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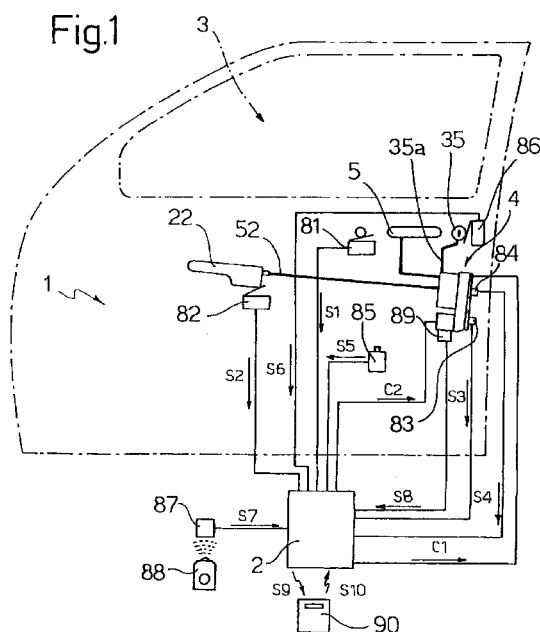
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(54) **Locking system for a door of a motor vehicle**

(57) Locking system (1) for a door (3) of a motor vehicle, comprising a lock (4) provided with a locking unit (7), an operating unit (8) capable of interacting with the locking unit (7) to cause it to open, a safety lever (37) which can be placed in a first and a second position for blocking and enabling, respectively, the opening of the locking unit (7) from the outside, a first electrical actuator (58) having an output member (60) movable along a first path (S) to cause the opening of the locking unit (7) independently of the position assumed by the safety lever (37), and a second electrical actuator (39) for moving the safety lever (37) between the blocking and enabling positions; the system (1) is also provided with a control unit (2) comprising user recognition means (100) which can be activated selectively to generate a signal to permit opening in the presence of a user authorized to open the lock (4) from the outside in the condition in which the safety lever (37) is in the blocking position, and first and second driving means (99, 104) generating corresponding operating signals (C1, C2) for the first and the second actuator (58, 39) respectively in response to the signal enabling opening from the user recognition means (100); the operating signal (C2) is generated after the operating signal (C1) and following the opening of the locking unit (7).



Description

[0001] The present invention relates to a locking system for one or more doors of a motor vehicle, of the type comprising one or more locks associated with the corresponding doors and an electronic control unit for these locks.

[0002] As is known, a conventional lock comprises a locking mechanism, an operating device of a mechanical type capable of being connected to the manual operating elements associated with the door of the motor vehicle, such as the internal and external handles, and capable of interacting with the locking mechanism to cause it to open, a safety mechanism which can be placed in a first and a second position, for blocking and enabling, respectively, the opening of the locking mechanism from the outside, an electrical opening actuator interacting with the operating device to cause the opening of the locking mechanism, and an electrical door locking actuator to move the safety mechanism between the blocking and enabling positions.

[0003] In locking systems of the conventional type, the control unit is connected to the actuators of each lock to operate them simultaneously and to activate what is called the "central locking" function.

[0004] More particularly, the present invention relates to a locking system of the "passive entry" type; this means that, when the opening of the lock of the motor vehicle from the outside is blocked (safety function on), the locking system is capable of electronically identifying the user during the operation of an external handle of a door of the motor vehicle, and of causing the corresponding lock to open only if the user is positively identified.

[0005] In greater detail, the locking system permits the opening of the locks of the motor vehicle from the outside simply by the operation of the corresponding external handles exclusively by a user possessing a personal identity card provided with a microchip in which a user identity code is stored.

[0006] For the purpose of recognizing the user in possession of the aforesaid identity card, the control unit is capable of: transmitting an interrogation signal for the activation of the microchip associated with the identity card; of receiving from the microchip a response signal containing the user identity code; of comparing the user identity code with a code of its own which is stored; and of sending corresponding operating signals for the electrical actuators of each lock only if the codes coincide.

[0007] In particular, with reference to each lock, if the aforementioned codes coincide, the control unit activates the door locking actuator to move the safety mechanism from the blocking position to the enabling position, and, when the safety function has been turned off, activates the opening actuator to cause the opening of the locking mechanism.

[0008] The total time required for opening the lock

from the outside proves to be relatively long, since it is equal to the sum of the operating times of the door locking and opening actuators, and may therefore prove to be longer than the time of operation of the external handle by the user, thus imparting to the user a sensation that the system is jammed.

[0009] The object of the present invention is to provide a locking system for a door of a motor vehicle which makes it possible to overcome in a simple and economical way the disadvantage associated with the known locking systems described above.

[0010] The aforesaid object is achieved by the present invention, in that it relates to a locking system for at least one door of a motor vehicle, comprising:

- a lock provided with a locking unit, an operating unit connectable to corresponding manual operating elements associated with the said door and capable of interacting with the said locking unit to cause it to open, at least one safety lever which can be placed in a first and a second position, for blocking and enabling, respectively, the opening of the said locking unit from the outside, a first electrical actuator for causing the opening of the said locking unit, and a second electrical actuator for moving the said safety lever between the said blocking and enabling positions; and
 - a control unit comprising user recognition means which can be activated selectively to generate a signal to enable opening in the presence of a user authorized to open the said lock from the outside in the condition in which the safety lever is placed in the said blocking position, and operating means generating corresponding signals for operating the said first and second actuators in response to the said signal enabling opening from the said user recognition means;
- characterized in that the said first actuator comprises an output member movable along a first path to cause the opening of the said locking unit independently of the position assumed by the said safety lever, and in that the said operating means comprise first means of driving the said first actuator, and second means of driving the said second actuator which can be activated after the said first driving means and following the opening of the said locking unit.

[0011] To enable the present invention to be understood more clearly, a preferred embodiment is described below, purely by way of example and without limitation, with reference to the attached drawings, in which:

Figure 1 shows schematically and partially a locking system according to the present invention, with reference to a front door of a motor vehicle;

Figure 2 is a front elevation of a lock forming part of

the locking system of Figure 1;

Figure 3 is a perspective view from the rear of the lock of Figure 2, on an enlarged scale and with parts removed for clarity;

Figure 4 shows, in partial section and on a reduced scale, a detail of the lock of Figure 3;

Figures 5 to 10 are schematic rear views of the lock of Figure 2, with parts removed for clarity and different operating configurations; and

Figure 11 is a logical block diagram showing the operation of a control unit of the locking system of Figure 1.

[0012] With reference to Figure 1, the number 1 indicates as a whole a locking system for the doors of a motor vehicle, this system essentially comprising a plurality of locks associated with the corresponding doors and an electronic control unit 2 for the locks.

[0013] The illustration of the system 1 shows only the central control components and the system components associated with a front door 3 of the motor vehicle and with a corresponding lock 4, to which the following description makes specific reference. It is to be understood that the other doors of the motor vehicle and the corresponding locks are provided with corresponding components except where specified otherwise.

[0014] The system 1 is of the "passive entry" type; this means that, when the opening of the lock 4 from the outside is blocked (safety function on), the system 1 is capable of electronically identifying the user during the operation of an external handle 5 of the door 3 and of causing the lock 4 to open only if the user is positively identified.

[0015] With reference to Figures 2 to 10, the lock 4 essentially comprises a frame 6 which can be fixed to the door 3, and two units 7, 8, for locking and operating respectively, joined together and both supported by the frame 6.

[0016] The locking unit 7 (Figure 2) comprises, in a well-known manner, a fork 9 and a stop 10 pivoted about corresponding pins 11, 12 fixed integrally with the frame 6 and having axes A, B parallel to each other.

[0017] The fork 9 consists of a shaped plate, is pivoted in an intermediate portion about the pin 11, and can interact with a fixed striking member 15 integral with a jamb (not shown) of the door 3.

[0018] In particular, the fork 9 is movable between an opening position (not shown) in which it permits the entry of the striking member 15 into its C-shaped seat 16, and a locking position, in which it secures the striking member 15 in the seat 16. The fork 9 is pushed towards the opening position, in which it is located with its side in contact with a stop edge 17 of the frame 6, by a spring (of a known type and not illustrated) wound around the pin 11.

[0019] The stop 10 consists of a shaped plate approximately coplanar with the fork 9, and is pushed in a well-known manner towards a peripheral edge of the

fork 9 by a spring (of a known type and not illustrated) wound around the pin 12.

[0020] In particular, the stop 10 has an L-shaped terminal corner 18 which can be snap-fitted to a lateral edge of the seat 16 of the fork 9 to releasably secure the fork 9 in the locking position.

[0021] The stop 10 carries an integral operating finger 19 (Figures 2, 5-10) extending from one of its free ends parallel to the axes A and B and capable of interacting with the operating unit 8, as described below, to receive opening forces from this operating unit.

[0022] With reference to Figures 3 to 10, the operating unit 8 comprises two opening mechanisms 20, 21 which are supported by the frame 6 and can be connected to the external handle 5 and to an internal handle 22 (Figure 1), respectively, of the door 3 to open the lock 4 from the outside and from the inside respectively. The operating unit 8 also comprises a safety device 23 supported by the frame 6 and providing what is known as the safety function, in other words the function of blocking the opening of the lock 4 from the outside of the motor vehicle.

[0023] The opening mechanism 20 comprises an external operating lever 24 connected in a well-known manner to the handle 5 and mounted rotatably on a pin 25 supported by the frame 6 coaxially with a corresponding axis C parallel to the axes A and B, and a transmission lever 26, which is coupled in a selectively releasable way to the lever 24, is movable in a plane orthogonal to the axes A, B, C, and, for the purpose of opening the lock 4, is capable of interacting unidirectionally with the finger 19 of the stop 10.

