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(54) Motor vehicle door lock

(57) When the vehicle door is closed a locking pin (6) secured on the door frame is introduced into a swivel latch (2) and the swivel latch moves into the locking position, and a catch (3) applies a force to a closure stop (7) on the swivel latch (2) after the door is closed, which force is derived from the friction force (P) set up by an elastically strained door seal. An actuator (5) has an actuating slide (9) having two control stops (10, 11), a toggle lever mechanism (12) having two arms (14, 15) meeting at a centre pivot (13) and an over-centre spring, and an electric motor (17) driving a crank transmission member (18), the actuating slide (9) being connected to the crank transmission member (18) and the toggle lever mechanism (12) being linked to the swivel latch (2) at one end and a housing (1) at the other end. The toggle lever mechanism (12) is held in an over-centre position (A) urged towards the crank transmission member when the swivel latch (2) is in its locking position, with the control stop (10) on the actuating slide (9) side lying against the centre pivot (13). When the crank transmission member (18) is rotated out of the rest position the toggle lever mechanism (12) is first urged, by the control stop (10) at the centre pivot (13) into an over-centre position opposite to that first mentioned, and then the catch (3) is swivelled into the freed position by the other control stop (11) on the actuating slide (9).

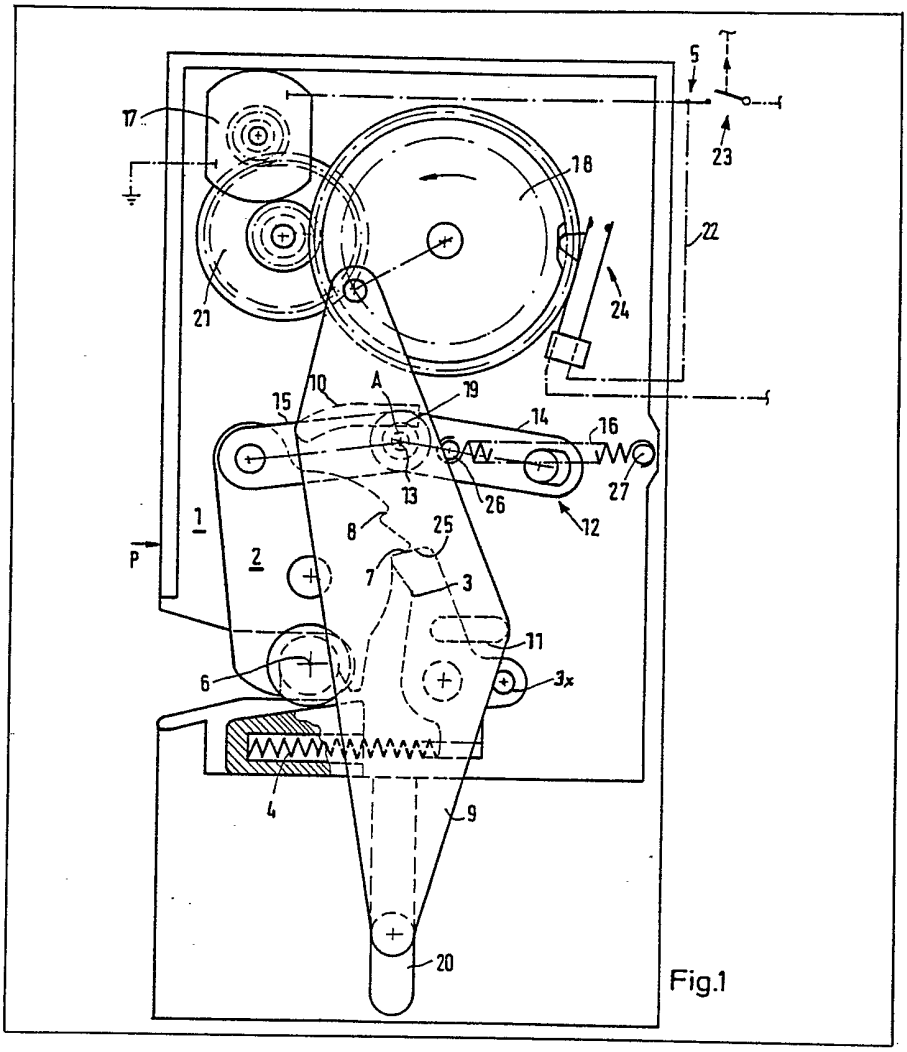

Fig.1

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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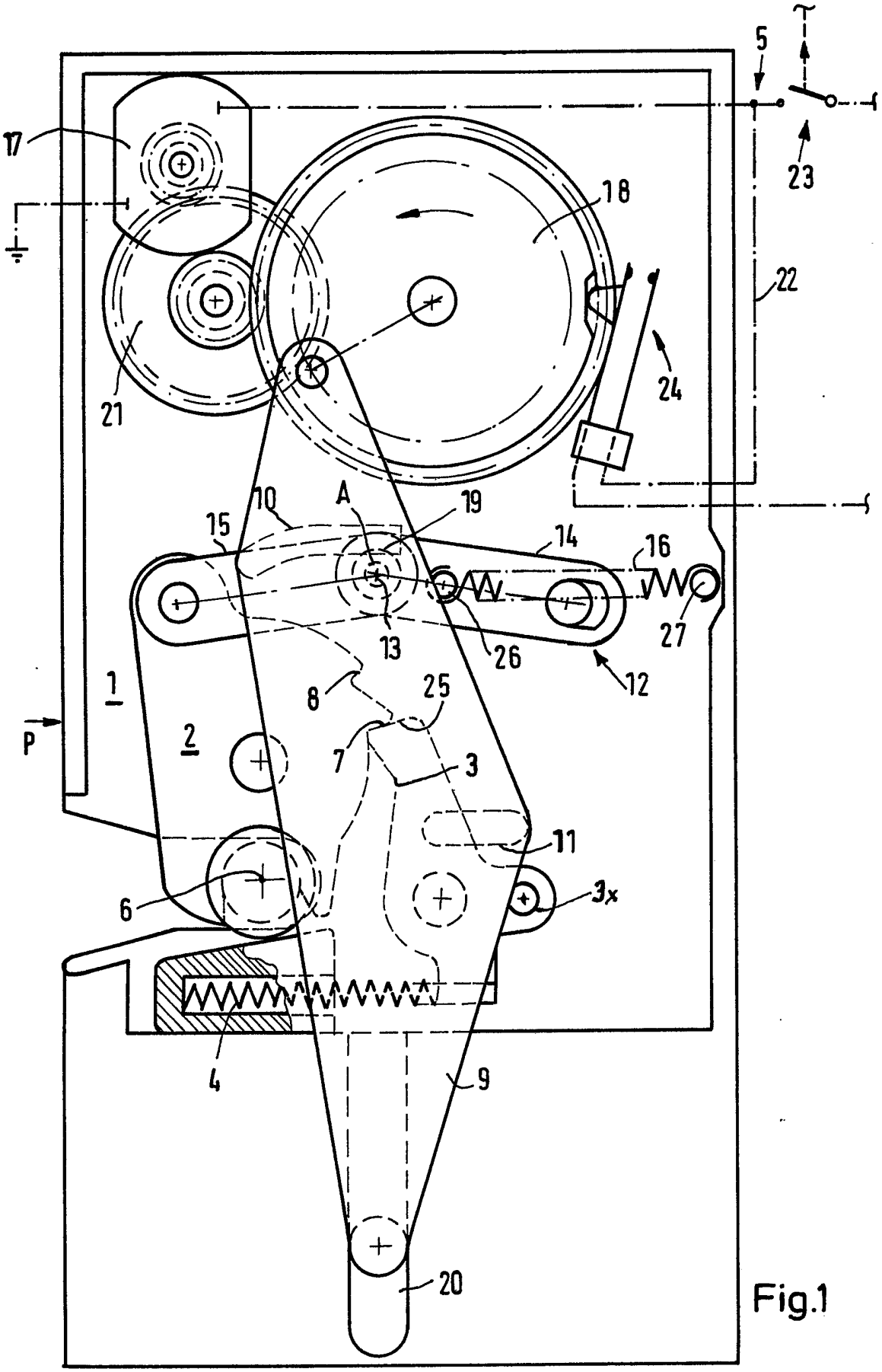

