(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 001 442 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.05.2000 Bulletin 2000/20

(51) Int. Cl.[7]: **H01H 13/56**

(21) Application number: **99122327.2**

(22) Date of filing: **09.11.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **11.11.1998 JP 32041598**

(71) Applicant:
ALPS ELECTRIC CO., LTD.
Ota-ku Tokyo 145 (JP)

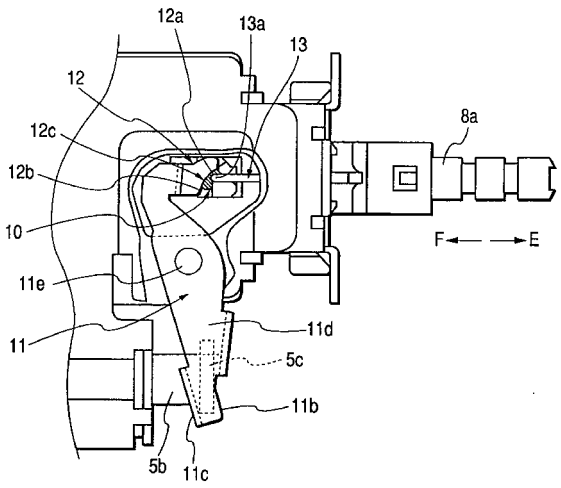
(72) Inventors:
- **Goto, Yoshimi**
  Furukawa-shi, Miyagi-ken (JP)
- **Ashina, Katsuhiro**
  Furukawa-shi, Miyagi-ken (JP)

(74) Representative:
Klunker . Schmitt-Nilson . Hirsch
Winzererstrasse 106
80797 München (DE)

(54) Switching device

(57) According to a switching device of this invention, a cam face has first and second inclined surfaces; a driving member having the cam face is driven by means of a small-sized solenoid, so that a lock member locking a slide member by means of the first inclined surface can easily be pushed to unlock even when the attraction force of the solenoid is little at the time of start of attraction.

FIG. 8



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates to a switching device suitable for use as a power switch of such electronic equipment as televisions, monitors, etc., and more particularly to a switching device having an automatic breaking function.

2. Description of Related Art

[0002] Referring to Figs. 12 to 14, a conventional switching device will be explained. First, as shown in Fig. 12, an AC switch section 33 and a solenoid section 35 are formed on a frame 20. On the right side in the drawing of the AC switch section 33, a DC switch section 34 formed of a member separately from the frame 20 is attached. The AC switch section 33, the solenoid section 22, and the DC switch section 34 are integrally arranged.

[0003] In the casing 23 attached to the AC switch section 33, there is disposed a slide member 21 which can perform ON/OFF operation of switches in the AC switch section 33 and the DC switch section 34. An operating shaft 21a formed integrally with the slide member 21 is protruding out of the frame 20. The slide member 21 is constantly pressed with elasticity in the direction of the arrow A. When the operating shaft 21a is in the leftmost position in the drawing, the switches of the AC switch section 33 and DC switch section 34 are OFF in the initial position.

[0004] As the slide member 21 is depressed in the direction of the arrow B from this initial position, the switches of the AC switch section 33 and the DC switch section 34 are actuated to ON to lock the slide member 21.

[0005] In the slide member 21 a cam recess 29 is formed as shown in Fig. 14. The cam recess 29 is formed by cutting to a specific depth in the surface of the slide member 21. At the bottom of the cam recess 29, a cam bottom surface 29a including a plurality of inclined surfaces and stepped sections is formed. Also on the cam bottom surface 29a a heart cam 30 having a lock wall 30a is projectively formed.

[0006] The cam recess 29 is so designed that the lock member 27 will be positioned therein. The lock member 27 is bent squarely at both ends in the same direction; and a rocking support 27a is formed on one end and a locking portion 27b is formed on the other end.

[0007] The rocking support 27a of the lock member 27 is pivotally supported on a casing 23, and is so adapted that with the reciprocating motion of the slide member 21 the locking portion 27b slides on the cam bottom surface 29a of the cam recess 29, thus moving around the heart cam 30.

[0008] An unillustrated solenoid attached on the solenoid section 22 is designed to be attracted by the plunger 22a to move in the direction of the arrow B.

[0009] The driving cam 24 which is driven by the solenoid is rotatably supported on the frame 20. With one end of the driving cam 24, the plunger 22a of the solenoid is engaged, so that the driving cam 24 will be turned by the attraction of the plunger 22a.

[0010] An unlocking portion 25 formed at the other end of the driving cam 24 is positioned in the cam recess 29 of the slide member 21. The unlocking portion 25 is formed in a crest form having two straight inclined surfaces 25a and 25b as shown in Fig. 13.

[0011] Operation of such a conventional switching device is as follows: when the solenoid is in an unexcited state in the initial position, the locking portion 27b of the lock member 27 is positioned in the upper part in the drawing of the heart cam 30, off the lock wall 30a of the heart cam 30 as shown in Fig. 13.

