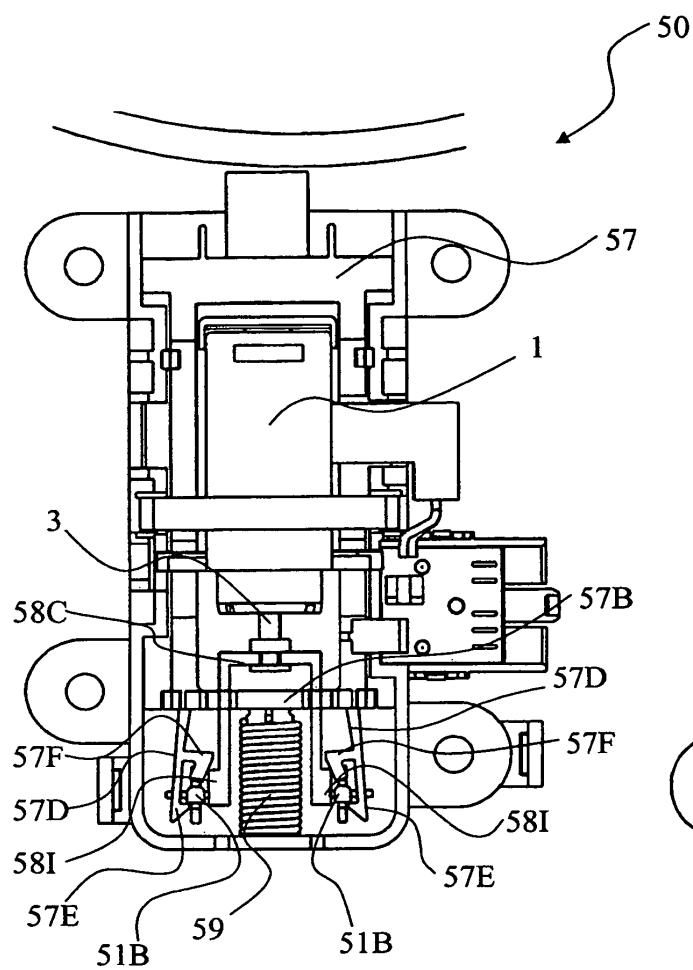


Fig.9

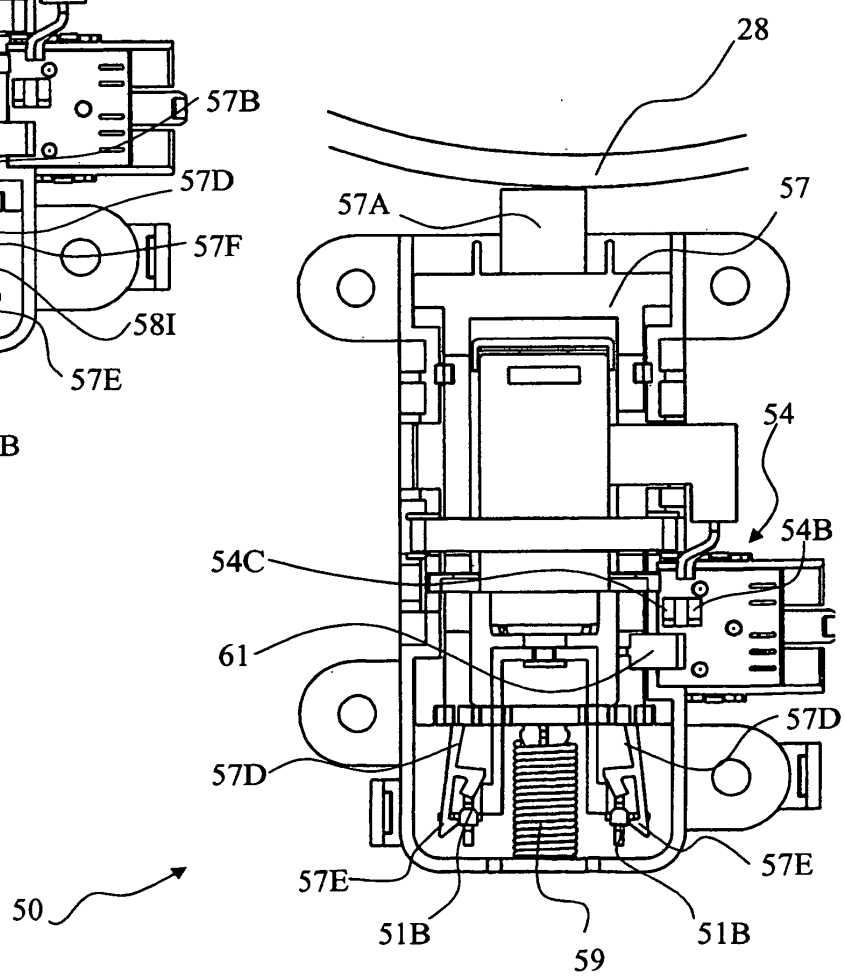