Fig.1

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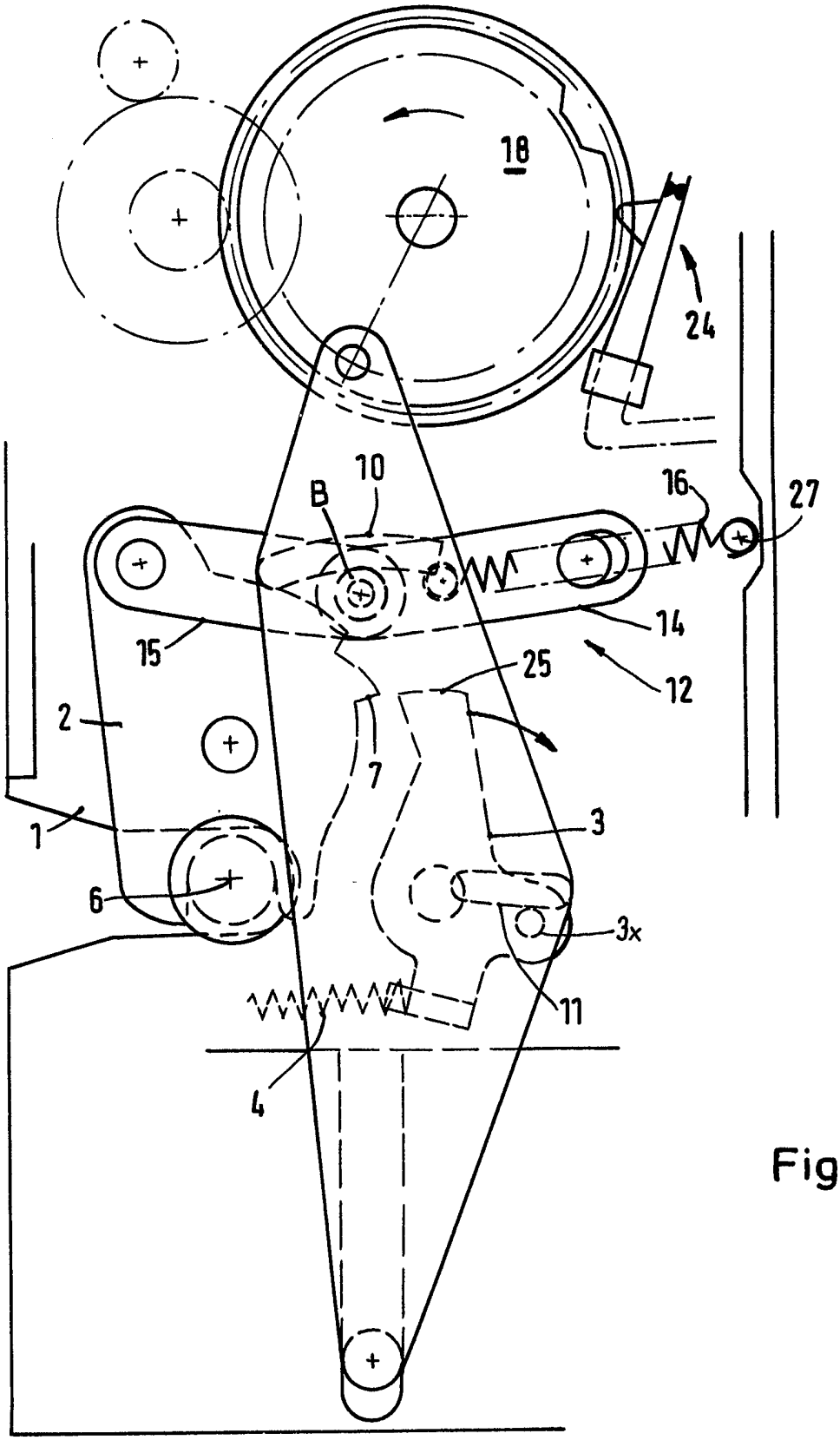

Fig. 2

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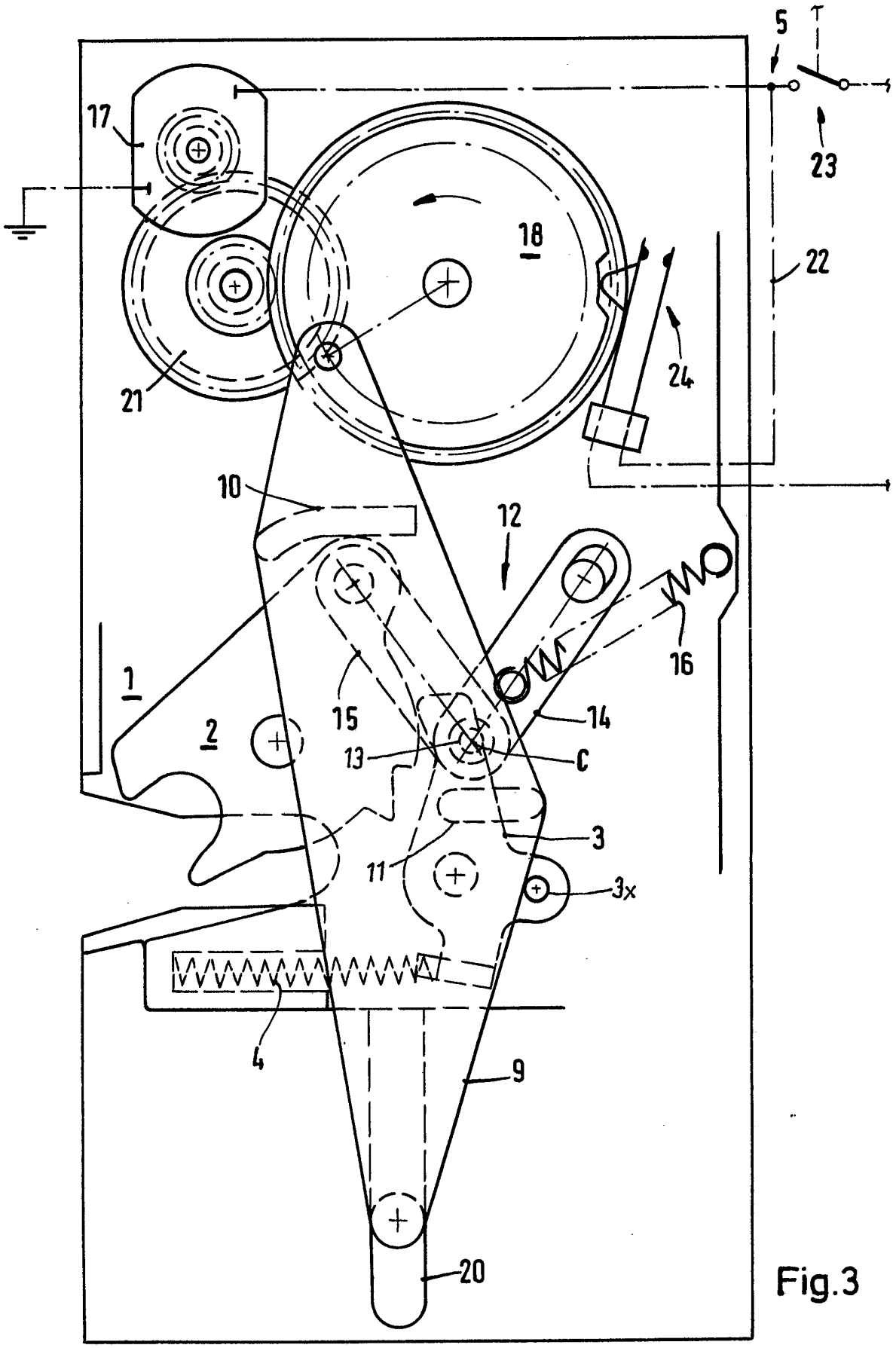