[0012] At this time, the driving cam 24 is in the position in which the unlocking portion 25 is off the lock member 27; and the switches of the AC switch section 33 and the DC switch section 34 are in the OFF position in the initial state.

[0013] Next, when the operating shaft 21a is pushed in the direction of the arrow B to move the slide member 21, the locking portion 27b of the lock member 27 slides on the cam bottom surface 29a of the cam recess 29 until it comes to the lock wall 30a of the heart cam 30 as shown in Fig. 13A, thereby restricting the movement of the slide member 21 in the direction of the arrow A to the locked position and accordingly turning on the switches of the AC switch section 33 and the DC switch section 34.

[0014] Next, to turn off the switches of the AC switch section 33 and the DC switch section 34, the current is supplied to the solenoid, which attracts the plunger 22a in the direction of the arrow B. Then, the driving cam 24 turns in the direction of the arrow C shown in Fig. 13B, to move the unlocking portion 25 in the direction of the arrow D, thus pushing the locking portion 27b in the locked state in contact with the inclined surface 25a.

[0015] Then, the locking portion 27b moves downwardly in the drawing along the inclined surface 25a, coming off from the lock wall 30a and accordingly unlocking the slide member 21.

[0016] The slide member 21 is moved in the direction of the arrow A by the elastic force of an elastic member not depicted, to turn off the switches of the AC switch section 33 and the DC switch section 34, thus automatically resetting to the initial position.

[0017] The attraction force characteristic of the solenoid shows that the attraction force is at the lowest level in the initial period of attraction by the plunger 22a and grows with an increase in the attraction force attracting the plunger 22a.

[0018] When the slide member 21 is unlocked, that is, when the lock member 27 is moved away from the lock wall 30a, a great deal of force is needed at the time of starting the locking portion 27b; after the locking portion 27b has started moving, the lock member 27 can easily be moved even with a small force.

[0019] In the conventional switching device, the lock member 27 is moved away from the lock wall 30a along the inclined surface 25a of the same angle when the slide member 21 is unlocked. Therefore, to initiate the lock member 27 which requires a maximum force, it is necessary to start the lock member 27 by the solenoid 27 when the force of attraction for initiating the lock member is at the lowest level. If the force to move the lock member 27 after initiating may be a small force, the attraction force of the solenoid 21 increases, resulting in a lowered operation efficiency of the solenoid 27.

[0020] Therefore there arises such a problem that a large-sized solenoid 27 is needed to smoothly initiate the lock member 27 and accordingly the switching device itself is required to be made compact.

SUMMARY OF THE INVENTION

[0021] It is an object of this invention to provide a switching device capable of solving the above-described problem and downsizing at a low cost.

[0022] As a first means to solve the aforesaid problem, the switching device of this invention includes a driving member having a cam face at one end, a driving source for driving the driving member, a reciprocally movable slide member which can operate a switch on and off, a lock wall formed on a part of the slide member, and a lock member which contacts the lock wall when the slide member is moved in one direction, to thereby lock the slide member. In the switching device of such a constitution, the cam face is formed by combining a plurality of different faces; the driving member is driven by the driving source when the slide member is locked by the lock member; and the lock member held by the cam face in contact with the lock wall is pressed in a direction nearly orthogonal to the direction of movement of the slide member, to thereby unlock the slide member.

[0023] Furthermore, as a second means to solve the above-described problem, the switching device is provided with the cam face previously stated that, when the slide member is to be unlocked, the lock member, when pressed to start by the cam face, moves a little, and moves largely after starting.

[0024] Furthermore, as a third means to solve the above-described problem, the cam face is comprised of a combination of a plurality of straight inclined surfaces formed at different angles. The cam face has a first inclined surface for pushing the lock member at the time of starting and a second inclined surface for pushing the lock member after starting. The angle of the first inclined surface in relation to the direction of movement of the cam face is decreased to reduce the travel of the lock member, and the angle of the second inclined surface in relation to the direction of movement of the cam face is increased to increase the travel of the lock member.

[0025] Furthermore, as a fourth means to solve the above-described problem, the cam face is comprised of a combination of a plurality of curved surfaces. The cam face has a first curved surface for pushing the lock member at the time of start of the lock member and a second curved surface for pushing the lock member after starting. The angle formed by the tangent of the first curved surface relative to the direction of movement of the cam face is reduced to decrease the travel of the lock member and the angle formed by the tangent of the second curved surface relative to the direction of movement of the cam face is increased to thereby increase the travel of the lock member.