Fig.10

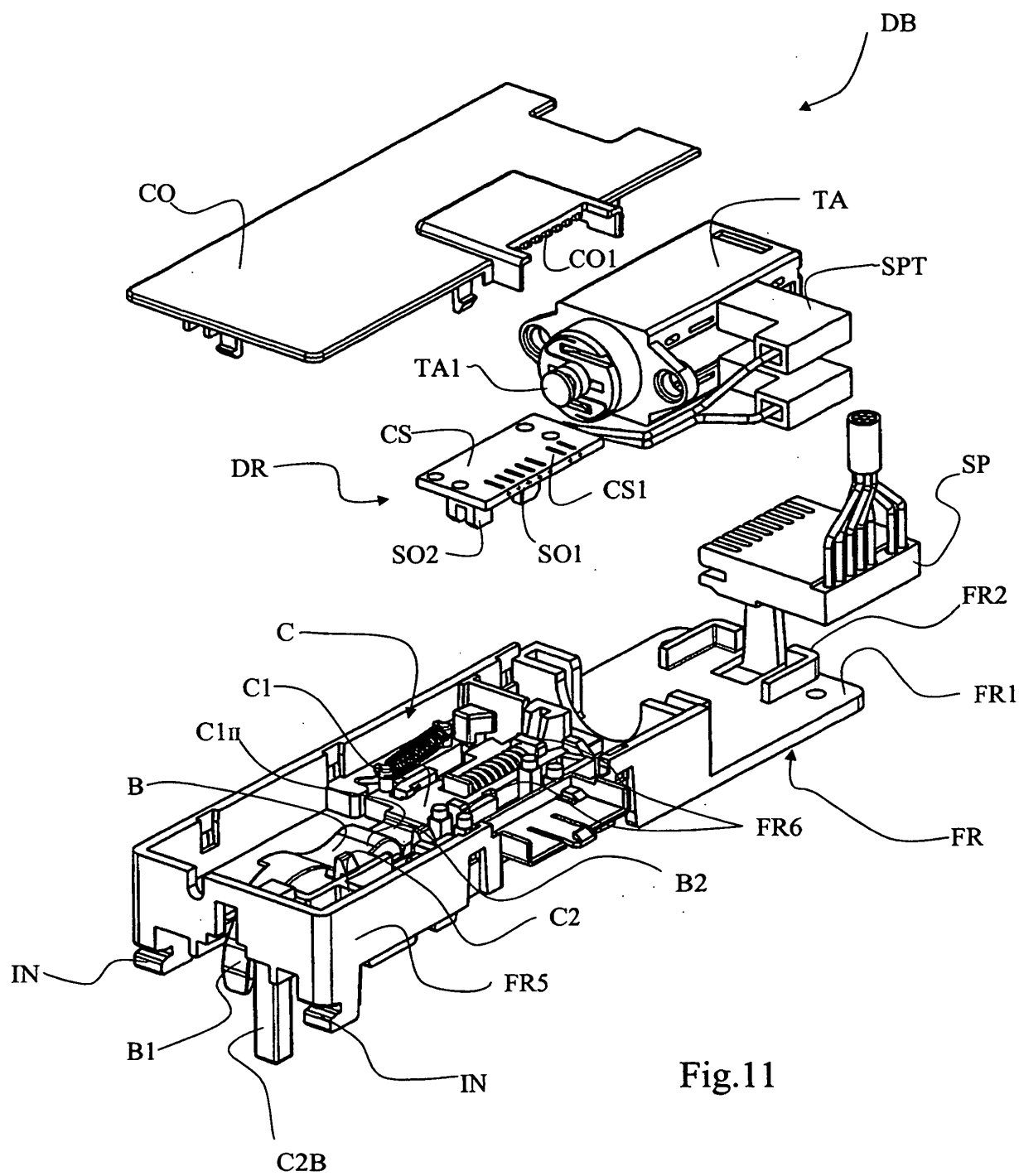


Fig.11

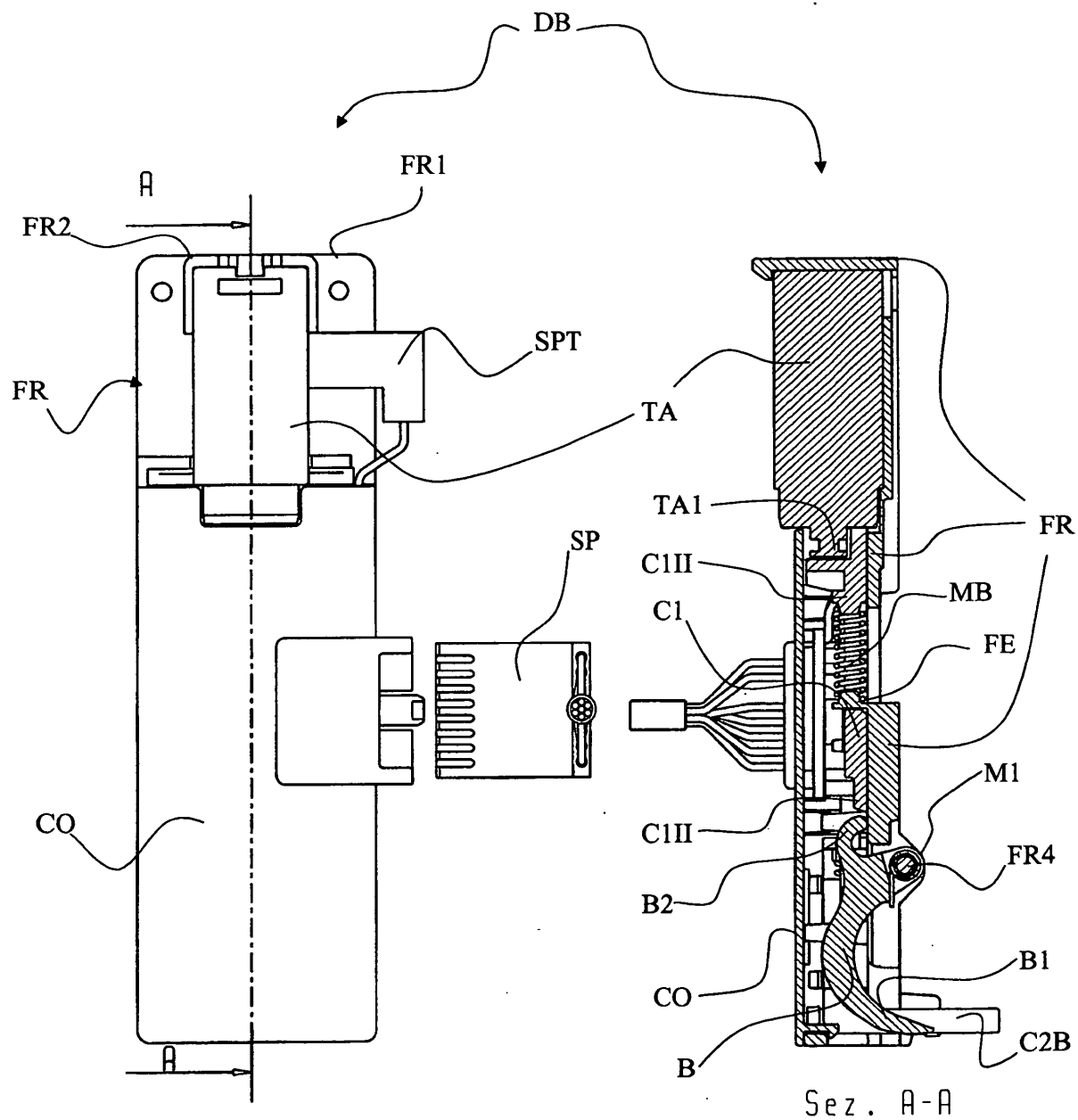