Fig.3

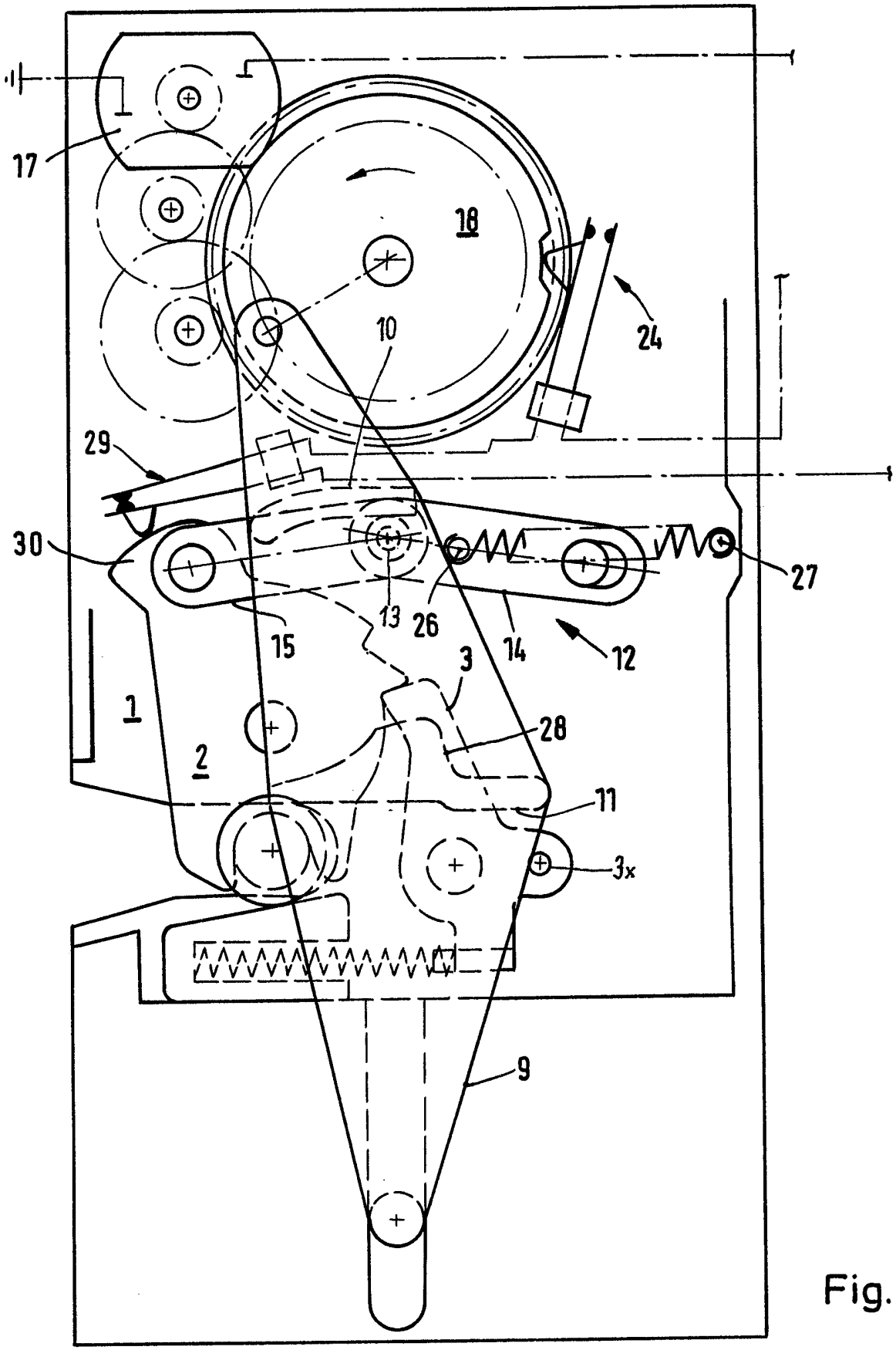

Fig.4

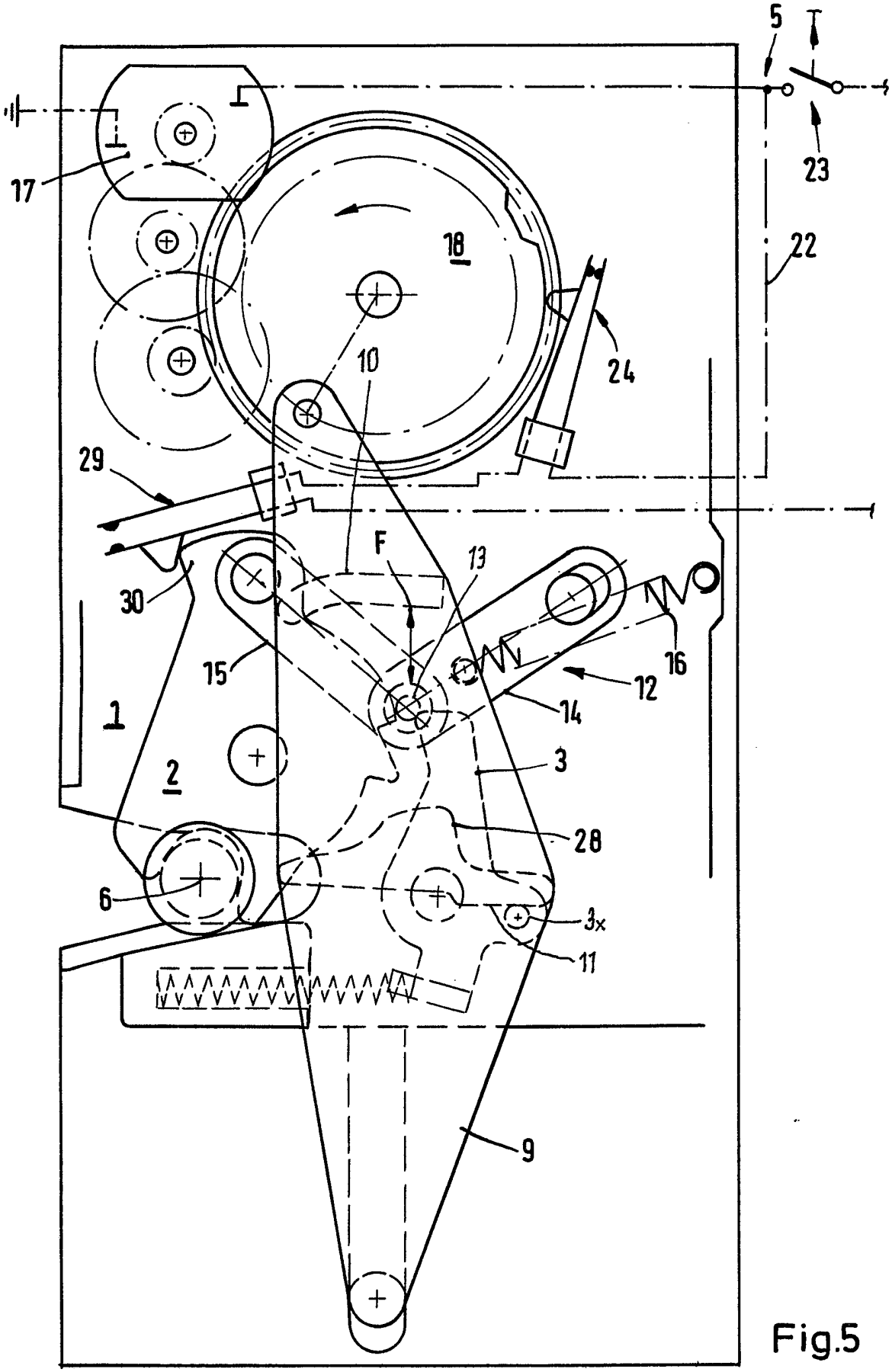