[0026] Other objects, together with the foregoing, are attained in the embodiments described in the following description and illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a perspective view showing a switching device of this invention;

Fig. 2 is a plan view showing a major portion of a cam recess portion according to this invention;

Fig. 3 is a schematic sectional view explaining the shape of a cam face of a cam recess portion according to this invention;

Fig. 4 is a plan view of a driving member according to this invention;

Fig. 5 is a perspective view of a lock member according to this invention;

Fig. 6 is a schematic view explaining the movement of the lock member according to this invention;

Fig. 7 is an enlarged view of a major portion explaining the operation of the driving member and the lock member according to this invention;

Fig. 8 is an enlarged view of a major portion explaining the operation of the driving member and the lock member according to this invention;

Fig. 9 is an enlarged view of a major portion explaining the operation of the driving member and the lock member according to this invention;

Fig. 10 is a graph explaining the relationship between the attraction characteristic of a solenoid and the driving force of the lock member according to this invention;

Fig. 11 is a schematic view explaining other embodiments of the driving member according to this invention;

Fig. 12 is a plan view of a conventional switching device;

Fig. 13 is a schematic view explaining the operation of the conventional switching device; and

Fig. 14 is a schematic view explaining the operation of the conventional switching device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] A first embodiment of a switching device according to this invention will hereinafter be described with reference to the accompanying drawings. Fig. 1 is a perspective view showing a switching device of this invention; Fig. 2 is a plan view showing a major portion of a cam recess portion according to this invention; Fig. 3 is a schematic sectional view explaining the shape of a cam face of a cam recess portion according to this invention; Fig. 4 is a plan view of a driving member according to this invention; Fig. 5 is a perspective view of a lock member according to this invention; Fig. 6 is a schematic view explaining the movement of the lock member according to this invention; Figs. 7, 8 and 9 are enlarged views of a major portion explaining the operation of the driving member and the lock member according to this invention; Fig. 10 is a graph showing a relationship between the attraction characteristic of a solenoid of this invention and the driving force exerted to the cam face when moving the lock member from the locked position; and Fig. 11 is an enlarged view of a major portion of other embodiments of the cam face according to this invention.

[0029] The switching device of this invention has a first frame 1 made of a metal such an iron plate as shown in Fig. 1. The first frame 1 has, on the right front side in the drawing, a flat-surface stepped section 1a formed partly projecting upwardly to a specific level, and a hollow section 1b is formed under the stepped section 1a. On the stepped section 1a a projecting portion 1c is formed projecting out downwardly in the drawing.

[0030] On the left rear side in the drawing of the stepped section 1a of the first frame 1, an AC switch section 2 is formed. Beside the AC switch section 2 a driving source mounting section 3 is juxtaposed. The AC switch section 2 has a casing 4 made of a resin material having an unillustrated AC switch inside. The casing 4 is closed in the upper part with a metal cover 4a.

[0031] In the driving source mounting section 3, the driving source, e.g., a solenoid 5, is juxtaposed on one side face of the casing 4. The solenoid 5 which is the driving source has a coil 5a and a plunger 5b, so that a later-described driving member 11 can be driven.

[0032] The solenoid 5 is so adapted that when the coil 5a is excited from the initial state, that is, from the non-excited state, the plunger 5b is attracted in the direction of the arrow P by a specific force of attraction.

[0033] On the left rear side in the drawing of the AC switch section 2, a second frame 6 made of a metal such as an iron plate which is a member separate from the first frame 1 is attached by caulking to the casing 4. On the second frame 6 a DC switch section 7 is formed. A DC switch not depicted is attached in the DC switch section 7.

[0034] On the casing 4 attached on the first frame 1, a reciprocally movable slide member 8 is provided to actuate unillustrated switches of the AC switch section 2 and the DC switch section 7 on and off by reciprocally moving in the directions of the arrows E and F.

[0035] The slide member 8 is formed integrally with an operating shaft 8a which protrudes outwardly to the right side of the casing 4 in the drawing. The slide member 8 is constantly elastically pressed in the direction of the arrow E by an unillustrated elastic member consisting of a coil spring and other. When the operating shaft 8a is in the rightmost position in the drawing, the switch circuit not shown of the AC switch section 2 and the DC switch section 7 are in the initial state in the OFF position.

[0036] When the operating shaft 8a is pushed to move the slide member 8 from the initial position in the direction of the arrow F against the elastic force of the elastic member not depicted, the switches of the AC switch section 2 and the DC switch section 7 are actuated to ON by an unillustrated switch operating section formed at the slide member 8 within the casing 4.

[0037] In the slide member 8 arranged in the lower part in the drawing of the stepped section 1a of the first frame 1, a cam recess 9 indicated by a thick line in Fig. 2 is formed to a specific depth. At the bottom of the cam recess 9 there is formed a cam bottom surface 9a including step-like level surfaces a, c, d, e and f, and inclined surfaces b and g.

[0038] Formed deepest in the cam bottom surface 9a is the level surface f; the second deep are the two level surfaces a and e, which are formed to the same depth; the third deep is the level surface d; and the fourth deep (the shallowest surface) is the level surface c. The level surface a and the level surface c are connected by the inclined surface b. From a slightly higher portion than the level surface a to the level surface f is connected by the inclined surface g.

[0039] Around the cam recess 9 is formed a level surface h which is much shallower than the level surface c which is the shallowest in the cam bottom surface 9a. Around this level surface h is formed a level surface j which serves as the surface of the slide member 8.