Fig.12

Fig.12/I

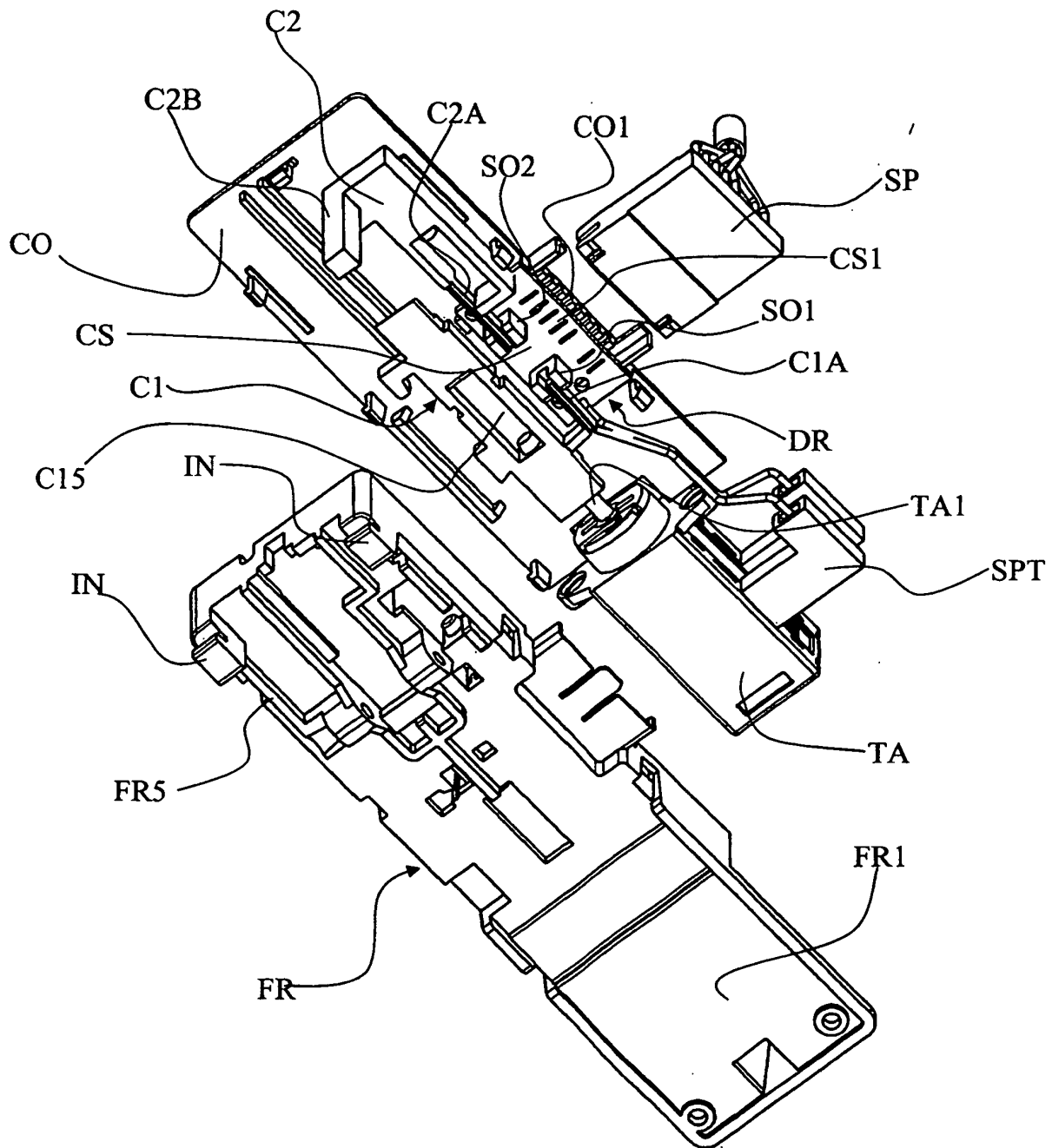


Fig.13