[0024] In particular, the lever 24 is substantially flat, is of elongate form, has one of its ends connectable to the handle 5, and has its opposite end engaged with the pin 25.

[0025] The lever 24 also has, in an intermediate position, a slot 27 engaged by a transverse tooth 28 of the transmission lever 26, and can rotate about the axis C, against the thrust of a spiral torsion spring (not shown) mounted on the pin 25, between a rest position and an opening position in which it can act on the stop 10 by means of the lever 26 and the finger 19 to open the lock 4 by disengaging the fork 9 from the striking member 15.

[0026] The slot 27 is substantially L-shaped, and comprises a releasing portion 29, which is formed substantially along a circumference having its centre in the axis C, and within which the tooth 28 can slide freely regardless of the position of the lever 24, and a retaining portion 30, which extends transversely from the portion 29 towards the axis C, and within which the tooth 28 is retained so that a substantially rectilinear movement orthogonal to the axes A, B, C is imparted to the lever 26 when the lever 24 is moved between its rest and opening positions.

[0027] The lever 26 is also of elongate form and has, in addition to the tooth 28, two slots 31 and 32

located successively along the lever 26 after the tooth 28. The slot 31 extends parallel to a longitudinal axis of the lever 26 and is engaged slidably by a supporting pin 33 of the lever 26 mounted on the frame 6 coaxially with an axis D parallel to the axis C; the slot 32 is engaged slidably by a corresponding pin 34 carried by the safety device 23 parallel to the pin 33, and has two rectilinear portions, of which one is longitudinal and one is inclined with respect to the larger dimension of the lever 26, meeting at an intermediate elbow forming a stable support for the pin 34. A curvilinear end 36 of the lever 26, outwardly convex and located at the opposite end from the tooth 28, can interact with the finger 19 of the stop 10.

[0028] The safety device 23 can act, through the pin 34, on the lever 26 to make it rotate about the axis D. The device 23 comprises a substantially flat safety lever 37 which is positively coupled to the lever 26 by the pin 34 and is rotatable on a pin 38 supported by the frame 6 coaxially with a corresponding axis E parallel to the axes A, B, C, D, and an electrical door-locking actuator 39 which is operated by the control unit 2 and can rotate the lever 37 between a blocking position (Figures 6 to 9), in which, by rotating the lever 26 by means of the pin 34 (in the anti-clockwise direction in Figures 5 to 10 and about the axis D), it releases the levers 24 and 26 from each other by placing the tooth 28 of the lever 26 within the releasing portion 29 of the slot 27 in such a way as to prevent the lock 4 from being opened from the outside, and an enabling position (Figures 5 and 10), in which it engages the levers 24 and 26 with each other by placing the tooth 28 within the portion 30 of the slot 27 in such a way as to enable the lock 4 to be opened from the outside. The safety lever 37 is held stably in each of the aforesaid positions by a spring with two stable states, which is of a known type and is not shown.

[0029] In particular, the lever 37 extends in the same plane as the lever 24 and below the lever 26 with reference to Figures 3 to 10. The lever 37 comprises a first arm 40 pivoted at one of its ends on the pin 38 and extending in a substantially radial direction from the pin 38, and a second arm 41 projecting laterally from an intermediate portion of the arm 40 in a direction substantially orthogonal to the latter and carrying two projecting appendages 42, 43 which are substantially parallel to the arm 40.

[0030] The arm 40 has an end portion 44 which is opposite the pin 38 and is connectable in a well-known manner by means of an operating link 35a to a key-operated unit 35 of the door 3 to activate or disable the safety device 23.

[0031] The appendage 42 carries a projecting pin 34 at its free end, while the appendage 43 is located opposite the appendage 42 with respect to the arm 40 and carries, in turn, a projecting pin 45 coupled to the actuator 39.

[0032] The actuator 39 comprises a geared motor (of a known type and not visible in the attached figures),

which is housed within a casing 46 integral with the frame 6, and which has one of its output gears (not illustrated) joined to and angularly integral with a fork-shaped lever 47 which is rotatable about an axis F parallel to the axes A, B, C, D, E. One free end of the lever 47 has a U-shaped seat engaged by the pin 45 of the appendage 43 of the safety lever 37.

[0033] The lever 47 is rotatable about the axis F between a first angular position (Figures 6 to 9), corresponding to the blocking position of the lever 37, and a second angular position (Figures 5 and 10), corresponding to the enabling position of the lever 37.

[0034] The actuator 39 is also provided with an electrical connector 49, whose insulating casing is formed in one piece with the casing 46.

[0035] The opening mechanism 21 comprises a substantially flat opening lever 50, which is mounted rotatably on a pin 51 supported by the frame 6 coaxially with a corresponding axis G parallel to the axes A, B, C, C, E, F, and is connected in a selectively releasable way to the internal handle 22 by means of a link 52 (Figure 1), and, for the purpose of opening the lock 4, can interact unidirectionally with the finger 19 of the stop 10.

[0036] In particular, the lever 50 is of elongate form, is located above the levers 26 and 37 with reference to Figures 3 to 10, has one of its ends engaged with the pin 51 and extends in a substantially radial direction from the pin 51 and to the side of the finger 19.

[0037] The lever 50 also has, in a widened intermediate portion, a slot 53 engaged slidably by a transverse finger 54 of the link 52, and can rotate about the axis G, against the thrust of a spiral torsion spring (not shown) mounted on the pin 51, between a rest position and an opening position, in which one of its lateral edges can act on the finger 19 of the stop 10 to open the lock 4 by disengaging the fork 9 from the striking member 15.

[0038] The slot 53 is substantially L-shaped, and comprises a rectilinear retaining portion 55, which extends longitudinally along the lever 50 and within which the finger 54 is retained to impart the rotation between the rest and opening positions to the lever 50, and a releasing portion 56 which is also rectilinear, which extends transversely to the retaining portion 55 and within which the finger 54 can slide freely regardless of the position of the handle 22 and consequently of the link 52.

[0039] The lever 50 terminates, at the opposite end from the pin 51, in a terminal projection 57 with a rounded outer profile, whose function will be made clear in the following text.

[0040] According to an important aspect of the present invention, the lock 1 additionally comprises an electrical actuator 58 operated by the control unit 2 and capable of interacting with the projection 57 of the lever 50 and, by means of the latter, with the finger 19 of the stop 10, to open the lock 4 independently of the position in which the safety lever 37 is placed.

[0041] According to the above description, in order

to open the lock 4 from the outside, in the condition in which the safety lever 37 is placed in the blocking position, the control unit 2, after having successfully recognized the user who operates the handle 5 of the door 3, initially operates the actuator 58 to open the lock 4 and the door 3 and, when the door 3 has been opened, operates the actuator 39 to move the safety lever 37 from the blocking position to the enabling position. Thus the time elapsing between the operation of the handle 5 by the user and the opening of the door 3 includes only the time taken for the activation and movement of the actuator 58 and is independent of the time taken for the activation and movement of the actuator 39 for releasing the safety function.

[0042] With particular reference to Figure 3, the actuator 58 comprises a geared motor 59 having an output member 60 of elongate form, extending transversely to the opening lever 50 at the position of the projection 57 and at an end of the lever 50 opposite the finger 19 of the stop 10. A rounded free end 61 of the output member 60 can interact with the projection 57 of the opening lever 50, to rotate the lever between its rest and opening positions. In particular, the output member 60 is mounted slidably within a guide portion 67 (shown schematically in Figure 4) of the frame 6 along a direction H orthogonal to the axes A, B, C, D, E, F, G, and is loaded on opposite sides by a pair of springs 65a, 65b to hold it stably in a rest position (Figures 3, 4, 5, 6, 8, 10) in which the springs 65a, 65b are in equilibrium with each other and the free end 61 of the output member 60 is separated from the projection 57 of the opening lever 50.

[0043] By the operation of the geared motor 59, the output member 60 can be moved along an opening path S from the rest position to a first operational limit position (Figure 9) in which its free end 61 acts on the opening lever 50 to place it in the opening position.

[0044] The geared motor 59 comprises, in a well-known manner, an electric motor 62 supported by the frame 6 and a geared reduction unit 63, one of whose output gears 64 carries integrally and coaxially a screw 66a (Figure 4), which in turn is engaged within a terminal female threaded portion 66b of the output member 60 opposite the end 61.

[0045] Again with reference to Figures 3 to 10, the operating unit 8 also comprises a disabling lever 70 providing the function known as "dead lock", in other words that of blocking the opening of the lock 4 from inside the motor vehicle. The disabling lever 70 is mounted rotatably on the pin 38, can interact with the finger 54 of the link 52 to release it selectively from the opening lever 50, and is engaged with the safety lever 37 by "lost motion" connecting means which, as will be explained in detail subsequently, provide a transmission of motion between the levers 37 and 70 only in specific operating conditions of the lock 4.

[0046] In particular, the disabling lever 70 is substantially V-shaped and comprises two arms 71, 72

which diverge from a vertex portion 73 of the lever 70.

[0047] The arm 71 has a fork-shaped free end portion 74 pivoted on the pin 38 and engaged with a certain degree of play by a finger 75 projecting from the output member 60 in a direction parallel to the axes A, B, C, D, E, F, G. In greater detail, the fork-shaped end portion 74 consists of a pair of projections 79a, 79b projecting from the arm 71 towards the output member 60.