[0040] Near the central part of the cam bottom surface 9a, a heart cam portion 10 having the lock wall 10a is projectingly formed. The projection of the heart cam portion 10 is formed at the same level as the level surface h around the cam recess 9. The lock wall 10a is formed on the right side in the drawing of the heart cam portion 10, and the locking portion 13a of the later-described lock member 13 contacts the lock wall 10a to thereby lock the slide member 8.

[0041] The rotatable driving member 11 is disposed in the hollow section 1b formed by the provision of the

stepped section 1a of the first frame 1. The driving member 11 is made of a metal such as an iron plate, and has, at one end in the upper part of the drawing, an unlocking portion 12 having a cam face 12c formed by combining two straight inclined surfaces at different angles, that is, a first inclined surface 12a and a second inclined surface 12b.

[0042] The first and second inclined surfaces 12a and 12b of the cam face 12c are formed at different angles. That is, as shown in Fig. 4, the first inclined surface 12a has a narrow angle H in relation to the arrow G which is the direction of movement of the cam face 12c while the second inclined surface 12c has a wide angle J in relation to the arrow G which is the direction of the movement of the cam face 12c.

[0043] At the other end in the lower part in Fig. 4 of the driving member 11, there is formed a solenoid engagement portion 11b which engages with the forward end 5c of the plunger 5b of the solenoid 5. The solenoid engagement portion 11b is formed by bending an engagement wall 11c.

[0044] The driving member 11 has a flat connecting portion 11d which is formed for connecting the unlocking portion 12 with the solenoid engagement portion 11b. The connecting portion 11d has, near the unlocking portion 12, a hole 11e formed for insertion of the projecting portion 1c of the first frame 1, so that the driving member 11 will be rotatably supported in the hole 11e on the center of rotation within the hollow section 1b of the first frame 1.

[0045] The driving member 11, when attracted by the solenoid 5, can be turned in the direction of the arrow P of the plunger 5b as shown in Fig. 1.

[0046] The lock member 13 capable of moving the slide member 8 in one direction into a locked position is made of a round metal rod as shown in Fig. 5, both ends of which are bent nearly squarely in the same direction. A locking portion 13a is formed on one end, and a rocking pin portion 13b is formed on the other end.

[0047] The rocking pin portion 13b of the lock member 13 is fitted in an unillustrated hole formed in the casing 4. The locking portion 13a is rockably positioned in the cam recess 9 of the slide member 8.

[0048] The lock member 13, with the locking portion 13a positioned on the cam bottom surface 9a of the cam recess 9, slides on the cam bottom surface 9a with the reciprocal motion of the slide member 8 in the directions of the arrows E and F, and the locking portion 13a can rock around the heart cam portion 10 on the center of the rocking pin portion 13b.

[0049] The driving source, e.g., the solenoid 5, is so designed that the driving force is at the lowest level at the time of starting driving, gradually increasing after starting driving. That is, the solenoid 5, as previously explained in the conventional technique, has such an attraction characteristic that, as shown in Fig. 10, the force of attraction is at the lowest level when the supply of electric current to the coil 5a is started to attract the plunger 5b, increasing as the plunger 5b is drawn into the coil 5a.

[0050] When the slide member 8 is to be unlocked from the locked position, a force required to move the lock member 13 from the lock wall 10a is at the highest level during the starting of the lock member 13, and gradually decreases after starting movement of the lock member 13.

[0051] In the present embodiment of this invention, therefore, the unlocking portion 12 is provided with such a cam face 12c that, when unlocking the slide member 8, the amount of movement of the lock member 13 by the cam face 12c is small at the time the lock member 13 is started, and increases after the lock member 13 is started.

[0052] That is, as shown in Fig. 4, the cam face 12c of this invention is comprised of a combination of a plurality of straight inclined surfaces formed at different angles. The cam face 12c has the first inclined surface 12a for pushing the lock member 13 at the time of starting the lock member 13, and the second inclined surface 12b for pushing the lock member 13 at the time of starting the lock member 13. The first inclined surface 12a has a narrow angle H with respect to the direction of movement (the arrow G) of the cam face 12c; the lock member 13, when started, is moved a little by the cam face 12c, and the second inclined surface 12b has a wide angle J with respect to the direction of movement (the arrow G) of the cam face 12c, so that the lock member 13, after starting, may be moved largely by the cam face 12c.

[0053] When a great deal of driving force is required to start the lock member 13 for unlocking the slide member 8, therefore, the lock member 13 is pushed with the first inclined surface 12a formed at the small angle H. Therefore, as shown in Fig. 10, the force to be exerted to the cam face 12c at the time of start of the lock member 13 decreases. Even a small-sized solenoid 5 can easily initiate the lock member 13 with a little driving force.

[0054] After the lock member 13 is started, the lock member 13 is pushed by the second inclined surface 12b of the large angle J; therefore the force applied to the cam face 12c increases. However, as attraction by the solenoid 5 has been started, the force of attraction increases to easily move the locking portion 13a, thereby enabling to smoothly move to unlock the locking portion 13a.

[0055] It is, therefore, possible to downsize the shape of the cam face 12c.