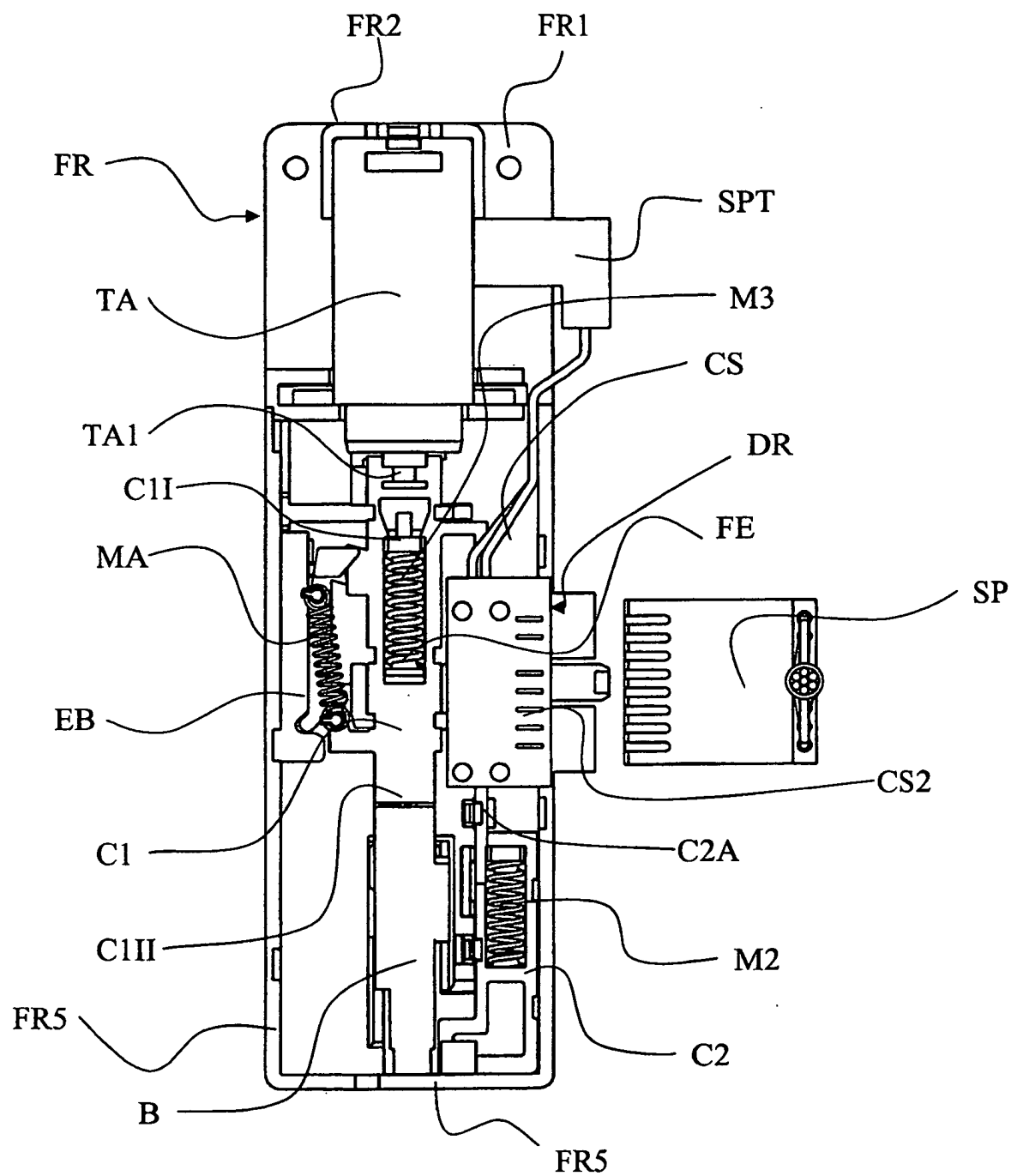


Fig.14

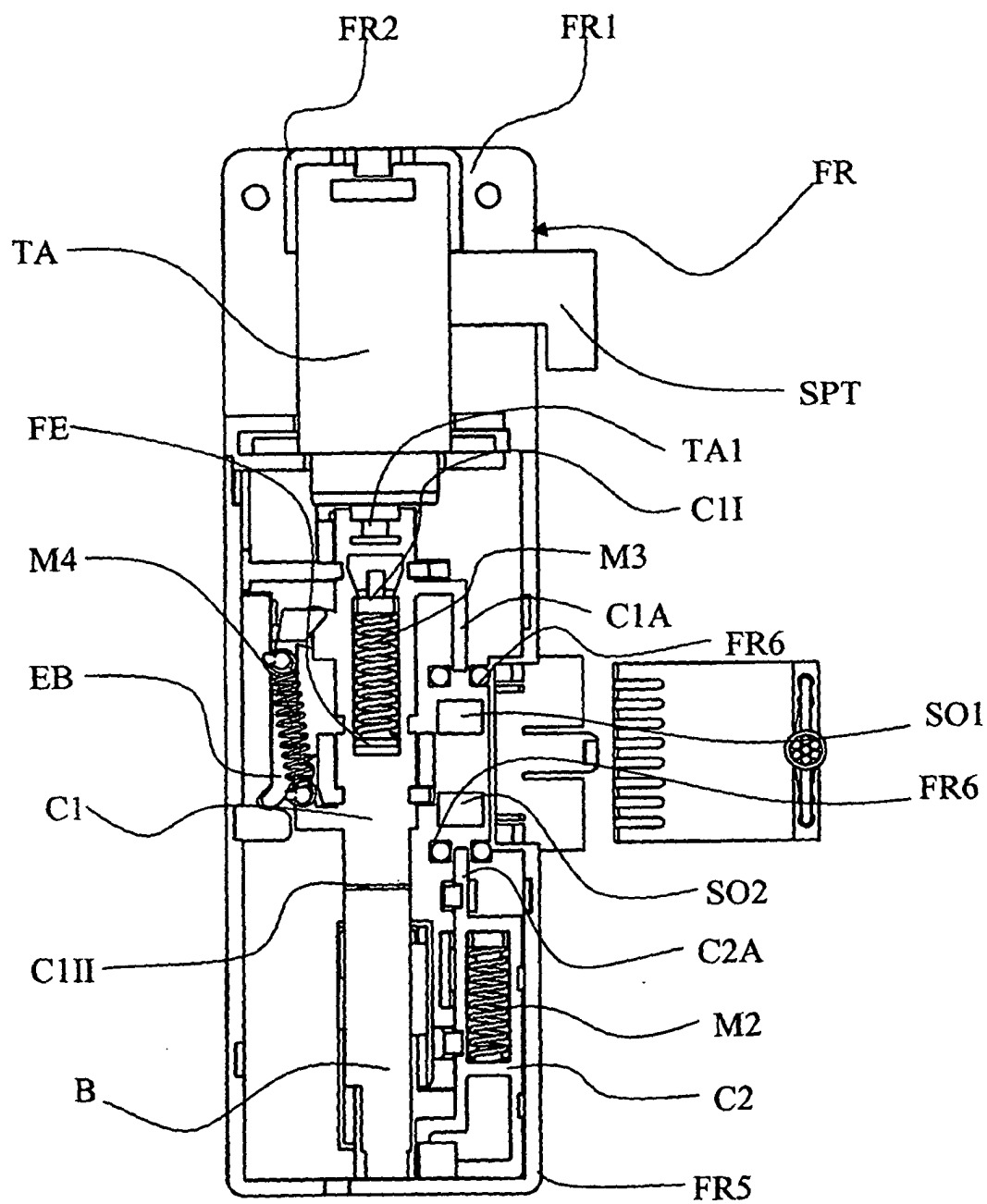