[0048] The disabling lever 70 extends in two planes parallel to each other; more precisely, the fork-shaped end portion 74 is coplanar with the opening lever 50, while the remaining part of the disabling lever 70 extends above the opening lever 50 with reference to Figures 3 to 10.

[0049] At a free end, the arm 72 has a slot 78, having a profile substantially in the shape of a right-angled triangle with rounded vertices, which is engaged by the finger 54 of the link 52.

[0050] In the rest position of the opening lever 50, the finger 54 of the link 52 is held at one end vertex of the slot 78 (Figures 5, 6, 9 and 10) and there is a clearance between it and an opposite end of the slot 78, in the direction of rotation of the lever 50. Thus, when the lever 50 is placed in the rest position, the rotation of the disabling lever 70 about the pin 38 has the effect of moving the finger 54 along the retaining portion 55 of the slot 53 to the start of the releasing portion 56; additionally, the finger 54 of the link 52 can move freely within the slot 78 not only when it is engaged in the retaining portion 55 of the slot 53 and can move the opening lever 50 between the rest and opening positions, but also when it is engaged in the releasing portion 56 of the slot 53.

[0051] The disabling lever 70 is movable between an enabling position ("dead lock" function off), in which it holds the finger 54 of the link 52 in the retaining portion 55 of the slot 53, thus permitting the opening of the lock 4 by the operation of the internal handle 22 (Figures 5, 6, 9 and 10), and a blocking position ("dead lock" function on), in which it holds the finger 54 of the link 52 in the releasing portion 56 of the slot 53 of the opening lever 50, thus making the internal handle 22 inoperative (Figure 7 and 8). The disabling lever 70 is held stably in each of the aforesaid positions by a spring with two stable states, of a known type, which is not illustrated.

[0052] The disabling lever 70 is moved from the enabling position to the blocking position by moving the output member 60 from the rest position to a second limit operating position (Figure 7) along a path T for engaging the "dead lock" function, which is the opposite of the opening path S. The output member 60 is moved along the path T by supplying the electric motor 62 with a power supply voltage of opposite polarity to that of the power supply voltage used to move the output member 60 along the path S.

[0053] On completion of the movements along the path S and T, the output member 60 is returned to the rest position by the action of the springs 65a and 65b.

[0054] In the enabling position of the lever 70 (Figures 5, 6, 9 and 10), the fork-shaped end portion 74 is positioned so that it is inclined with respect to the output member 60, in such a way that the projection 79a adjacent to the opening lever 50 is moved laterally with respect to the trajectory along which the finger 75 travels during the movement of the output member 60 along the path S, and does not interfere with the opening of the lock 4.

[0055] In the blocking position of the lever 70 (Figures 7 and 8), the fork-shaped end portion 74 is positioned so that it is substantially orthogonal to the output member 60, and the projection 79a adjacent to the opening lever 50 is therefore positioned on the trajectory along which the finger 75 travels during the movement of the output member 60 along the path S, in such a way that, during the aforesaid movement, the interaction between the finger 75 and the projection 79a returns the lever 70 to the enabling position.

[0056] In greater detail, the "lost motion" connecting means comprise a through slot 76 formed in the vertex portion 73 of the disabling lever 70 and extending substantially along a circumference having its centre on the axis E of the pin 38, and a finger 77 which projects from the arm 40 of the safety lever 37 in the area from which the arm 41 extends, and which is engaged slidably in the slot 76.

[0057] The slot 76 and the finger 77 can transmit the motion between the levers 37 and 70 only during the movement of the lever 70 from the enabling position to the blocking position, when the lever 37 is placed in the enabling position, and during the movement of the lever 37 from the blocking position to the enabling position, when the lever 70 is placed in the blocking position. In operating conditions of the levers 37 and 70 different from those stated, the slot 76 and the finger 77 are able to disengage the levers 37 and 70 from each other.

[0058] When the disabling lever 70 and the safety lever 37 are placed in the corresponding enabling positions (Figures 5 and 10), the finger 77 occupies an upper end 76a of the slot 76 with reference to Figures 5 and 10, and is separated from an opposite end 76b of the slot 76; in practice, the finger 77 and the end 76a of the slot 76 have a clearance between them in the direction of rotation of the safety lever 37 from the enabling position to the blocking position. Consequently, in this configuration, the finger 77 can slide freely within the slot 76 during the movement of the safety lever 37 between the enabling and blocking positions; additionally, a movement of the disabling lever 70 into the blocking position causes, as a result of the interaction between the end 76a of the slot 76 and the finger 77, the movement of the safety lever 37 into the blocking position.

[0059] When the safety lever 37 and the disabling lever 70 are placed in the corresponding blocking positions (Figures 7 and 8), the finger 77 again occupies the end 76a of the slot 76, and consequently a movement of

the safety lever 37 into the enabling position causes, as a result of the interaction between the finger 77 and the end 76a of the slot 76, the rotation of the disabling lever 70 into the enabling position.

[0060] Conversely, again in the condition in which the safety lever 37 and the disabling lever 70 are placed in the corresponding blocking positions (Figures 7 and 8), a movement of the disabling lever 70 between the blocking and enabling positions simply causes the slot 76 to slide with respect to the finger 77 and does not cause the safety lever 37 to move.

[0061] With reference to Figure 1, the control unit 2 can receive a plurality of input signals of the logical type from elements for detecting the operating condition of the locks of the motor vehicle, and particularly of the lock 4 of the door 3, and of operating parameters of the motor vehicle correlated with them, and can generate output signals C1, C2 for operating the electrical actuators of each lock, and particularly the electrical actuators 39, 58 of the lock 4.

[0062] With reference to the door 3 and the corresponding lock 4, the control unit 2 receives a signal S1 from a microswitch 81 associated with the external handle 5 of the door 3, this signal having a high logical level (S1 equal to 1) when the external handle 5 is operated, a signal S2 from a microswitch 82 associated with the internal handle 22 of the door 3, this signal having a high logical level (S2 equal to 1) when the internal handle 22 is operated, a signal S3 from a microswitch 83 associated with the safety lever 37, this signal having a high logical level (S3 equal to 1) when the safety lever 37 is placed in the blocking position (safety function on), a signal S4 from a microswitch 84 associated with the disabling lever 70, this signal having a high logical level (S4 equal to 1) when the disabling lever 70 is placed in the blocking position ("dead lock" function on), a signal S5 from an inertial switch 85 having a high logical level (S5 equal to 1) in case of impact, a signal S6 and a signal S7 obtained, respectively, from a microswitch 86 operable by means of the key-operated unit 35 and from an on-board receiver 87 associated with a remote controller 88, these being capable of turning the safety and "dead lock" functions on and off, and a signal S8 from a microswitch 89 associated with the fork 9, this signal having a high logical level (S8 equal to 1) when the fork 9 is not in the closing position against the striking member 15.

[0063] As mentioned previously, the system 1 is of the "passive entry" type; in other words, when the safety lever 37 is placed in the blocking position, it allows the lock 4 to be opened from the outside by simple operation of the external handle 5 exclusively by a user in possession of a personal identity card 90 provided with microchips in which a user identification code is stored.

[0064] In order to recognize the user possessing the identity card 90, the control unit 2 is capable of transmitting an interrogation signal S9 to activate the microchip associated with the identity card 90, of receiv-

ing from the microchip a response signal S10 containing the user identification code, of comparing the user identification code with a stored code of its own, and of sending the signals C1 and C2 for operating the electrical actuators 39, 58 only when the codes coincide.

[0065] The lock 4 operates in the following way.

[0066] In normal operating conditions, the operation of the lock 4 is purely electrical and is controlled by the control unit 2 by the activation of the electrical actuators 39, 53. As will be explained more clearly in the following text, the lock 4 is opened by the manual operation of the external handle 5 and the internal handles 22, and this is done both mechanically, by movement of the levers 24, 26, 50, and electronically, by recognition of the user if appropriate and activation of the actuator 58 by the control unit 2, with a cycle time shorter than the cycle time required by the mechanical opening; the lock 4 can thus be opened in a "soft" way, in other words without any force.

[0067] The safety function, in other words the blocking of the opening of the door 3 from the outside of the motor vehicle, is carried out either in a conventional mechanical way, by placing the safety lever 37 in the blocking position, or electronically, by using the control unit 2 to block the operation of the electric motor 62 in response to the operation of the external handle 5 if the user is not recognized by the control unit 2.

[0068] In emergency conditions, in other words if there is a failure of the electrical system, the lock 4 can still be opened by operating the external handle 5 and internal handle 22, by means of which the lever 24 and the lever 50 respectively are moved; the safety function can be disabled manually from the outside by using the key.

[0069] The operation will now be described, beginning with the configuration in Figure 5, in which the lock 4 is locked and the safety function and the "dead lock" function, in other words that of blocking opening from the outside and from the inside, are de-activated.

[0070] In this condition, the safety lever 37 and the disabling lever 70 are placed in the corresponding enabling positions, and consequently the lever 26 is engaged with the external operating lever 24, because the tooth 28 is placed inside the retaining portion 30 of the slot 27, and the link 52 for opening the lock 4 from the inside is engaged with the opening lever 50, because the finger 54 of the link 52 engages the retaining portion 55 of the slot 53. Additionally, the finger 77 of the safety lever 37 occupies the end 76a of the slot 76 of the disabling lever 70.

[0071] From this configuration, the lock 4 is opened by electrical operation, from either the inside or from the outside, by means of the activation by the control unit 2 of the electrical actuator 58, whose output member 60 is moved along the opening path S from the rest position to the first operating position and, by interacting with the projection 57, causes the opening lever 50 to rotate from the rest position to the opening position.