[0056] In the switching device of this invention, as shown in Fig. 7, the operating shaft 8a of the slide member 8 is protruded out in the direction of the arrow E by the action of an unillustrated elastic member when the solenoid 5 is in the initial position in the non-excited state. The switches of both the AC switch section 2 and the DC switch section 3 are designed to be operated to OFF position.

[0057] The locking portion 13a of the lock member 13 in the initial state is positioned on the level surface a of the cam recess 9 shown in Fig. 6. Because the solenoid 5 is in a non-excited state, the driving member 11 can move into contact with, and away from, the locking portion 13a on the level surface a of which the cam face 12c is located.

[0058] When the operating shaft 8a is pushed to move the slide member 8 in the direction of the arrow F to turn on the switches of the AC switch section 2 and the DC switch section 3, the locking portion 13a of the lock member 13 is pushed upwardly by the inclined surface b from the level surface a shown in Fig. 3, passing the fourth deep (shallowest) level surface c while rocking onto the third deep level surface d.

[0059] At this time, the slide member 8 moving in the direction of the arrow F contacts an unillustrated stopper portion of the casing 4, thus coming to a stop. And the switches of the AC switch section 2 and the DC switch section 3 are turned ON.

[0060] Upon removal of the pushing force that has been exerted to the operating shaft 8a, the slide member 8 is pushed to return in the direction of the arrow E with the elastic force of an unillustrated elastic member. At this time, as shown in Fig. 6, the locking portion 13a of the lock member 13 which is positioned in the level portion d moves to be positioned in the level portion e, where the lock member 13a contacts the lock wall 10a of the heart cam portion 10, thus locking the movement of the slide member 8 in the direction of the arrow E, that is, locking the slide member 8. At this time, the switches of the AC switch section 2 and the DC switch section 3 are in ON position.

[0061] The driving member 11 is of such a design that, because the solenoid 5 is in a non-excited condition, the cam face 12c can be moved into contact with, and away from, the locking portion 13a in the locked state.

[0062] In the explanation made by referring to Fig. 6, the locking portion 13a moves in the directions of the arrows E and F, that is, in the lateral direction in the drawing within the cam recess 9. Actually, however, the slide member 8 reciprocally moves in the directions of the arrows E and F; the locking portion 13a of the lock member 13 just rocks on the center of the rocking pin portion 13b within the cam recess 9, and can not move in the directions of the arrows E and F.

[0063] Next, to turn off the AC switch 2 and the DC switch 3, a specific amount of electric current is supplied to the coil 5a of the solenoid 5 to excite the coil 5a, to thereby attract to move the plunger 5b in the direction of the arrow P as shown in Fig. 9.

[0064] With the attraction of the plunger 5b in the direction of the arrow P, the driving member 11 turns in the direction of the arrow K to move the cam face 12c in the direction of the arrow G. Then, the first inclined surface 12a pushes to move the locking portion 13a from the locked position, thus starting the locking portion 13a downwardly to start unlocking the slide member 8.

[0065] As the solenoid 5 is further attracted, the locking portion 13a being pushed by the first inclined surface 12a is pushed by the second inclined surface 12b, moving the lock member 13 off from the lock wall 10a of the heart can portion 10.

[0066] Then, the slide member 8 is moved by the action of an unillustrated elastic member in the direction of the arrow E, automatically returning to the initial position, where the switches of the AC switch section 2 and the DC switch section 3 are turned off. At this time, the locking portion 13a of the lock member 13 comes off from the third deep level portion e at the cam bottom surface 9a of the cam recess 9 which makes up the lock wall 10a of the heart cam portion 10, being positioned in the first deepest level portion f. Then, with the movement of the slide member 8 in the direction of the arrow E, the locking portion 13a is pushed upwardly from the level portion f with the inclined surface g to the second deepest level surface a.

[0067] The switching device of this invention, as previously described, has the automatically breaking function that the slide member 8 is automatically unlocked by means of the driving member 11 which is driven by a driving source such as the solenoid 5, and also the switches of the AC switch section 2 and the DC switch section 3 are automatically turned to OFF.

[0068] As the operating shaft 8a is manually operated in the direction of the arrow F from the initial state of the switch in OFF position, the switches of the AC switch section 2 and the DC switch section 3 can be set to ON position, thus locking the switch member 8 in the locked position. Furthermore, the locking portion 13a is moved to the level portion f of the cam bottom surface 9a by manually stroking the operating shaft 8a further in the direction of the arrow F, thereby unlocking the slide member 8 to allow manually breaking the switches of the AC switch section 2 and the DC switch section 3.

[0069] In the above-described embodiment, the cam face 12c of the driving member 11 having the first and second inclined surfaces 12a and 12b has been explained. However, the cam face 12c of this invention is not limited to one having the two inclined surfaces 12a and 12b and may be one having a combination of a plurality (two or more) of the inclined surfaces.