Fig.5

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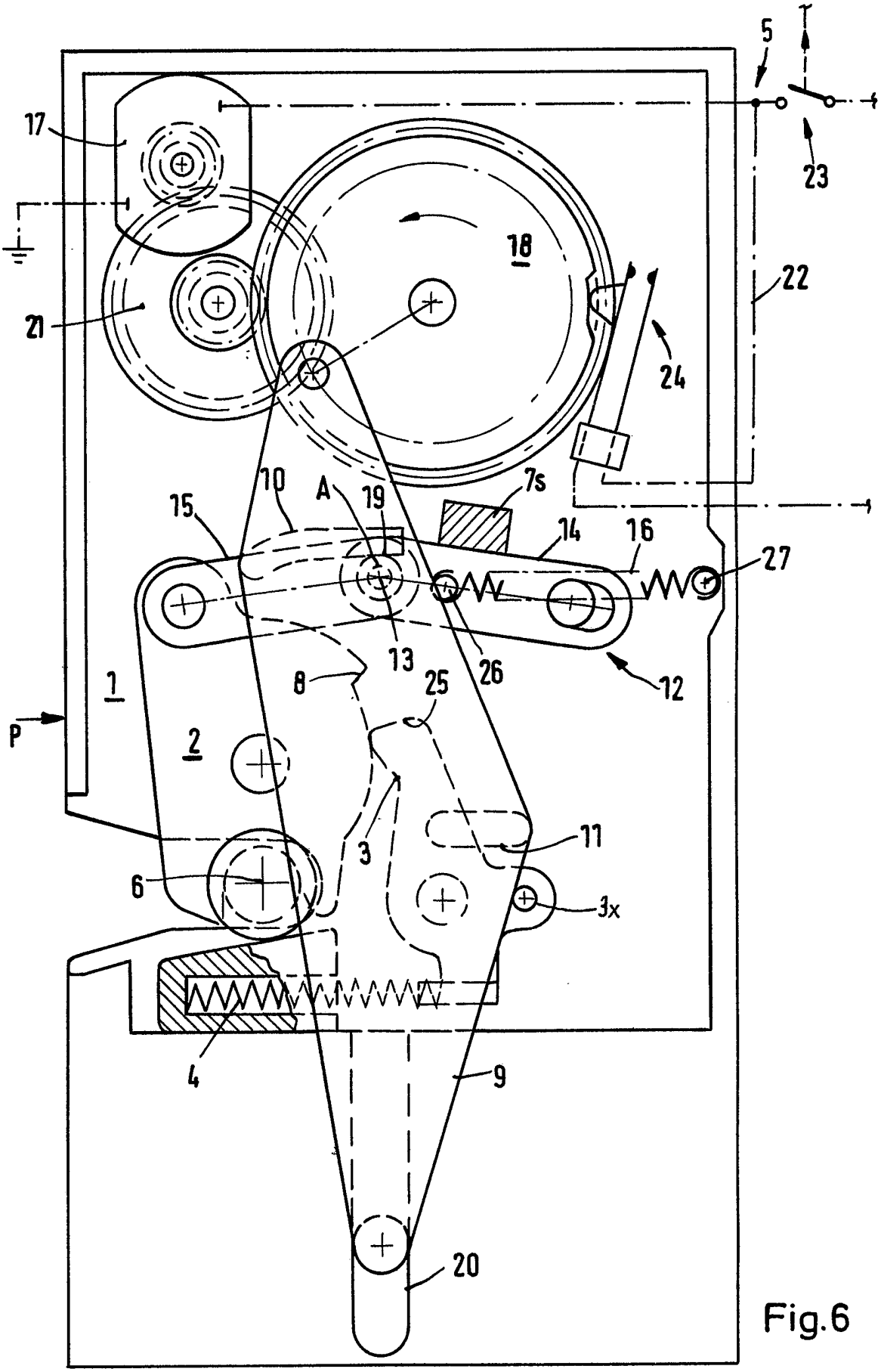