[0072] In greater detail, after the external handle 5 or the internal handle 22 has been operated, the microswitch 81 or the microswitch 82 is triggered, causing the corresponding signal S1 or S2 to switch from the low logical level (S1 equal to 0, S2 equal to 0) to the high logical level (S1 equal to 1, S2 equal to 1). In response to these changes, the control unit 2 activates the electronic actuator 58.

[0073] The operation of the external handle 5 or internal handle 22 causes, in parallel with the opening by means of the electrical actuator 58, the mechanical opening of the lock 4, which, since it requires a cycle time which is longer than the cycle time required for electrical opening, is effective only in the case of a failure of the electrical system of the motor vehicle. In particular, the operation of the external handle 5 causes the lever 24 to rotate about the pin 25 from the rest position to the opening position and, owing to the interaction between the retaining portion 30 of the slot 27 and the tooth 28, causes the movement of the lever 26, which interacts with the finger 19 and consequently releases the stop 10 from the fork 9, thus releasing the striking member 15. Similarly, the operation of the internal handle 22 causes the link 52 to move and, by the interaction of the finger 54 with the retaining portion 55 of the slot 53, causes the opening lever 50 to rotate from the rest position to the opening position, in which it interacts with the finger 19 and consequently releases the stop 10 from the fork 9, thus releasing the striking member 15.

[0074] The safety function is enabled or disabled by rotating the safety lever 37 in opposite directions by means of the electrical actuator 39.

[0075] In particular, by supplying power supply voltages of opposite polarities to the geared motor of the electrical actuator 39, the fork-shaped lever 47 is made to rotate in opposite directions about the axis F, and, by acting on the pin 45, to cause the safety lever 37 to rotate between the enabling and blocking positions.

[0076] When moving from the enabling position (Figure 5) to the blocking position (Figure 6), the safety lever 37 rotates, by means of the pin 34, the lever 26, which is released from the lever 24 because the tooth 28 is placed within the releasing portion 29 of the slot 27, thus making the lever 24 inoperative and preventing the mechanical opening of the lock 4.

[0077] The "dead lock" function is enabled by using the electric motor 62 to move the output member 60 along the path T from the rest position to the second operating position (Figure 7); in particular, during the aforesaid movement of the output member 60, the finger 75 interacts in the direction H with the projection 79b, causing the disabling lever 70 to rotate about the axis E from the enabling position to the blocking position.

[0078] If the safety lever 37 is placed in the enabling position, the rotation of the disabling lever 70 from the enabling position to the blocking position causes the lever 37 to move into the blocking position as a result of

the interaction between the end 76a of the slot 76 and the finger 77.

[0079] The "dead lock" function is disabled when the lock 4 is opened from the outside, by the interaction of the finger 75 with the projection 79a of the disabling lever 70 during the movement of the output member 60 along the path S (Figure 9), or when the safety function is disabled, in other words during the movement of the safety lever 37 from the blocking position to the enabling position, by the interaction between the finger 77 and the end 76a of the slot 76 of the disabling lever 70.

[0080] In the condition in which the safety lever 37 and disabling lever 70 are placed in the corresponding blocking positions (Figure 8), the lock 4 can be opened from the outside simply by operating the external handle 5, provided that the control unit 2 has recognized the user who is operating the handle 5.

[0081] In particular, after the external handle 5 has been moved by the user, the microswitch 83 is activated, switching the signal S3 from the low logical level (S3 equal to 0) to the high logical level (S3 equal to 1). In response to the aforesaid switch of the signal S3, the control unit 2 transmits the interrogation signal S9, which, when received by the microchip associated with the identity card 90 in the user's possession, sends the response signal S10 containing the user identification code.

[0082] The control unit 2, having received the response signal S10 from the user's identity card 90, extracts the user identification code from the signal S10 and compares the code with a stored code of its own. If the aforesaid codes coincide, the control unit 2 sends the operating signal C2 to activate the electrical actuator 58, whose output member 60 is therefore moved along the path S. During this movement, the interaction between the finger 75 and the projection 79a causes the disabling lever 70 to rotate from the blocking position to the enabling position (disabling of the "dead lock" function), while the interaction between the free end 61 of the output member 60 and the projection 57 causes the opening lever 50 to rotate from the rest position to the opening position, and consequently causes the lock 4 to open as a result of the interaction of the lever 50 with the finger 19 of the stop 10.

[0083] When the user has released the external handle 5, and consequently the signal S3 has returned to the low logical level (S3 equal to 0), the control unit 2 sends the operating signal C2 to activate the electrical actuator 39, which, by means of the lever 47, rotates the safety lever 37 from the blocking position to the enabling position.

[0084] Now that the overall operation of the lock 4 has been explained, the following text will describe the operation of the locking system 1, with particular reference to the block diagram in Figure 11 which shows the control program executed cyclically by the control unit 2. It should be pointed out that the locking system 1 has been illustrated for the sake of simplicity with reference

to only one front door 3 of the motor vehicle; clearly, however, the control unit 2 is connected to all the doors of the motor vehicle, and if necessary to the rear hatch, for the "centralized" execution of the functions of opening, enabling/disabling of the safety system and enabling/disabling of the "dead lock" function.

[0085] From the start of cycle box 95, the sequence continues to a following box 96 for checking the locking of the door 3; if the signal S8 is equal to 1 (fork 9 not in the locking position), there is a return to the start of the cycle; otherwise the sequence continues to a following box 97, in which a check is made to see whether the microswitch 81 associated with the external handle 5 has been activated. If the answer is affirmative, there is a move to a box 98 for checking the state of the signal S3 (microswitch 83). If the signal S3 has a low logical level (S3 equal to 0), corresponding to the enabling position of the safety lever 37, the sequence continues to a box 99 for activating the electrical actuator 58 for opening the lock 4. In the contrary case, in other words if the signal S3 has a high logical level (S3 equal to 1), corresponding to the blocking position of the safety lever 37, the sequence continues to a box 100, in which a check is made to see whether the user who has operated the external handle 5, and consequently the microswitch 81, has a personal identity card 90 and whether the user identification code stored in the microchip associated with the card 90 coincides with the code stored in the control unit 2. If the aforesaid codes coincide, permission is given for the opening of the lock 4, and consequently the sequence continues to the box 99 for activating the electrical actuator 58. However, if the user identification code and the code stored in the control unit 2 do not coincide, a return is made to the start of the cycle, and therefore the opening of the lock 4 is not permitted.

[0086] After a predetermined period, necessary for the completion of the opening of the lock 4 by the electrical actuator 58, the sequence passes from the box 99 to a box 101 for checking the status of the signal S3 (microswitch 83). If the signal S3 has a low logical level (S3 equal to 0), corresponding to the enabling position of the safety lever 37, a return is made to the start of the cycle, but if the signal S3 has a high logical level (S3 equal to 1), corresponding to the blocking position of the safety lever 37, the sequence continues to a box 102, in which a check is made to see whether the signal S1 has returned to the low logical level (S1 equal to 0), corresponding to the non-operation or release of the external handle 5. If the answer is negative, the sequence stops in box 102; if it is affirmative, the sequence continues to a further box 103 for checking the status of the signal S2 (microswitch 82). If the signal S2 is at the low logical level (S2 equal to 0), corresponding to the non-operation or release of the internal handle 22, the sequence continues to a box 104 for activating the electrical actuator 39 to rotate the safety lever 37 from the blocking position to the enabling position, from which a return is

made to the start of the cycle. If the disabling lever 70 is placed in the blocking position ("dead lock" on), the movement of the safety lever 37 from the blocking position to the enabling position causes, by the interaction between the finger 77 and the end 76a of the slot 76, the movement of the disabling lever 70 into the enabling position ("dead lock" off). If the signal S2 is at the high logical level (S2 equal to 1), the sequence stops in the box 103.

[0087] If it is found in box 97 that the signal S1 is at the low logical level (S1 equal to 0), in other words the external handle 5 has not been operated, the sequence moves to a box 105 for checking the status of the signal S2 (microswitch 82). If the signal S2 is at the high logical level (S2 equal to 1), in other words if the internal handle 22 has been operated, the sequence moves to a box 106 for checking the status of the signal S4 (microswitch 84). If the signal S4 is at the low logical level (S4 equal to 0), corresponding to the enabling position of the disabling lever 70 ("dead lock" off), the sequence moves to the box 99 for activating the electrical actuator 58 for opening the lock 4. If the signal S4 is at the high logical level (S4 equal to 1), in other words if the disabling lever 70 is placed in the blocking position, a return is made to the start of the cycle.

[0088] If it is found in box 105 that the signal S2 is at the low logical level (S2 equal to 0), in other words the internal handle 22 has not been operated, the sequence moves to a box 107, in which a check is made to see whether a request from the outside for the activation of the safety function has been made. If the answer is affirmative, the sequence continues to a box 108 for checking the status of the signal S3. If the signal S3 is at the low logical level (S3 equal to 0), in other words if the safety lever 37 is placed in the enabling position, the sequence moves to the box 104 for activating the electrical actuator 39 to rotate the safety lever 37 into the blocking position. If the signal S3 is at the high logical level (S3 equal to 1), indicating that the safety lever 37 is already placed in the blocking position, a return is made to the start of the cycle.

[0089] If it is found in box 107 that no request from the outside for the activation of the safety function is present, the sequence continues to a box 109, in which a check is made to see whether a request from the outside for the disabling of the safety function is present. If the answer is affirmative, the sequence continues to a box 110 for checking the status of the signal S3. If the signal S3 is at the high logical level (S3 equal to 1), in other words if the safety lever 37 is placed in the blocking position, the sequence moves to the box 104 for activating the electrical actuator 39 to rotate the safety lever 37 into the enabling position. If the signal S3 is at the low logical level (S3 equal to 0), in other words if the safety lever 37 is already placed in the enabling position, a return is made to the start of the cycle.