Fig.15

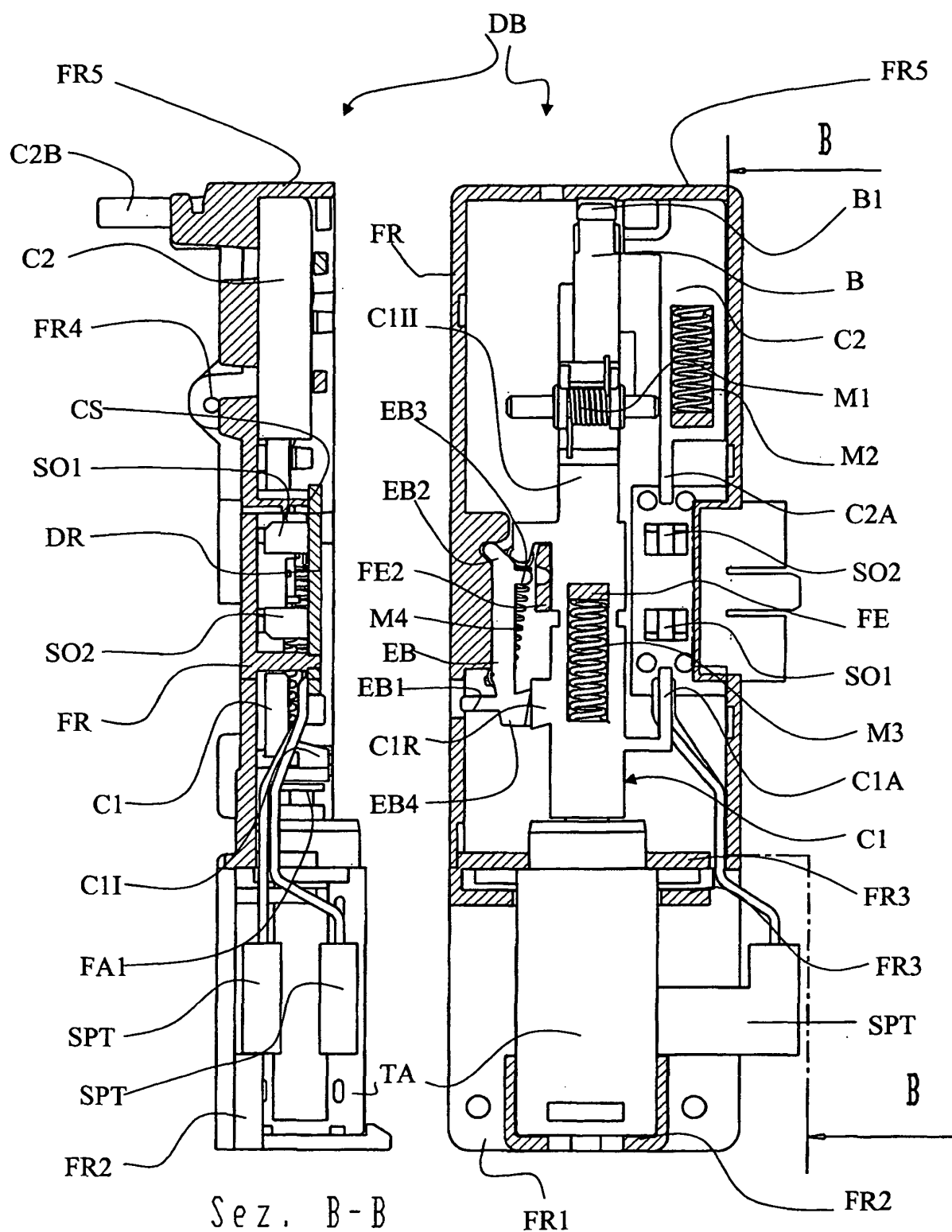
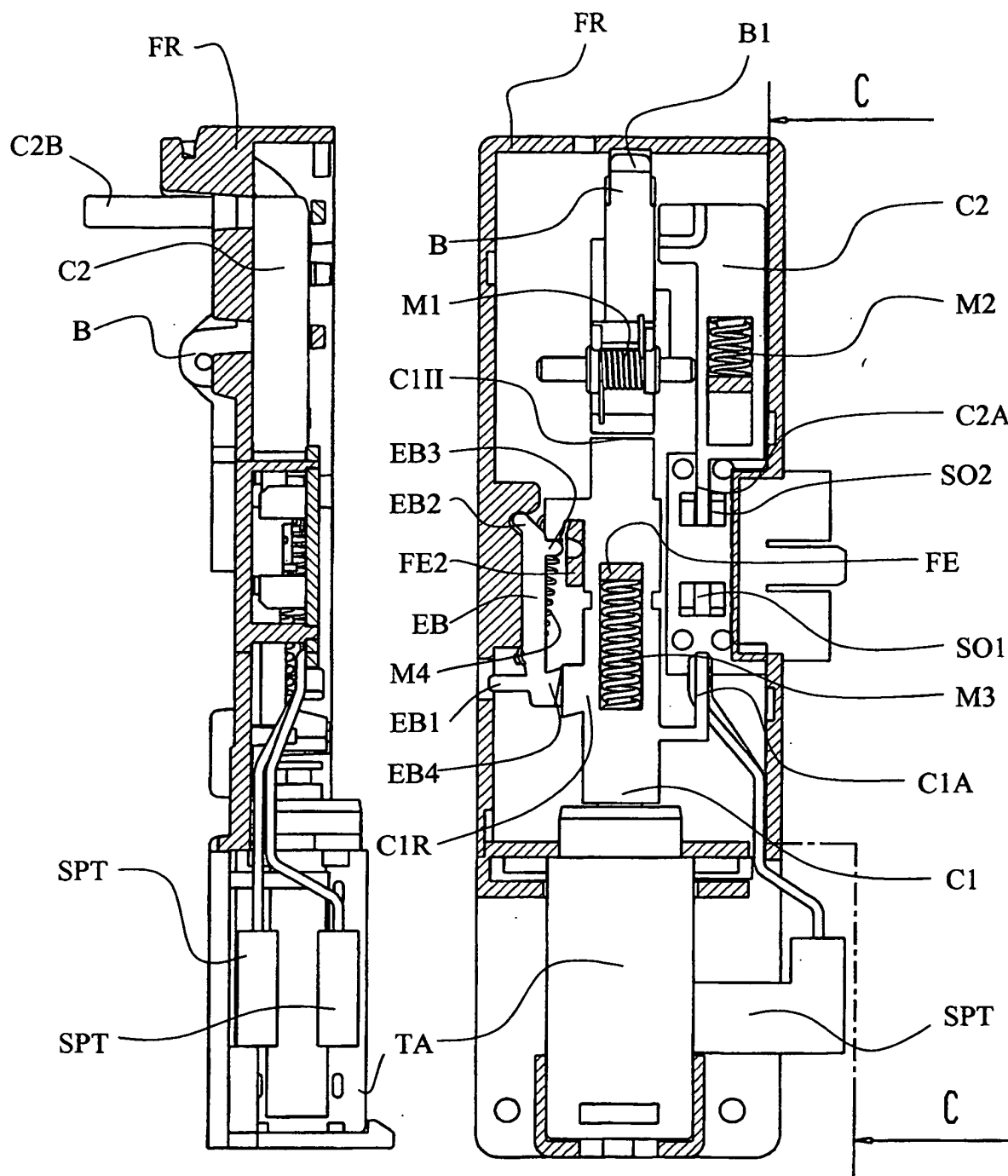