[0070] Furthermore, as shown in Fig. 11, the cam face 32c of the driving member 31 may be comprised of a combination of a plurality of curved surfaces having the first and second curved surfaces 32a and 32b; the first curved surface 32a being for pushing the lock member 13 at the time of unlocking the slide member 8, and the second curved surface 32b being for pushing the lock member 13 at the end of unlocking period of the slide member 8. The angles M and N formed by the tangents R and S of the first and second curved surfaces 32a and 32b in relation to the direction of the arrow G of the cam face 32c may be designed so that the angle N formed by the tangent S of the second curved surface

32b will be larger than the angle M formed by the tangent R of the first curved surface 32a.

[0071] Furthermore, in the present embodiment of this invention heretofore explained, the solenoid 5 is used in the driving source. The driving source, however, is not limited to the solenoid 5 and may be for instance an electric motor not depicted.

[0072] Furthermore, in this invention, the cam face 12c may be turned to move the driving member 11 in the reverse direction of driving of the plunger 5b of the solenoid 5, but may be moved in the same direction as the direction of driving of the driving source of the solenoid 5.

[0073] In the switching device of this invention, the cam face is formed of a combination of a plurality of different surfaces; when the slide member is locked in the locked position by the lock member, the driving member is driven by the driving source to push with the cam face the lock member which is in contact with the lock wall, in a direction nearly orthogonal to the direction of movement of the slide member, thereby unlocking the slide member. Therefore, even when the driving force of the driving source is little at the time of driving, the lock member can be smoothly started and unlocked from the locked state by the cam face which is comprised of a plurality of surfaces. It is, therefore, possible to make the driving source small in size and low in cost, and accordingly to provide a low-cost, small-size switching device.

[0074] Also there is provided the cam face which allows, when unlocking the slide member, the lock member being pushed by the cam face to travel a little at the time of starting the lock member, and to travel largely after starting. It is, therefore, possible to downsize the cam face.

[0075] Furthermore, the cam face is formed by combining a plurality of straight inclined surfaces. The cam face has the first inclined surface which pushes the lock member when starting the lock member, and the second inclined surface which pushes the lock member after starting the lock member. The first inclined surface has a narrow angle with respect to the direction of movement of the cam face, while the second inclined surface has a wide angle with respect to the direction of movement of the cam face, to thereby increase the travel of the lock member. Therefore, even when the driving force of the driving source is little during the initial period of driving, the lock member in the locked position can smoothly be started by the first inclined surface, enabling the use of a small-sized driving source. It is, therefore, possible to provide a small-sized, low-cost switching device.

[0076] The cam face is comprised of a combination of a plurality of curved surfaces. The cam face has the first curved surface for pushing the lock member at the time of starting the lock member and the second curved surface for pushing the lock member after starting. The angle formed by the tangent of the first curved surface relative to the direction of movement of the cam face is reduced to decrease the travel of the lock member and the angle formed by the tangent of the second curved surface relative to the direction of movement of the cam face is increased to thereby increase the travel of the lock member. The lock member, therefore, can be started further smoothly when unlocking.

Claims

1. A switching device including a driving member having a cam face at one end, a driving source for driving said driving member, a reciprocally movable slide member which can operate a switch on and off, a lock wall formed on a part of said slide member, and a lock member which contacts said lock wall when said slide member is moved in one direction, to thereby lock said slide member; said cam face being formed by combining a plurality of different faces; said driving member being driven by the driving source when said slide member is locked by said lock member; and said lock member held by said cam face which is in contact with said lock wall being pressed in a direction nearly orthogonal to the direction of movement of said slide member, to thereby unlock said slide member.

2. A switching device according to claim 1, wherein there is provided said cam face which allows, to unlock said slide member, said lock member to move a little when pressed to start said lock member by said cam face, and to move largely after starting said lock member.

3. A switching device according to claim 2, wherein said cam face is comprised of a combination of a plurality of straight inclined surfaces formed at different angles; said cam face has a first inclined surface for pushing said lock member at the time of starting said lock member, and a second inclined surface for pushing said lock member after starting said lock member; and the angle of said first inclined surface in relation to the direction of movement of said cam face is decreased to reduce the travel of said lock member, and the angle of said second inclined surface in relation to the direction of movement of said cam face is increased to increase the travel of said lock member.

4. A switching device according to claim 2, wherein said cam face is comprised of a combination of a plurality of curved surfaces; said cam face has a first curved surface for pushing said lock member at the time of starting said lock member, and a second curved surface for pushing said lock member after starting said lock member; and an angle formed by the tangent of said first curved surface with respect to the direction of movement of said cam face is reduced to decrease the travel of said lock member,

and an angle formed by the tangent of said second curved surface with respect to the direction of movement of said cam face is increased to thereby increase the travel of said lock member.