Fig.6

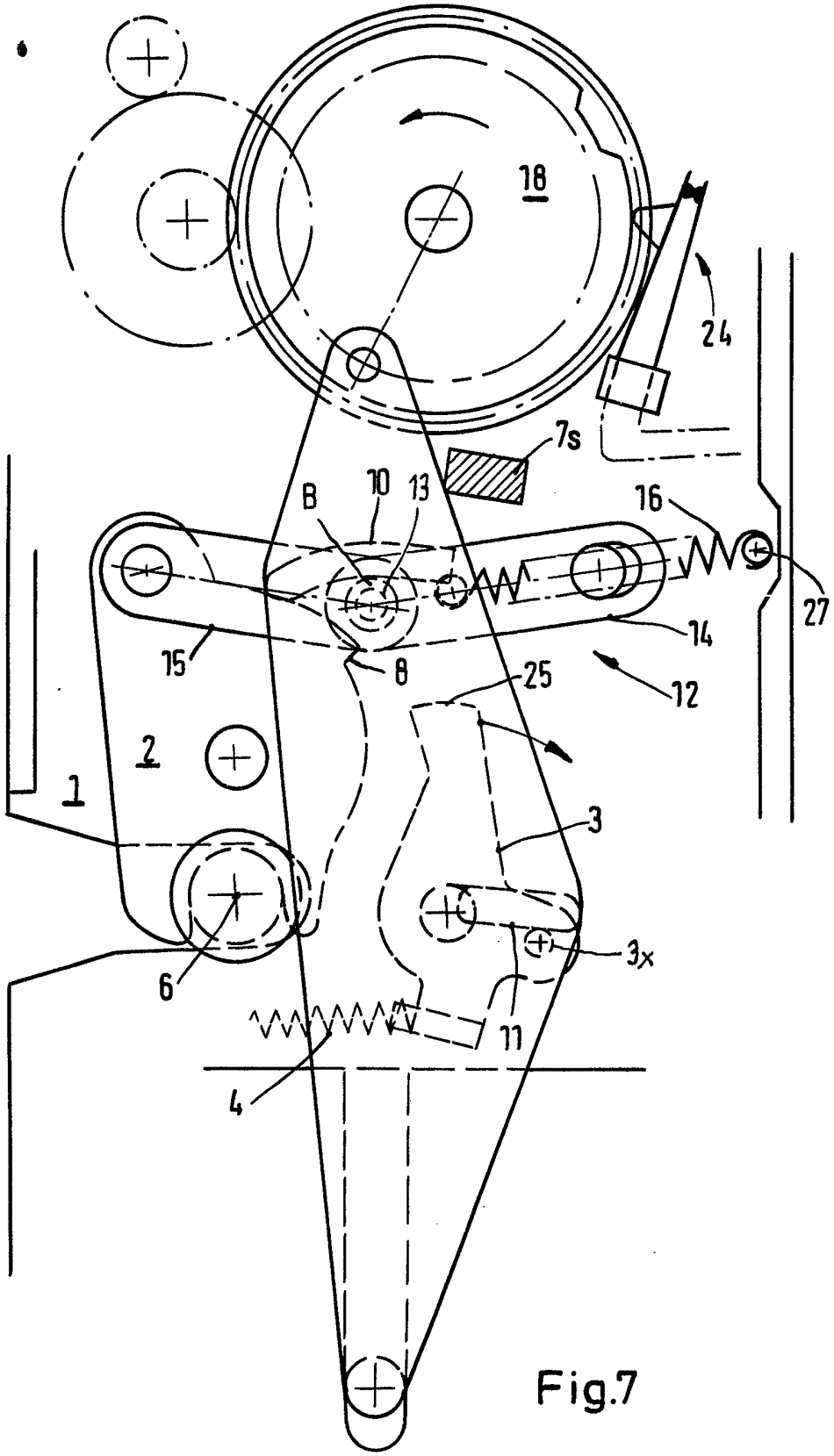

Fig.7

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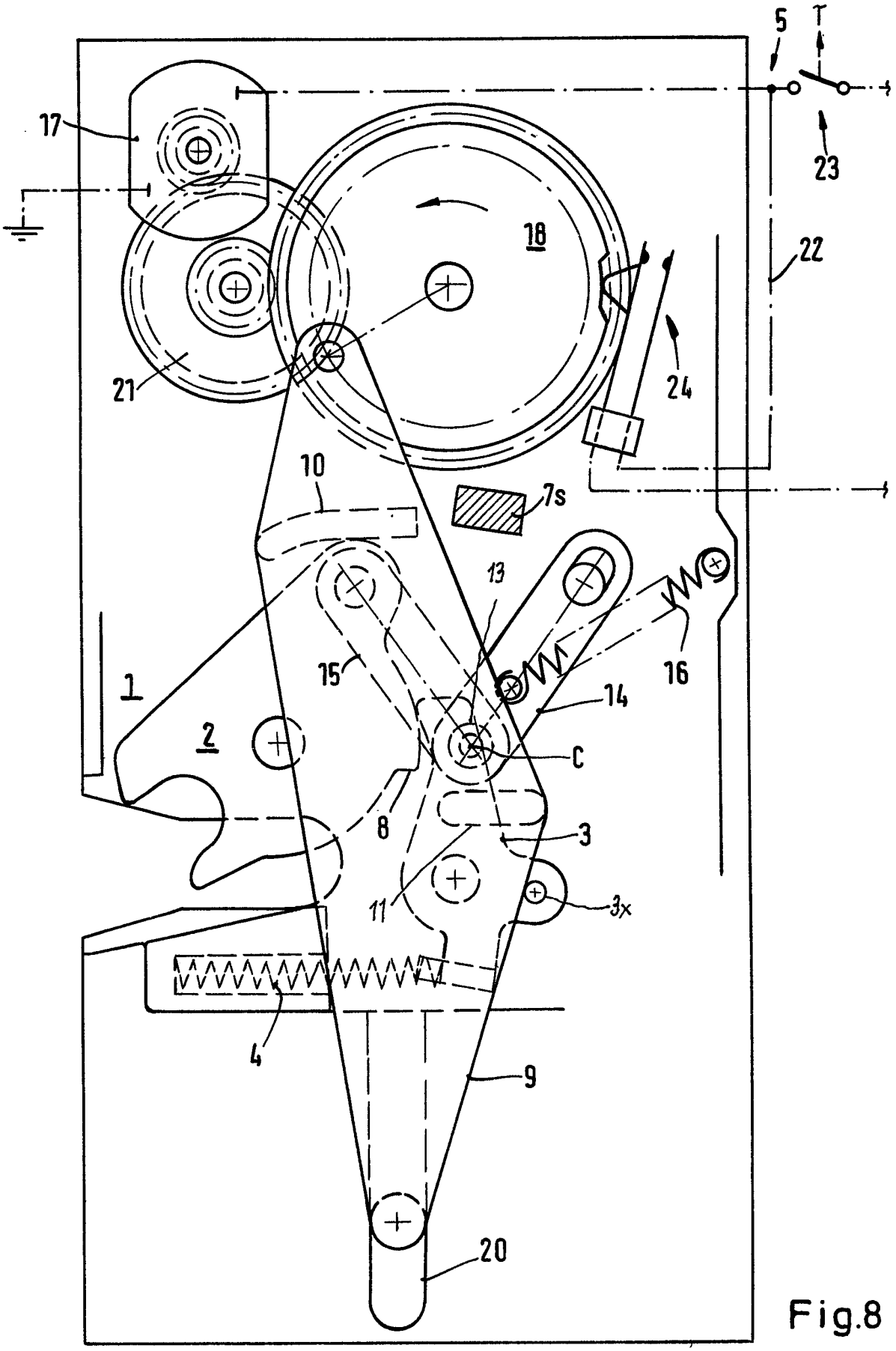