[0090] If it is found in box 109 that no request from the outside for the disabling of the safety function is

present, the sequence continues to a box 111, in which a check is made to see whether a request from the inside for the activation of the safety function is present. If the answer is affirmative, the sequence continues to a box 112 for checking the status of the signal S3. If the signal S3 is at the low logical level (S3 equal to 0), in other words if the safety lever 37 is placed in the enabling position, the sequence continues to the box 104 for activating the electrical actuator 39 to rotate the safety lever 37 into the blocking position. If the signal S3 is at the high logical level (S3 equal to 1), in other words if the safety lever 37 is already placed in the blocking position, a return is made to the start of the cycle.

[0091] If it is found in box 111 that no request from the inside for the activation of the safety function is present, the sequence continues to a box 113, in which a check is made to see whether a request from the inside for the disabling of the safety function is present. If the answer is affirmative, the sequence continues to a box 114 for checking the status of the signal S4. If the signal S4 is at the low logical level (S4 equal to 0), in other words if the disabling lever 70 is placed in the enabling position, the sequence continues to a further box 115 for checking the status of the signal S3. If the signal S3 is at the high logical level (S3 equal to 1), in other words if the safety lever 37 is placed in the blocking position, the sequence continues to the box 104 for activating the electrical actuator 39 to rotate the safety lever 37 into the enabling position, while, in the contrary case, in other words if the safety lever 37 is already placed in the enabling position (S3 equal to 0), a return is made to the start of the cycle.

[0092] If the signal S4 is at the high logical level (S4 equal to 1), in other words if the disabling lever 70 is placed in the blocking position, a return is made to the start of the cycle, and the disabling of the safety function from the interior of the motor vehicle is prevented.

[0093] If it is found in box 113 that a request from the inside for the disabling of the safety function is not present, the sequence continues to a box 116, in which a check is made to see whether a request from the outside for the activation of the "dead lock" function is present. If the answer is affirmative, the sequence moves to a box 117 for checking the status of the signal S4. If the signal S4 is at the low logical level (S4 equal to 0), in other words if the disabling lever 70 is placed in the enabling position, the sequence moves to a box 118 for activating the electrical actuator 58 to move the disabling lever 70 and, together with this, the safety lever 37 into the corresponding blocking positions. If the signal S4 is at the high logical level (S4 equal to 1), in other words if the disabling lever 70 is already placed in the blocking position, a return is made to the start of the cycle.

[0094] Alternatively, the "dead lock" function can be enabled from the outside by sequentially activating the electrical door locking actuator 39 (to rotate the safety lever 37 into the blocking position) and the electrical

opening actuator 58 (to rotate the disabling lever 70 into the blocking position).

[0095] If it is found in box 116 that no request from the outside for the activation of the "dead lock" function is present, the sequence continues to a box 119, in which a check is made to see whether the signal S5 (inertial switch 85) is at the high logical level (S5 equal to 1). If the answer is affirmative, in other words if there is an impact on the motor vehicle, the sequence continues to a box 120 for checking the status of the signal S3. If the signal S3 is at the high logical level (S3 equal to 1), in other words if the safety lever 37 is placed in the blocking position, the sequence moves to a box 121 for activating the electrical actuator 39 to rotate the safety lever 37 into the enabling position. If the signal S3 is at the low logical level (S3 equal to 0), in other words if the safety lever 37 is already placed in the enabling position, a return is made to the start of the cycle.

[0096] An examination of the characteristics of the locking system 1 produced according to the present invention will clearly show the advantages that the invention provides.

[0097] In particular, the fact that the output member of the opening actuator 58 is capable of interacting with the opening lever 50, to release the striking member 15 from the fork 9, independently of the position assumed by the safety lever 37 enables the lock 4 to be opened from the outside, by activation of the actuator 58, before the safety function is disabled by means of the actuator 39. Thus the total time required for opening the lock 4 from the outside becomes considerably shorter than the total opening times for the locks in known systems, since it depends solely on the operating time of the opening actuator 58 and is independent of the operating time of the door locking actuator 39.

[0098] For the same reason, the opening time of the door 3 becomes independent of the initial state of the corresponding lock 4 (safety and "dead lock" functions both on, safety and "dead lock" functions both off, or only the safety function on).

[0099] Additionally, the fact that the whole of the time required for the user to operate the external handle 5 can be used to carry out the opening of the lock 4, since the disabling of the safety and/or "dead lock" functions takes place after the release of the handle 5, makes it possible to use electrical opening actuators having relatively low-level intrinsic characteristics (speed, torque and dimensions), with a consequent reduction of the costs associated with them.

[0100] Finally, it is clear that modifications and variants of the locking system 1 and the lock 4 can be devised without departure from the protective scope of the present invention.

[0101] In particular, the lock 4 could be fixed to the jamb of the door 3 and could interact with a striking member which is integral with the door 3.

Claims

1. Locking system (1) for at least one door (3) of a motor vehicle, comprising:

- a lock (4) provided with a locking unit (7), an operating unit (8) connectable to corresponding manual operating members (5, 22) associated with the said door (3) and capable of interacting with the said locking unit (7) to cause in to open, at least one safety lever (37) which can be placed in a first and a second position for blocking and enabling, respectively, the opening of the said locking unit (7) from the outside, a first electrical actuator (58) for causing the opening of the said locking unit (7), and a second electrical actuator (39) for moving the said safety lever (37) between the said blocking and enabling positions; and
- a control unit (2) comprising user recognition means (100) which can be activated selectively to generate a signal to permit opening in the presence of a user authorized to open the said lock (4) from the outside in the condition in which the safety lever (37) is placed in the said blocking position, and first and second operating means (99, 104) generating corresponding operating signals (C1, C2) for the first and second actuator (58, 39) in response to the said signal permitting opening from the said user recognition means (100); characterized in that the said first actuator (58) comprises an output member (60) movable along a first path (S) to cause the opening of the said locking unit (7) independently of the position assumed by the said safety lever (37), and in that the said operating means comprise first driving means (99) for the said first actuator (58) and second driving means (104) for the said second actuator (39) which can be activated after the said first driving means (99) and following the opening of the said locking unit (7).

2. System according to Claim 1, characterized in that the said manual operating members comprise at least one external handle (5) and an internal handle (22), and in that the said operating unit (8) comprises:

- a first opening mechanism (20) connectable to the said external handle (5) for opening the said lock (4) from the outside of the said motor vehicle and comprising in turn an external operating lever (24) which is movable between a rest position and an opening position, and a transmission lever (26) interposed in a selectively releasable way between the said external

- operating lever (24) and the said locking unit (7), coupled for operation to the said safety lever (37) and movable between a retaining position, corresponding to the said enabling position of the said safety lever (37), in which it engages the said external operating lever (24) and the said locking unit (7) with each other to permit the opening of the said lock (4), and a releasing position, corresponding to the said blocking position of the said safety lever (37), in which it releases the said external operating lever (24) and the said locking unit (7) from each other, thus preventing the opening of the said lock (4) from the outside; and
- a second opening mechanism (21) connectable to the said internal handle (22) for opening the said lock (4) from the inside of the said motor vehicle, and comprising an opening lever (50) interacting with the said locking unit (7) and movable between a rest position and an opening position.
3. System according to Claim 2, characterized in that the said output member (60) of the said first actuator (58) interacts, along the said first path (S), with a striking portion (57) of the said opening lever (50).
 4. System according to any of the preceding claims, characterized in that it comprises first activating means (81) for the said user recognition means (100) connected to the said control unit (2) and activatable from the outside of the said door (3).
 5. System according to Claim 4, characterized in that the said first activating means comprise a first microswitch (81) associated with the said external handle (5).
 6. System according to any of the preceding claims, characterized in that it comprises second activating means (82) for the said first drive means (99), connected to the said control unit (2) and activatable from the inside of the said door (3).
 7. System according to Claim 6, characterized in that the said second activating means comprise a second microswitch (82) associated with the said internal handle (22).
 8. System according to any of the preceding claims, characterized in that the said operating unit (8) comprises means (70) of blocking the opening of the said lock (4) from the inside of the said motor vehicle, these means being capable of being selectively activated along a second path (T) of the said output member (60) of the said first actuator (58) and disabled along the said first path (S).
 9. System according to Claim 8, characterized in that the said first actuator (58) comprises first and second elastic means (65a, 65b) acting from opposite sides on the said output member (60) to keep it in a rest position, and in that the said output member (60) of the said first actuator (58) is movable in opposite directions along the corresponding said first and second paths (S, T) against the action of the said first and second elastic means (65a, 65b) and from the said rest position.
 10. System according to Claim 8 or 9, characterized in that the said second opening mechanism (21) comprises an operating link (52) interposed between the said opening lever (50) and the said internal handle (22) and first connecting means (53, 54) which can be selectively disabled and are interposed between the said opening lever (50) and the said operating link (52), the said blocking means comprising a disabling lever (70) which in turn comprises an operating portion (74) interacting with the said output member (60) of the said first actuator (58) and means (78) of disabling the said first connecting means (53, 54).
 11. System according to Claim 10, characterized in that the said first connecting means comprise a first finger (54) carried so that it projects from the said operating link (52) and a first slot (53) formed in the said opening lever (50), engaged slidably by the said first finger (54) and having a retaining portion (55) along which the said operating link (52) and the said opening lever (50) are coupled together, and a releasing portion (56) along which the said operating link (52) and the said opening lever (50) are uncoupled from each other.
 12. System according to Claim 11, characterized in that the said opening lever (50) is rotatable about a first pivot pin (51) and the said operating link (52) extends transversely with respect to the said opening lever (50), the said first slot (53) being substantially L-shaped and the said retaining portion (55) being transverse with respect to the said releasing portion (56) and extending longitudinally along the said opening lever (50).
 13. System according to any of Claims 10 to 12, characterized in that the said disabling lever (70) is rotatable about a second pivot pin (38), and in that the said operating portion (74) of the said disabling lever (70) is fork-shaped and interacts with a second finger (75) projecting from the said output member (60) of the said first actuator (58).
 14. System according to any of Claims 11 to 13, characterized in that the said means of disabling the said first connecting means (53, 54) comprise a

second slot (78) lying above the said first slot (53), engaged by the said first finger (54) of the said operating link (52) and capable of acting on the first finger (54) to move it from the said retaining portion (55) to the said releasing portion (56) of the said first slot (53) and vice versa. 5