FIG. 1

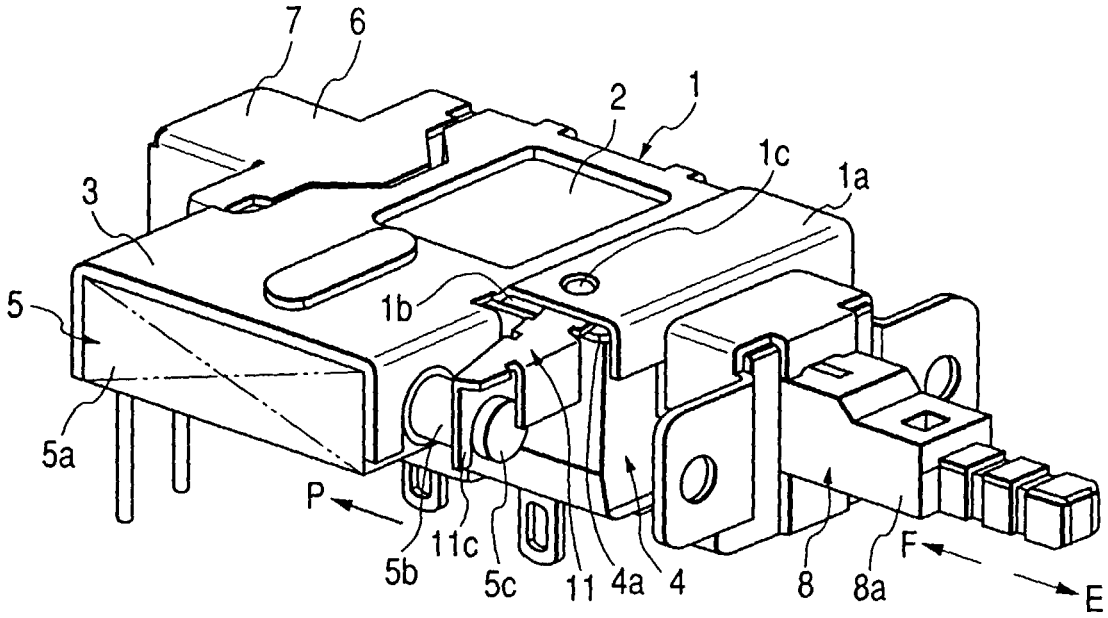

7
6
2
1
1c
1a
3
5
1b
5a
P
5b
11c
5c
11
4a
4
8
8a
F
E

FIG. 2

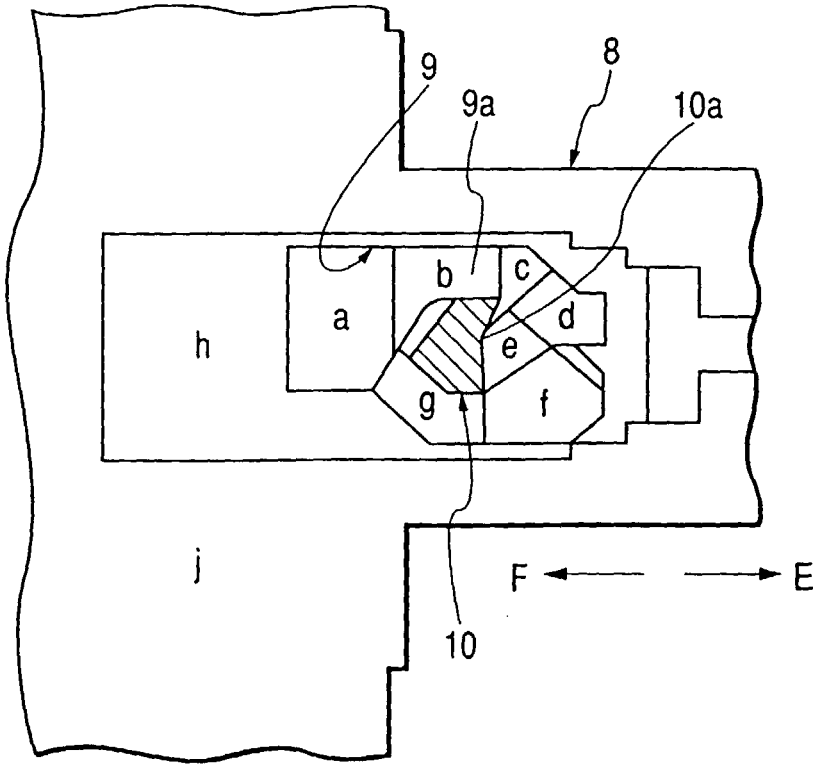

9
9a
8
10a
b
c
a
d
h
e
g
f
j
F
E
10

FIG. 3