Fig.8

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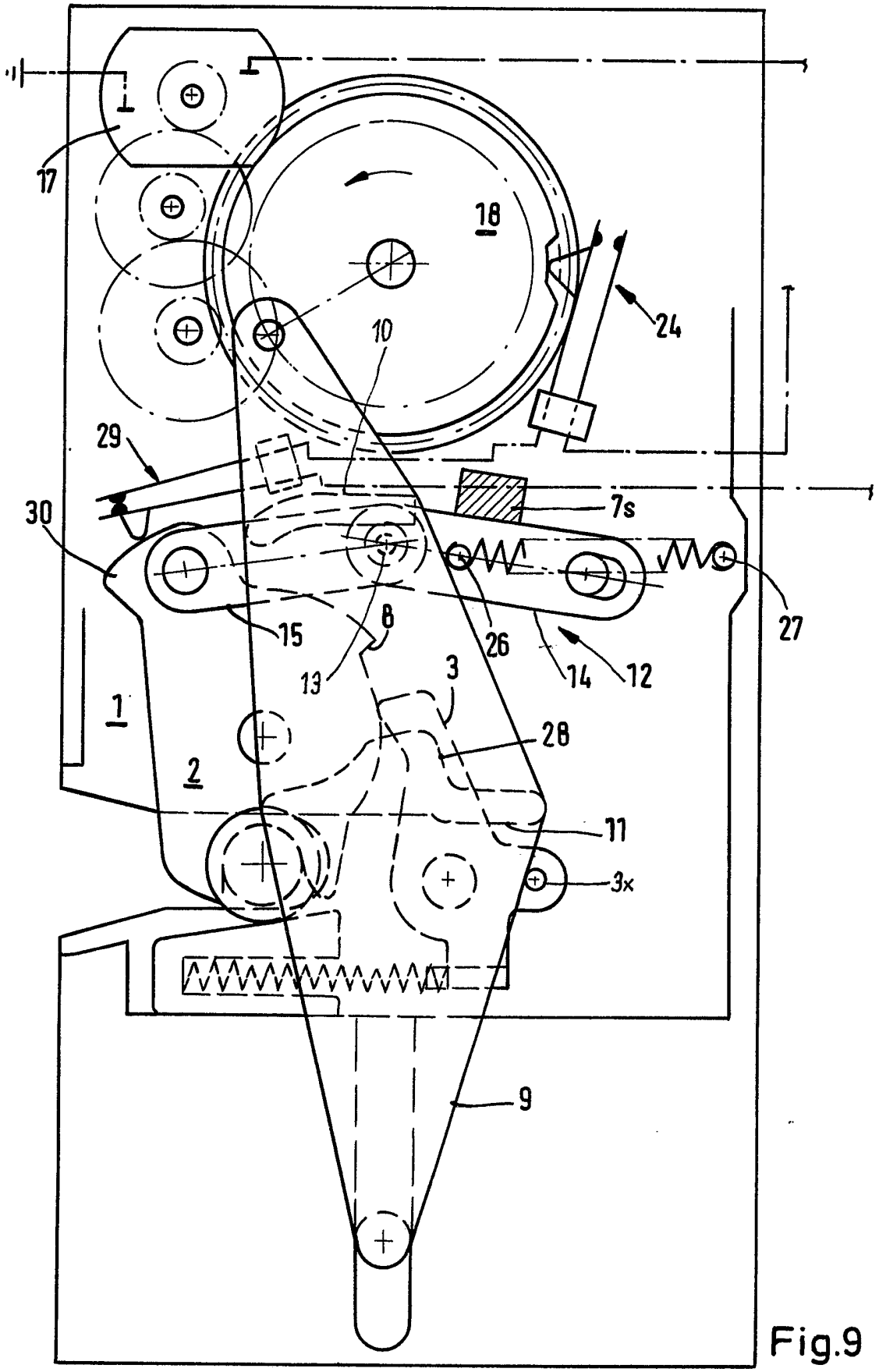

Fig.9

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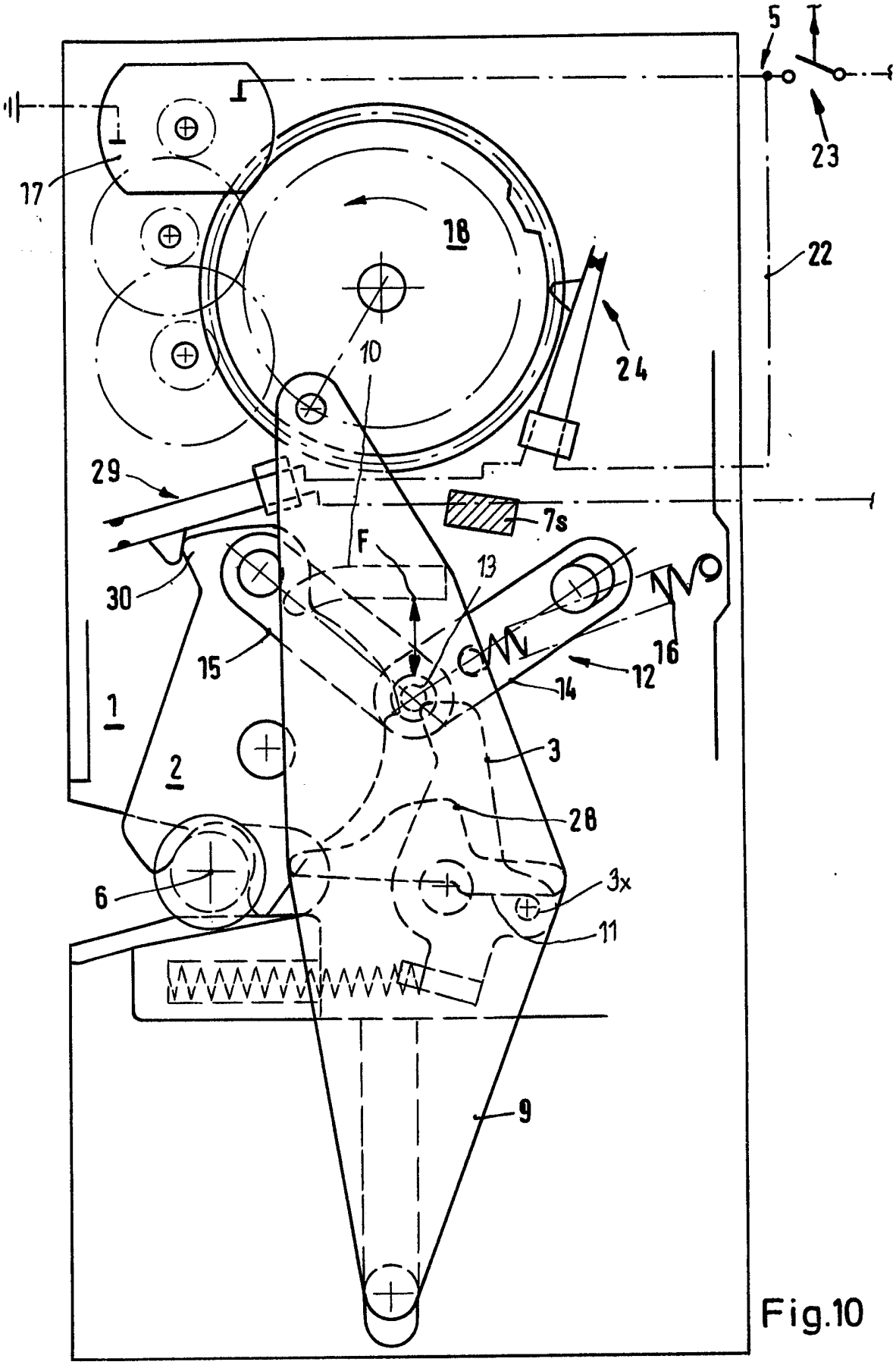

Fig.10

SPECIFICATION

Motor vehicle door lock

This invention relates to a door lock for a motor vehicle door, having a housing, a swivel latch, which may be a forked latch, a catch with a loading spring, and an actuator, in which when the motor vehicle door is closed a locking pin secured on the door frame can be introduced into the swivel latch and the swivel latch moves into the locking position, while the catch applies a force to a closure stop on the swivel latch after the motor vehicle door is closed, which force is derived from the friction force set up by an elastically strained door seal. The housing can be reduced to a simple carrier plate. For terminological simplicity the term "housing" will continue to be used. The closure stop on the swivel latch is also known in the art as a notch, and more particularly as a main notch when a safety notch or preliminary notch is also provided.