15. System according to Claim 14, characterized in that, in the said rest position of the said opening lever (50), the said first finger (54) is located at one end of the said second slot (78) and has a clearance, in the direction of rotation of the said opening lever (50), between itself and an opposite end of the second slot (78). 10

16. System according to Claim 14 or 15, characterized in that the said second slot (78) has a substantially triangular profile. 15

17. System according to any of Claims 10 to 16, characterized in that the said operating unit (8) comprises second connecting means (76, 77) of the "lost motion" type, interposed between the said safety lever (37) and the said disabling lever (70) for transmitting the motion between the said safety lever (37) and disabling lever (70) in specific operating conditions of the said lock (4). 20 25

18. System according to Claim 17, characterized in that the said second connecting means comprise a third finger (77) and a third slot (76) carried by the said safety lever (37) and disabling lever (70) for transmitting the motion between the safety lever (37) and disabling lever (70) only during the movement of the said disabling lever (70) from the said enabling position to the said blocking position, when the said safety lever (37) is placed in the said enabling position, and during the movement of the said safety lever (37) from the said blocking position to the said enabling position, when the said disabling lever (70) is placed in the said blocking position. 30 35 40

19. System according to Claim 18, characterized in that the said third finger (77) projects from the said safety lever (37) and the said third slot (76) is formed in the said disabling lever (70). 45

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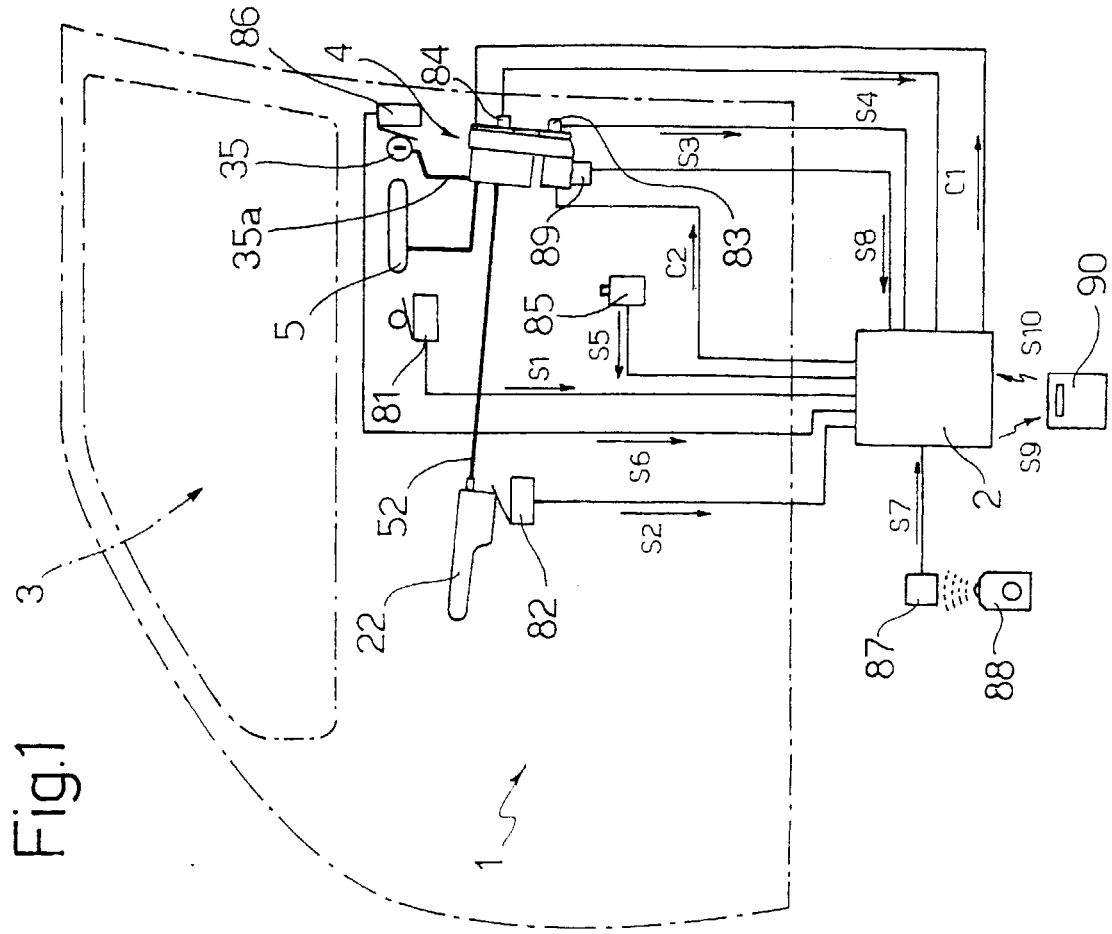