Fig.16/I

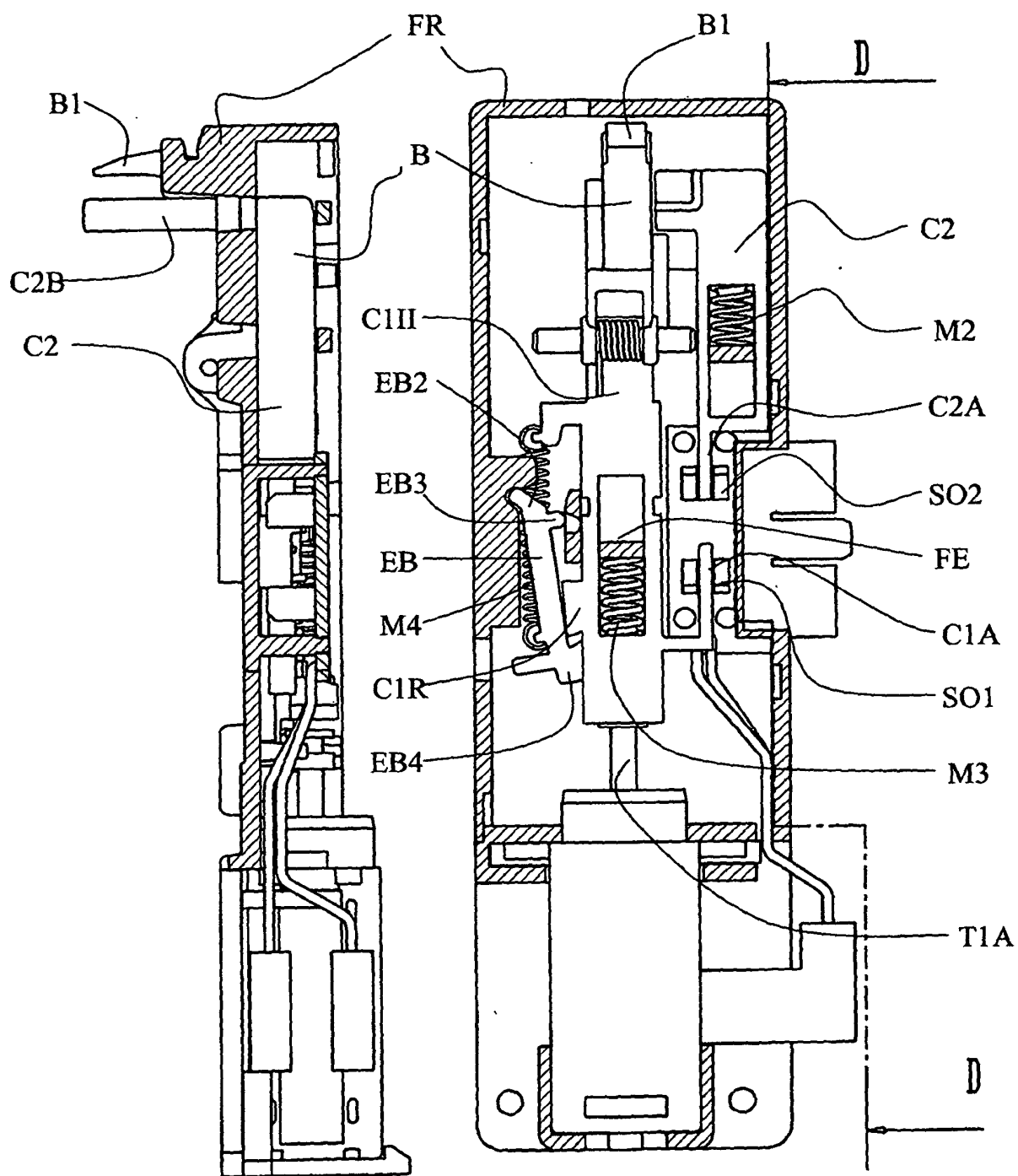
Fig.16



Sez. C-C

Fig. 17

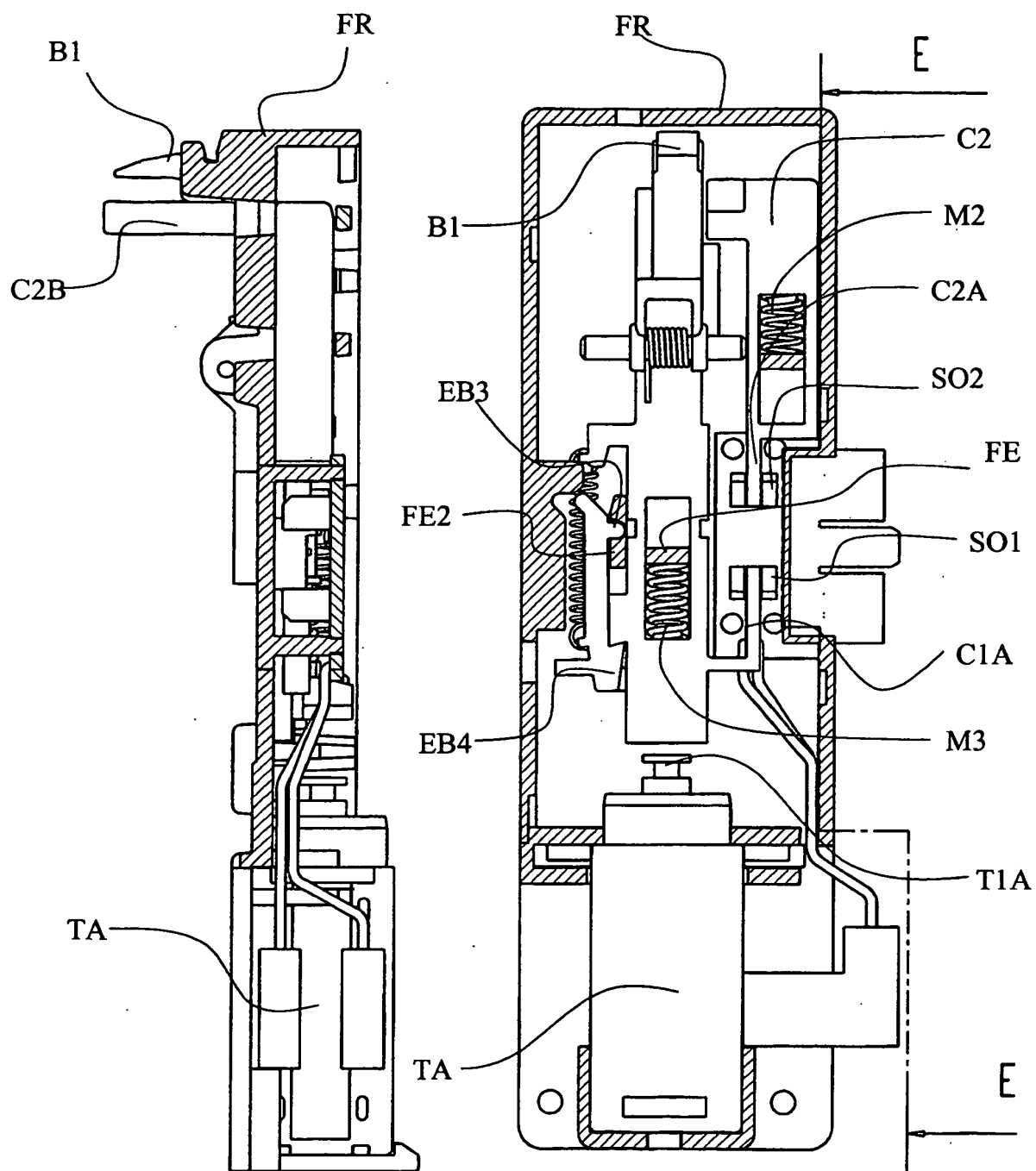
Fig. 17/I



Sez. D-D

Fig. 18/I

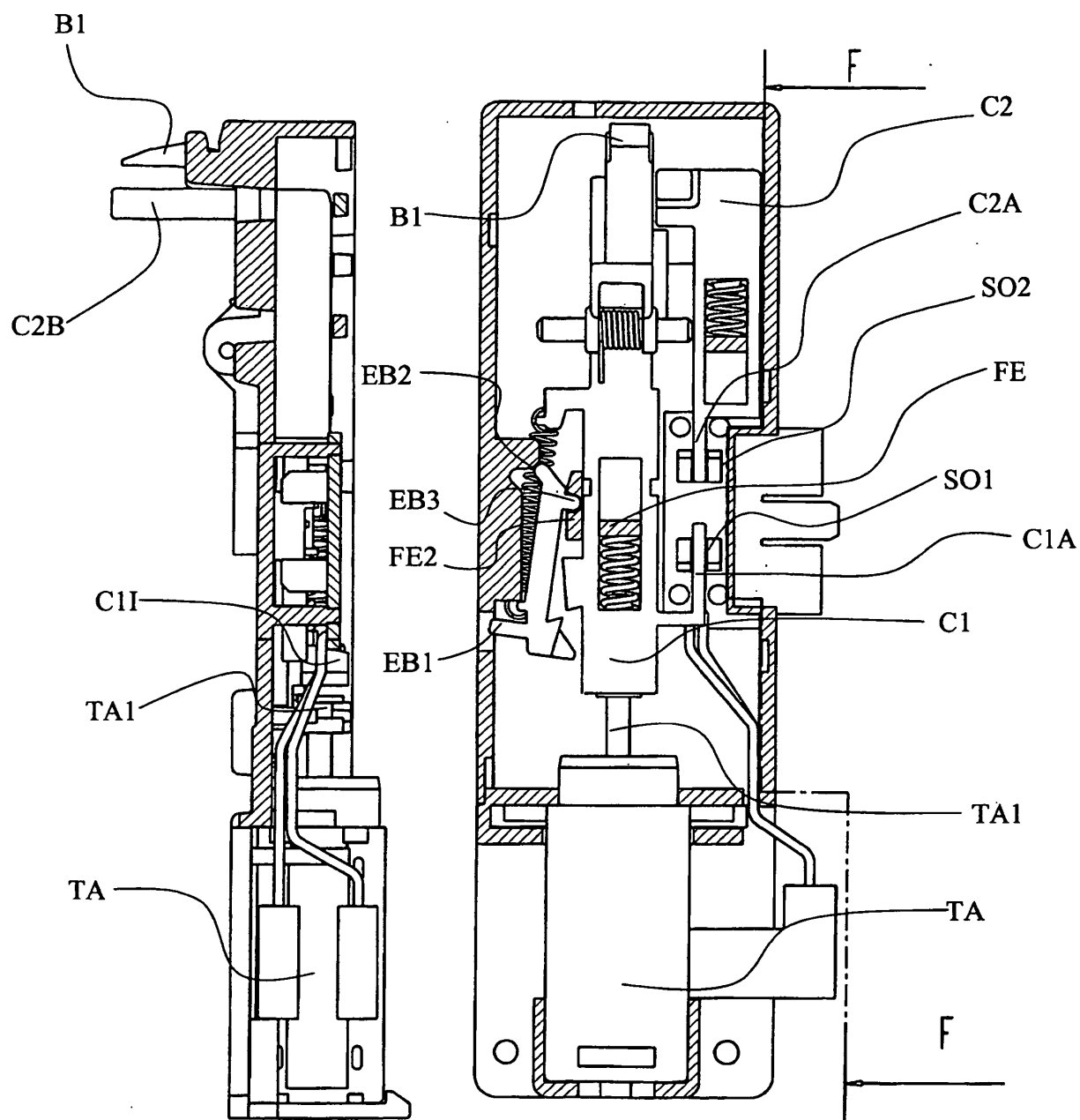
Fig. 18



Sez. E-E

Fig. 19

Fig. 19/I



Sez. F-F

Fig.20

Fig.20/I

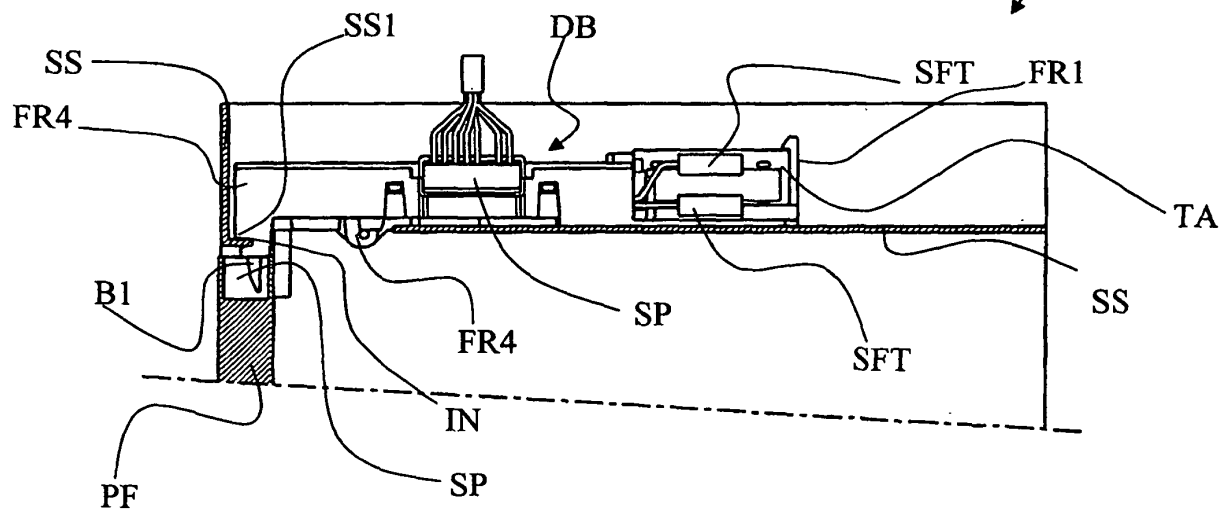
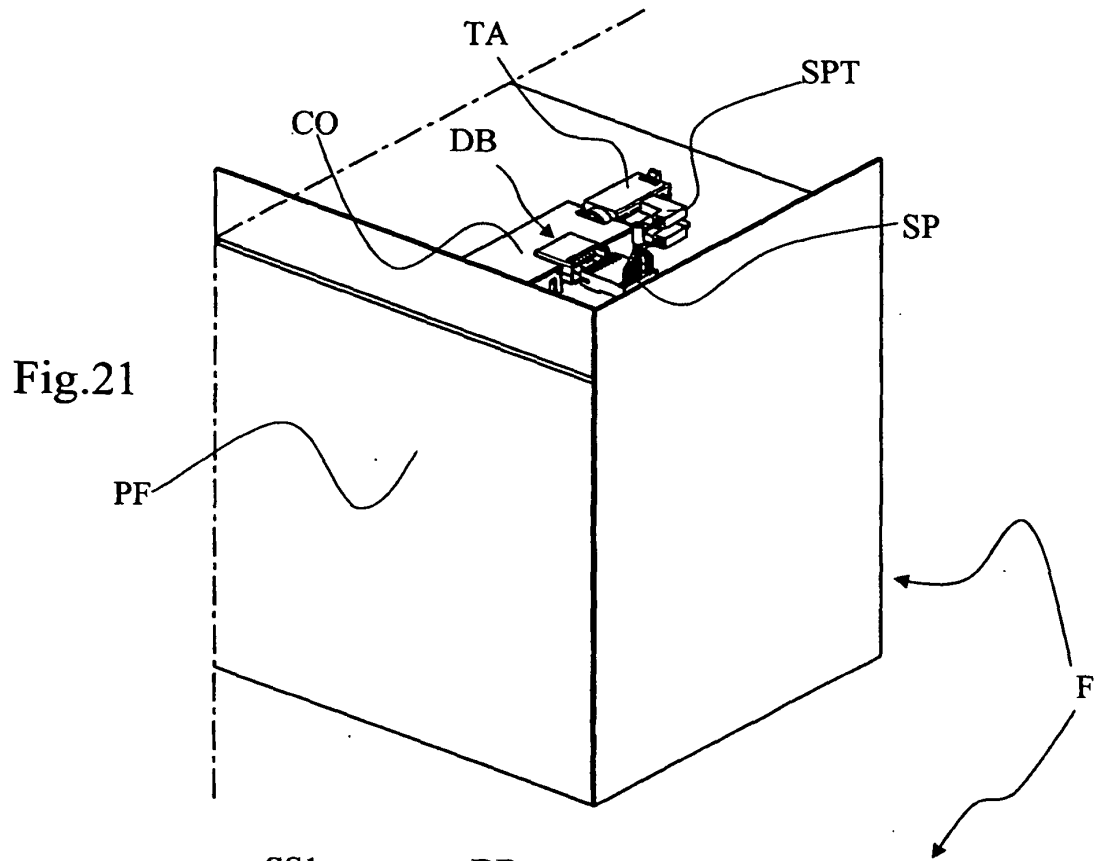


Fig.22



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 01 6491

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X,D	EP 1 041 186 A (ELTEK SPA) 4 October 2000 (2000-10-04)	1-4,7,9, 10, 13-15, 19-26, 28,30, 31,33-47	G05D23/19 F03G7/06
Y	* abstract * * paragraphs [0016] - [0104]; figures 5-9 *	5,6,8, 27,29,32	
Y,D	----- EP 0 781 920 A (ELTEK SPA) 2 July 1997 (1997-07-02) * abstract * * column 7, line 18 - column 8, line 11; figures 9-11 * -----	5,6,8, 27,29,32	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			G05D F03G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 October 2004	Examiner Helot, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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The members are as contained in the European Patent Office EDP file on
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