In a known door lock, the swivel latch and the catch together with the housing constitute highly mechanically loaded components, which carry the loads which must be applied for safety reasons when the door is closed. The door locks in question are outstandingly safe, functionally reliable and trustworthy by virtue of their design. The actuator consists of a set of mechanical levers and members adapted for manual operation. It is equipped with the appropriate operating handles, one on the inside of the motor vehicle door and another on the outside of the motor vehicle door. Operation usually only involves the opening movement, since locking is effected by slamming the door to close it. Substantial friction forces must be overcome in many cases in order to open the door; they are set up, in the closed position, between the catch and the closure stop on the swivel latch. In practice, the closure stop is often referred to as the main notch. A preliminary notch or safety notch is usually provided.

It is known in door locks of a different type to provide the actuator with an electric motor, so that the manual operation described above is no longer needed, and it is only necessary to actuate a switch or pushbutton for the electric motor. In this type of lock, in contrast to the type under discussion, there is neither a swivel latch nor a catch. Instead, the locking pin is held between forked levers which can be opened out with the aid of a setting member driven by the electric motor when it is required to open the door lock. Thus, this type dispenses with the swivel latch and the catch, though both are trustworthy components. The loads which the closed motor vehicle door must withstand for safety reasons cannot be sustained by this known door lock without further assistance. More particularly, the door may fly open in the event of an accident. On the other hand, it is impossible simply to substitute motorised for manual operation in the door lock of the first type considered, without further modification, since the friction forces already referred to, between the catch and the closure stop on the swivel latch, would necessitate using an electric motor of disadvantageously high rating, consuming a disadvantageously large amount of power.

The object of the invention is to provide a door lock of the type initially described with a motorised actuator incorporating an electric motor of low rating and power consumption.

According to the present invention, the actuator of a motor vehicle door lock of the type initially described comprises an actuating slide having two control stops, a toggle lever mechanism having two arms meeting at a centre pivot and an over-centre spring, and an electric motor driving a crank transmission member, the actuating slide being attached to the crank transmission member, the toggle lever mechanism being linked to the swivel latch at one end and the housing at the other end and being held in an over-centre position urged towards the crank transmission member when the swivel latch is in its locking position, the control stop on the crank transmission member side lying against the centre pivot in this case, while when the crank transmission member is swivelled out of the rest position the toggle lever mechanism is first urged, by the control stop at the centre pivot, through the centre position and into an over-centre position opposite to that first mentioned, and the catch is swivelled into the freed position by the second control stop.

The invention arises from the realisation that a door lock of the type in question can only be operated by a relatively small electric motor of low rating and power consumption provided that the friction force set up by the catch in the locked position on the associated closure stop on the swivel latch can previously be eliminated. The invention makes use of the toggle lever mechanism to eliminate this friction force, among other functions, more specifically by applying the mechanical advantage of toggle lever mechanisms so that the friction force can be overcome by an electric motor of low rating and power consumption.

The features of the invention already described will now be considered in more detail, along with further features, by reference to the accompanying drawings showing four embodiments thereof, purely by way of example. In the drawings, which are diagrammatic:—

Figure 1 shows a motor vehicle door lock in accordance with the invention in the closed position and having a motorised actuator for the opening movement only;

Figure 2 shows part of the lock of Figure 1 in an intermediate setting;

Figure 3 shows the lock of Figure 1 in the open position;

Figure 4 shows a modification of the lock of Figures 1, 2 and 3 in which the closure movement is also motorised;

Figure 5 shows the lock of Figure 4 in an intermediate setting;

Figure 6 is a view corresponding to Figure 1 of another embodiment of door lock in accordance

with the invention;

Figure 7 shows part of the lock of Figure 6 in an intermediate setting;

Figure 8 shows the lock of Figure 6 in the open position;

Figure 9 shows a modification of the lock of Figures 6, 7 and 8 in which the closure movement is also motorised; and

Figure 10 shows the lock of Figure 9 in an intermediate setting.

The door lock shown in Figures 1 to 3 is intended for a motor vehicle door and has a housing 1, a swivel latch 2 formed by a forked latch, a catch 3 with a loading spring 4 and an actuator 5. The basic arrangement is such that when the motor vehicle door is closed a locking pin 6 secured on the door frame, not shown, can be introduced into the swivel latch 2 and the swivel latch 2 moves into the locking position. The catch 3 applies a force to a closure stop 7 on the swivel latch 2 after the motor vehicle door is closed, which force is derived from the friction force P set up by an elastically strained door seal. The arrow P on the left in Figure 1 shows the direction of the force exerted on the door lock by the elastically strained door seal. The closure stop 7 constitutes what is known as the main notch. It is preceded by a preliminary or safety notch 8.

The actuator 5 is motorised and has an actuating slide 9 having two control stops 10 and 11, a toggle level mechanism 12 having two arms 14 and 15 meeting at a centre pivot 13 and an over-centre spring 16, and an electric motor 17 driving a crank transmission member 18 to which the actuating slide 9 is attached. The toggle lever mechanism 12 is linked to the swivel latch 2 at one end and the housing 1 at the other end. When the swivel latch 2 is in its locking position, this mechanism is held in an over-centre position A, urged towards the crank transmission member 18, as shown in Figure 1. It will be seen that in this position the control stop 10 contacts the centre pivot 13 at a point 19. When the crank transmission member 18 is rotated out of the rest position shown in Figure 1, the toggle lever mechanism 12 is first urged, by the control stop 10 engaging the centre pivot 13, through a centre position B as shown by Figure 2 and into an over-centre position C shown in Figure 3 opposite to that shown in Figure 1, and the catch 3 is swivelled into the freed position by the control stop 11 engaging a pin 3X on the catch as is illustrated in Figure 2. Figure 3 shows the open position of the lock. When the motor vehicle door is once again closed and the locking pin 6 is introduced into the swivel latch 2, the components will obviously return to the positions shown in Figure 1, without any further movement of the crank transmission member 18 from its position in Figure 3. The further end of the actuating slide 9 from the crank transmission member 18 will slide along a slot 20 of length compatible with the amplitude of the stroke of the crank transmission member. A reduction gear 21 is interposed between the electric motor 17 and the crank transmission member 18. It is clear from Figure 3 in particular that when the catch 3 is disengaged from the swivel latch 2 the latter can be swivelled into open position by the over-centre spring 16.

The electric motor 17 in this embodiment is non-reversible and has a supply circuit 22 with an external operating switch 23 and an internal cut-out switch 24. This internal cut-out switch 24 is actuated by the crank transmission member 18 after rotation through 360°.