Fig.1

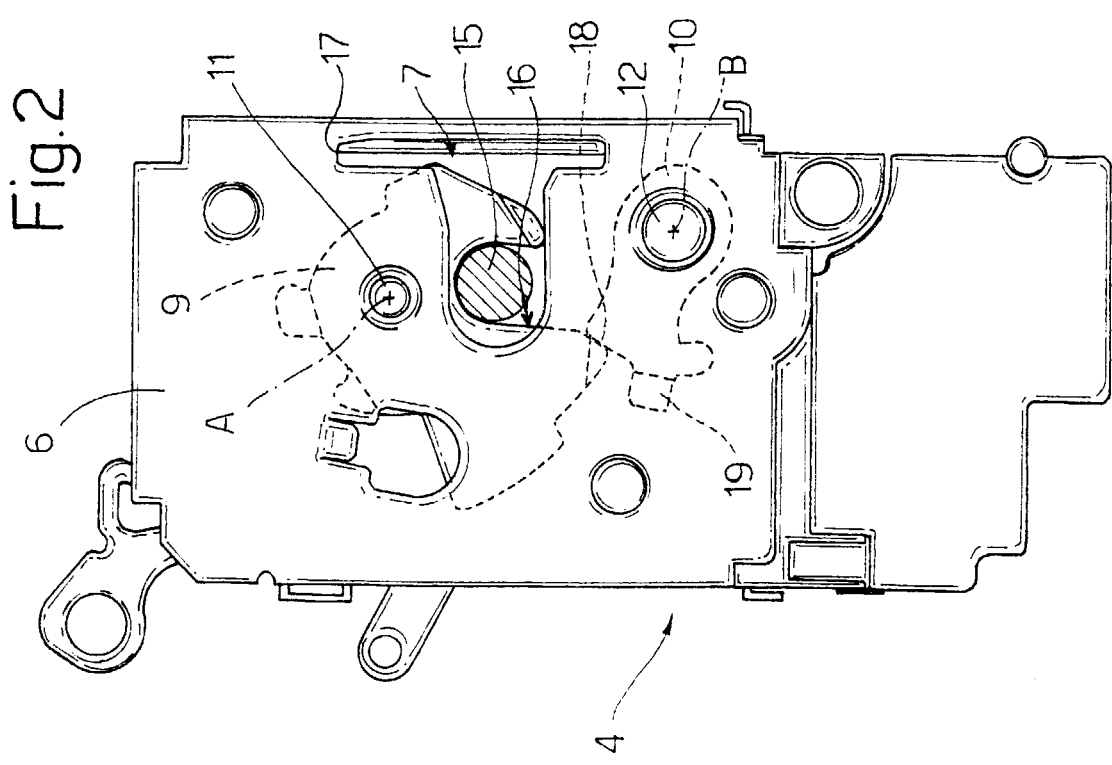


Fig.2

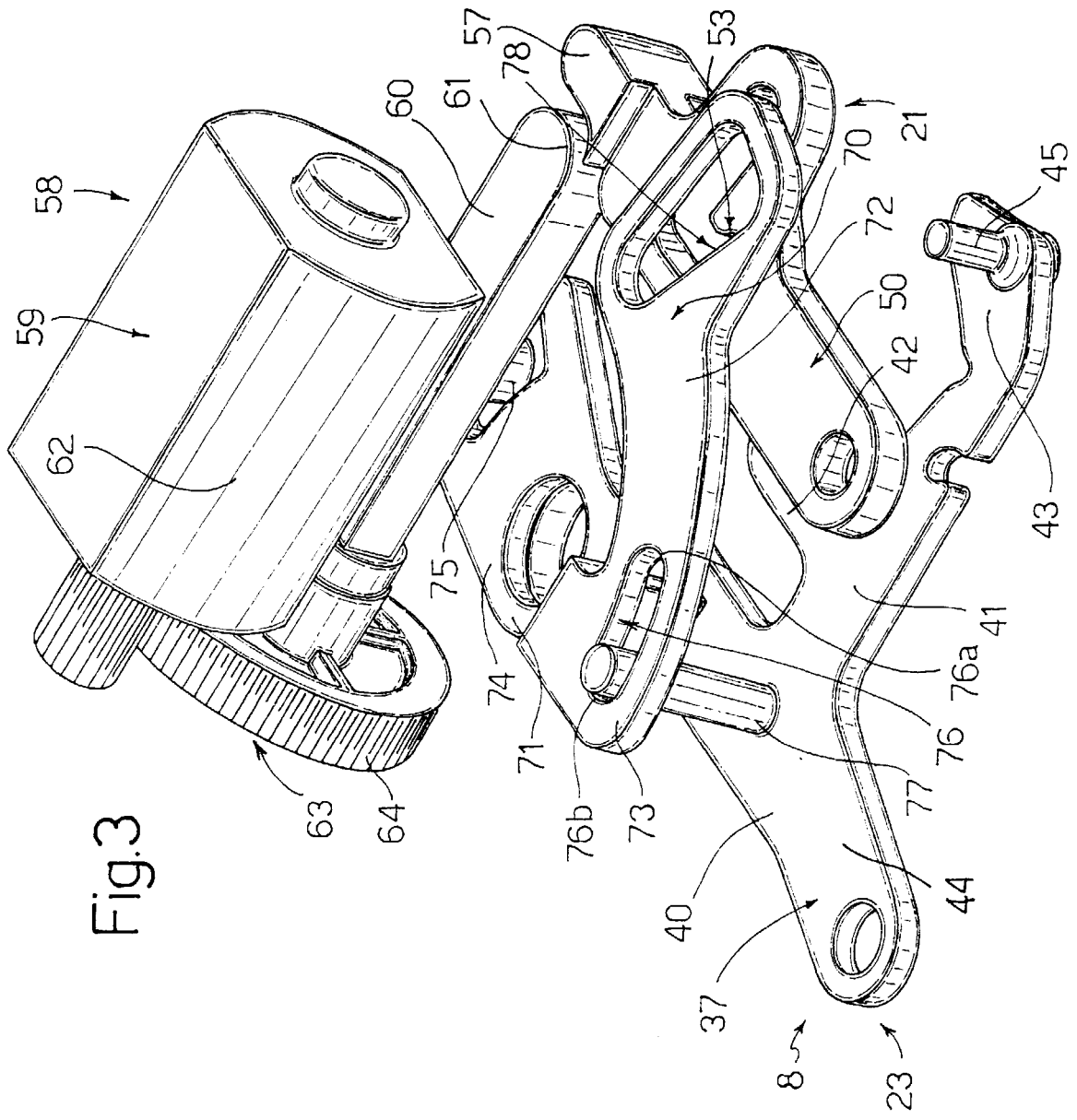


Fig.3

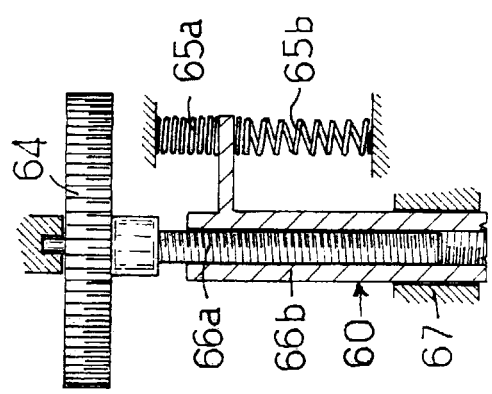
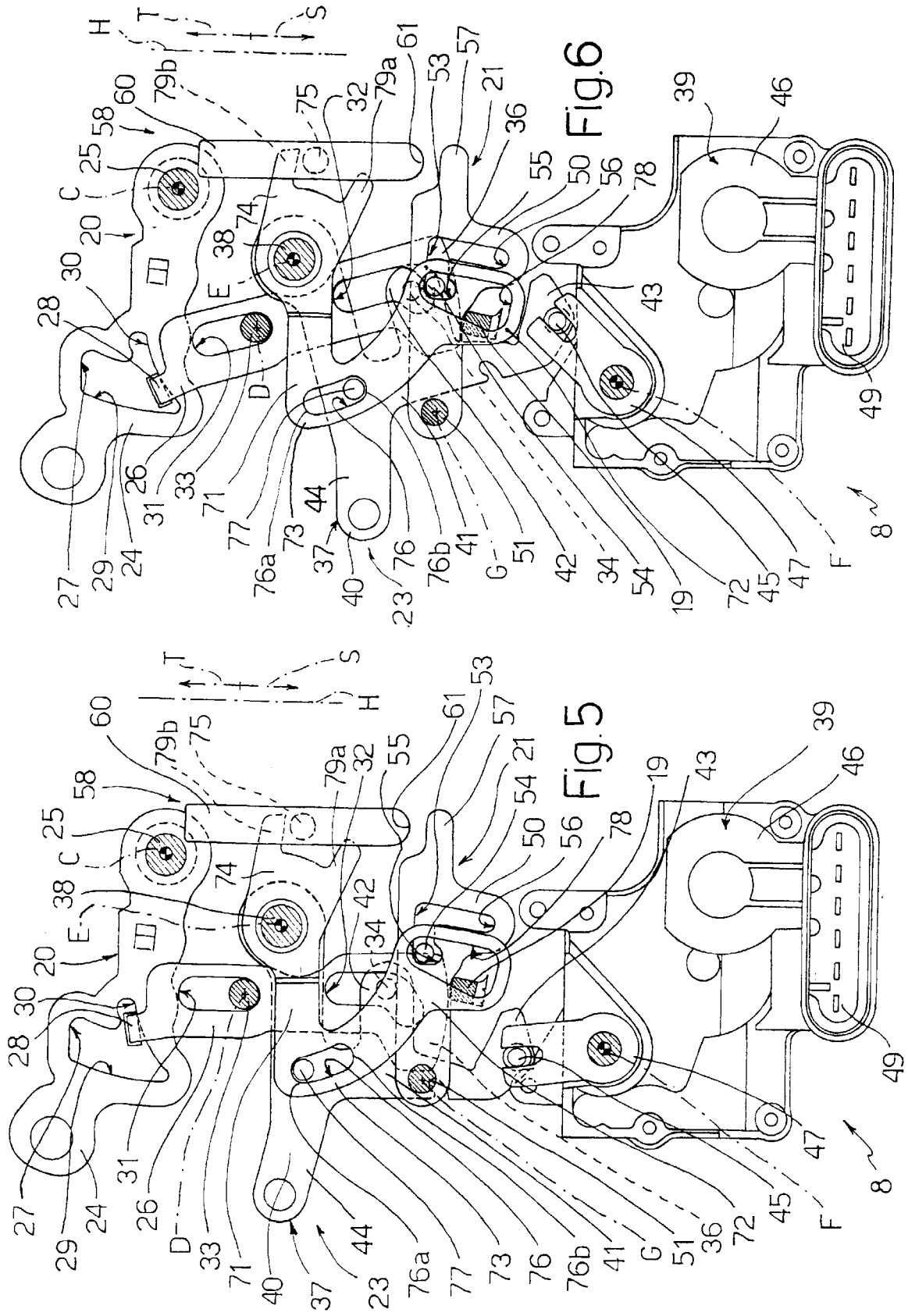
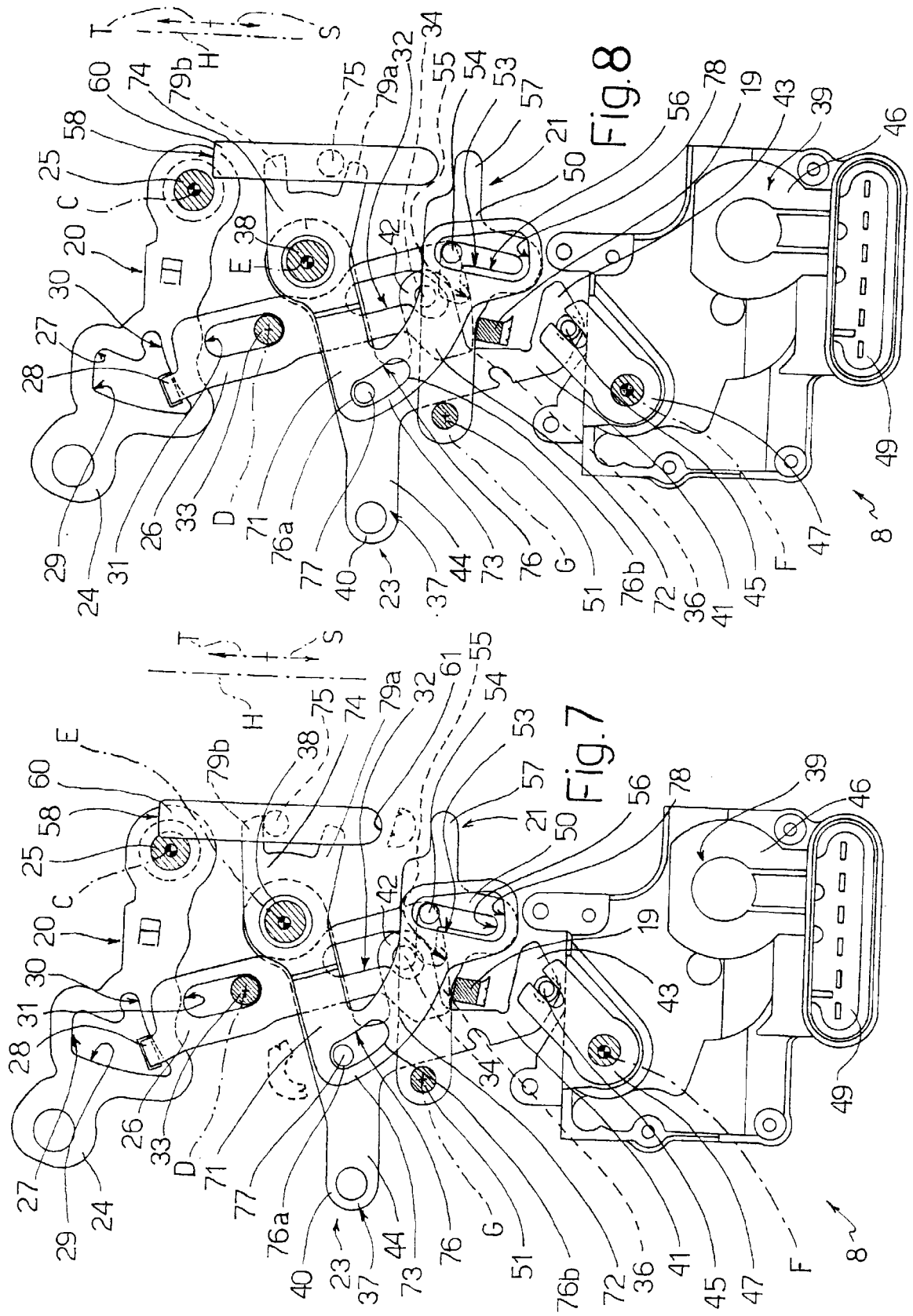