The interactions between the components can be seen by comparing Figures 1 to 3. In the closed position shown in Figure 1, the two lever arms 14 and 15 in the toggle lever mechanism 12 form an obtuse angle approaching 180°, so that when the lock is opened by the electric motor 17 the two lever arms 14 and 15 in the toggle lever mechanism 12 pass through an extended angle of 180°, i.e., through the centre position B as shown by Figure 2. Consequently, the swivel latch 2 moves first in the closure direction, so that the stops 7 and 25 on the swivel latch 2 and the catch 3 respectively are disengaged from each other and the friction force of the catch 3 on the closure stop 7 on the swivel latch 2 is eliminated. The control stops 10 and 11 on the actuating slide 9 are mutually disposed so that after passing through the centre position B the catch 3 moves in the opening direction before the swivel latch 2 moves any further in its opening direction. The over-centre spring 16 already referred to is disposed between a pin 26 on the lever arm 14 and a pin 27 on the housing 1, in such a manner that until the toggle lever mechanism 12 has reached the centre position B, but not beyond that position, it exerts a clockwise moment on the lever arm 14 as shown in Figure 1, but when the door lock is in the open position (Figure 3) it exerts an anticlockwise moment.

After a brief operation of the external switch 23 (by a button on the door handle for example), the internal cut-out switch 24 is initially closed, because voltage is applied to the electric motor 17 and it starts to rotate. After one revolution of the crank transmission member 18, the internal cut-out switch 24 opens and the voltage supply to the electric motor 17 is thereby interrupted.

The embodiment of a door lock of the invention shown in Figures 4 and 5 corresponds basically to that already described with respect to Figures 1 to 3 and functions in like manner. In these respects, the same references are applied to like components. However, the mechanism is now modified so that the swivel latch 2 is carried over from the open to the closed position by the toggle lever mechanism 12 when the actuating slide 9 moves towards the crank transmission member 18, the motor vehicle door being thereby locked by the motorised system. The carry-over is effected by a stop 28 on the slide 9 which bears on the centre pivot 13 from below. Accordingly, the supply circuit 22 includes an additional internal switch 29, which is opened by the swivel latch 2 after the motor has been switched on for

the opening movement and closed by the swivel latch 2 after the closure movement has been mechanically initiated. For this purpose, the swivel latch 2 has a setting nose 30 near its linkage point to the lever arm 15, which closes the switch 29 in the closed position and opens the said switch 29 when the swivel latch is in the open position. Figure 4 depicts the closed position of the lock and also depicts the additional internal switch 29 in the closed position. Figure 5 depicts a position between closed and open pistons of the lock and movement of the catch 3 over the so-called safety notch 8. The additional internal switch 29 is open in this intermediate position. Hence the door lock could be further opened from this position. If it is mechanically closed slightly further, the additional internal switch 29 will be closed, so that the closure movement will continue under motor power. It will be seen that for this purpose the actuating slide 9 is provided with the carry-over stop 28 in addition to the control stop 11 for the catch 3, as already shown in the embodiment described with reference to Figures 1 to 3. This carry-over stop provides a free travel F for the centre pivot 13 and hence for the toggle lever mechanism 12, between the two control stops 10 and 11, but it also ensures support for the closure movement as just described. In this situation, the electric motor 17 once again applies a large closure force on the swivel latch 2, by virtue of the mechanical advantage of the toggle lever mechanism 12. The additional switch 29 provides a time-controlled delay. This switch is closed when the door lock is in its closed position. When a swivelling movement in the opening direction is initiated in the swivel latch 2, the switch 29 delays its opening until the locking face of the closure stop 7 on the swivel latch 2 has passed beyond the stop 25 on the catch 3 and thus the catch 3 can no longer obstruct the swivelling movement of the swivel latch 2. The electric motor 17 stops and the door can now be opened entirely by hand. If the door is closed mechanically, the switch 27 completes the supply circuit 22 to the electric motor 17, so that the closure sequence already described above can be initiated.

The embodiment shown in Figures 6 to 10 corresponds basically to those shown in Figures 1 to 5. In these respects, the same references are applied to like components and the preceding functional descriptions can be referred to to avoid repetition. However, the swivel latch 2 no longer incorporates the closure stop 7 featured in the embodiments shown in Figures 1 to 5. It only retains the safety notch 8. The functions of the closure stop are now taken over by the toggle lever mechanism 12, with which a special catch 7s is associated for this purpose. The arrangement is such that the toggle lever mechanism 12 is held in the over-centre position A, urged towards the crank transmission member 18, against the catch 7s which is disposed on the housing 1 adjacent the crank transmission member side, while the toggle lever mechanism 12 can swivel into a position clear of the swivel latch 2 during or following its movement into the opposite over-centre position C. Because the swivel latch 2 only retains a single safety notch 8 for the catch 3, the force P derived from the strained door seal and acting through the swivel latch 2 is employed to secure the swivel latch 2 in its closed position with the toggle lever mechanism 12 against the catch 7s.

CLAIMS

1. A motor vehicle door lock having a housing, a swivel latch, a catch with a loading spring, and an actuator, in which when the motor vehicle door is closed a locking pin secured on the door frame can be introduced into the swivel latch and the swivel latch moves into the locking position, while the catch applies a force to a closure stop on the swivel latch after the motor vehicle door is closed, which force is derived from the friction force set up by an elastically strained door seal, the actuator comprising an actuating slide having two control stops, a toggle lever mechanism and having two arms meeting at a centre pivot and an over-centre spring, and an electric motor driving a crank transmission member the actuating slide being attached to the crank transmission system, the toggle lever mechanism being linked to the swivel latch at one end and the housing at the other end and being held in an over-centre position urged towards the crank transmission member when the swivel latch is in its locking position, the control stop on the crank transmission member side lying against the centre pivot in this case, while when the crank transmission member is swivelled out of the rest position the toggle lever mechanism is first urged, by the control stop at the centre pivot through the centre position and into an over-centre position opposite to that first mentioned, and the catch is swivelled into the freed position by the second control stop.

2. A door lock as in Claim 1, wherein the end of the actuating slide remote from the crank transmission member travels along a slot of length compatible with the amplitude of the stroke of the crank transmission member.

3. A door lock as in either of Claims 1, and 2, wherein a gear reduction is interposed between the electric motor and the crank transmission member.

4. A door lock as in any one of Claims 1 to 3, wherein when the catch is disengaged from the swivel latch the latter can be swivelled into open position by the over-centre spring.

5. A door lock as in any one of Claims 1 to 4, wherein the electric motor is non-reversible and has a supply circuit with an external operating switch and an internal cut-out switch, the internal cut-out switch being actuated by the crank transmission member or in conformity with the crank transmission member after rotation through 360°.

6. A door lock as in Claim 5, wherein the swivel latch is carried over from the open position through an intermediate free movement to the closed position by an additional carry-over stop

alongside the control stop for the catch at the centre pivot of the toggle lever mechanism, as the actuating slide moves towards the crank transmission member, thereby providing motorised closure of the motor vehicle door, the supply circuit having an additional internal switch to be opened by the swivel latch after initiating the motorised opening sequence and closed after initiating the mechanical closure sequence.

7. A door lock as in any one of Claims 1 to 6, wherein the toggle lever mechanism is held in the over-centre position urged towards the crank transmission member by a catch disposed on the housing towards the crank transmission system side, while the toggle lever mechanism can swivel into a position clear of the swivel latch during or following its movement into the opposite over-centre position, the swivel latch having only a single notch, being a safety notch for the catch, and a force derived from the strained door seal and acting through the swivel latch being employed to secure the swivel latch in its closed position with the toggle lever mechanism against the catch on the housing.

8. A motor vehicle door lock substantially as hereinbefore described with reference to Figures 1 to 3 or Figures 4 and 5 or Figures 6 to 8 or Figures 9 and 10 of the accompanying drawings.

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