Fig.4





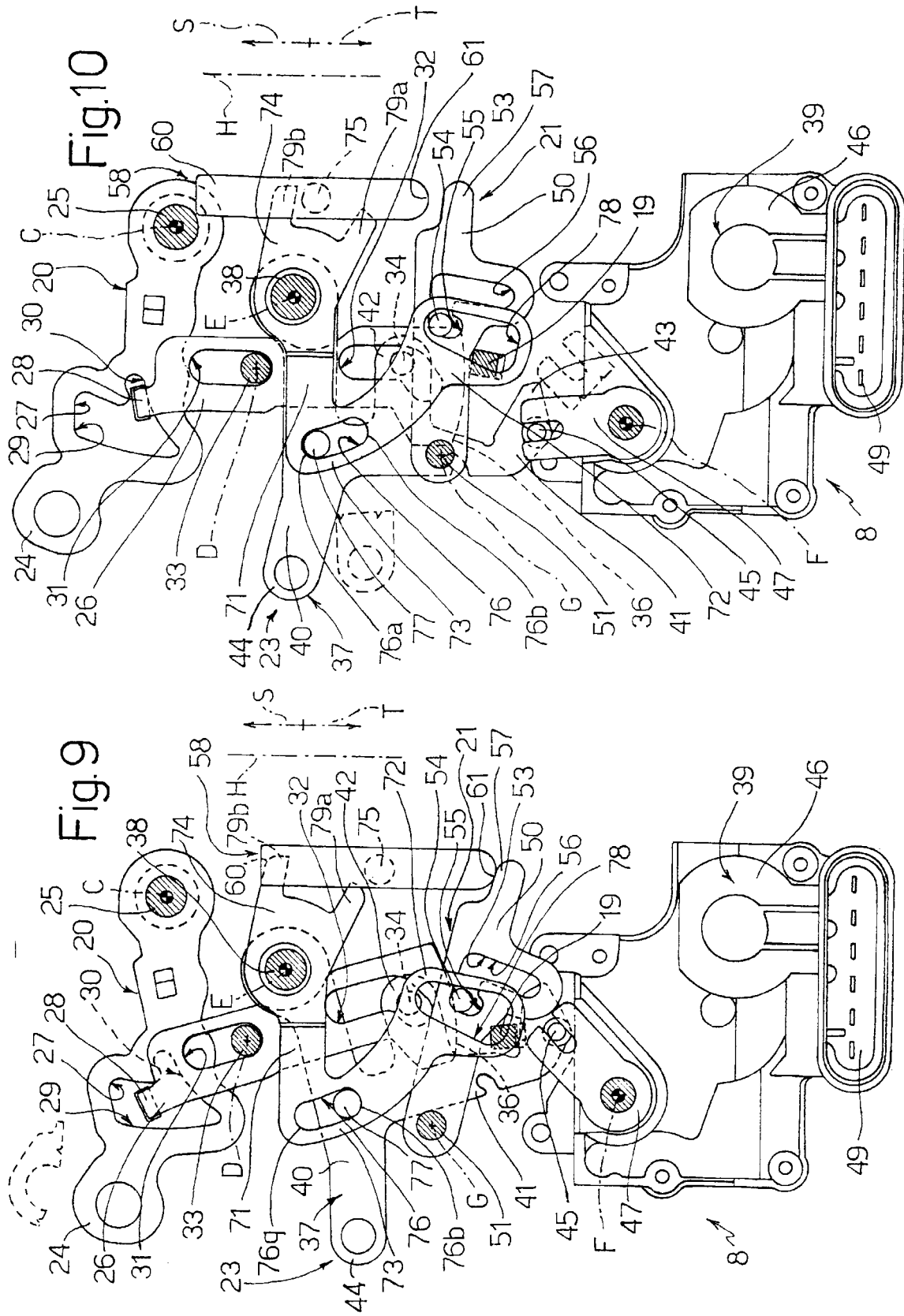
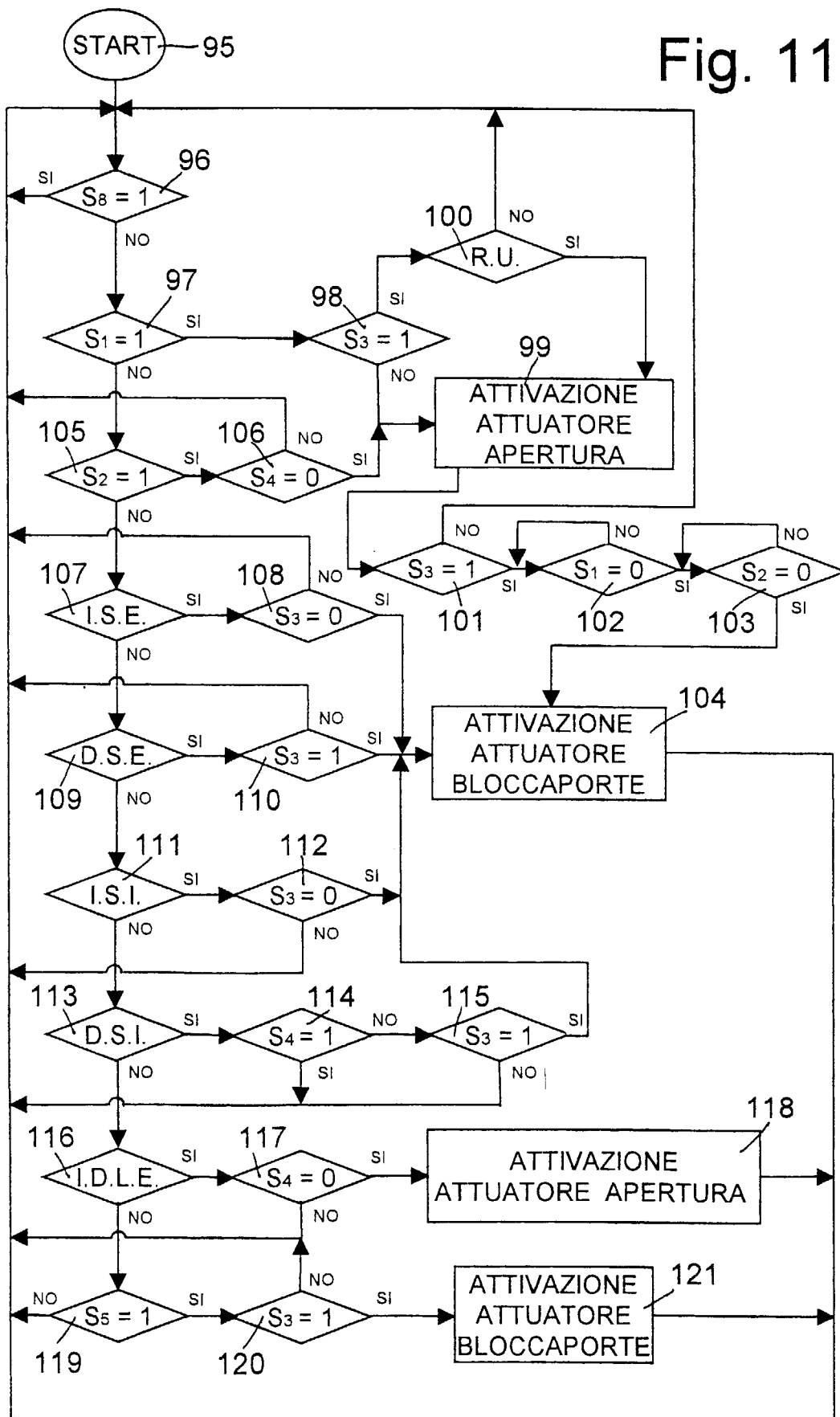


Fig. 11





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Place of search THE HAGUE		Date of completion of the search 16 June 2000	Examiner PEREZ MENDEZ, J
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EUROPEAN SEARCH REPORT

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