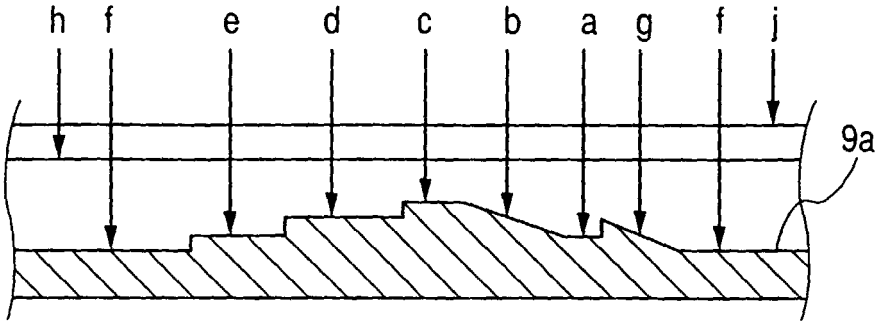


FIG. 4

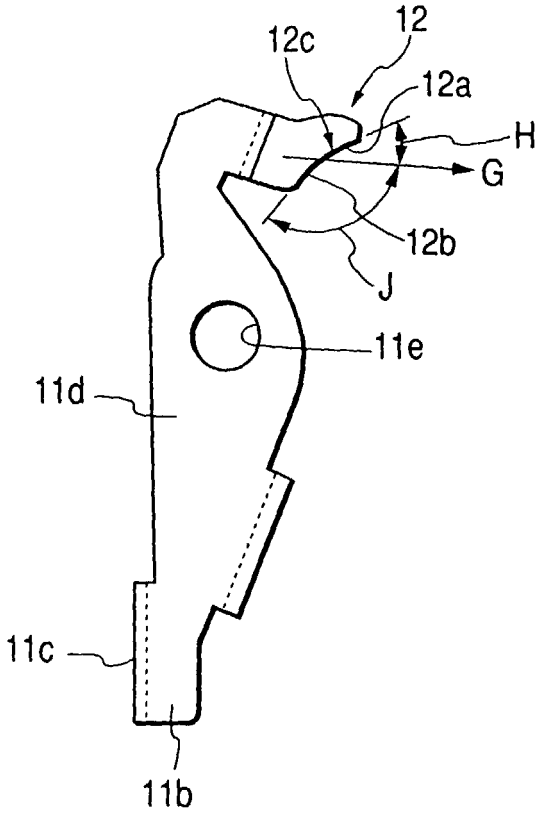


FIG. 5

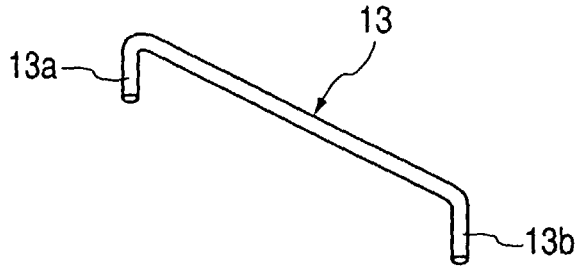


FIG. 6

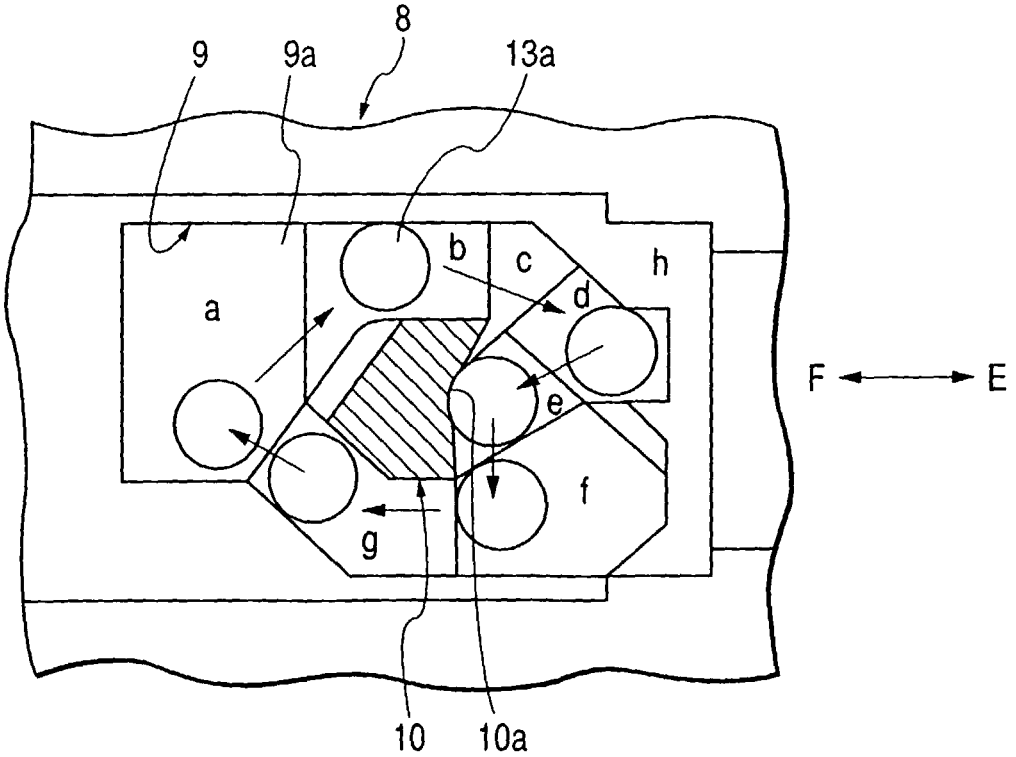


FIG. 7

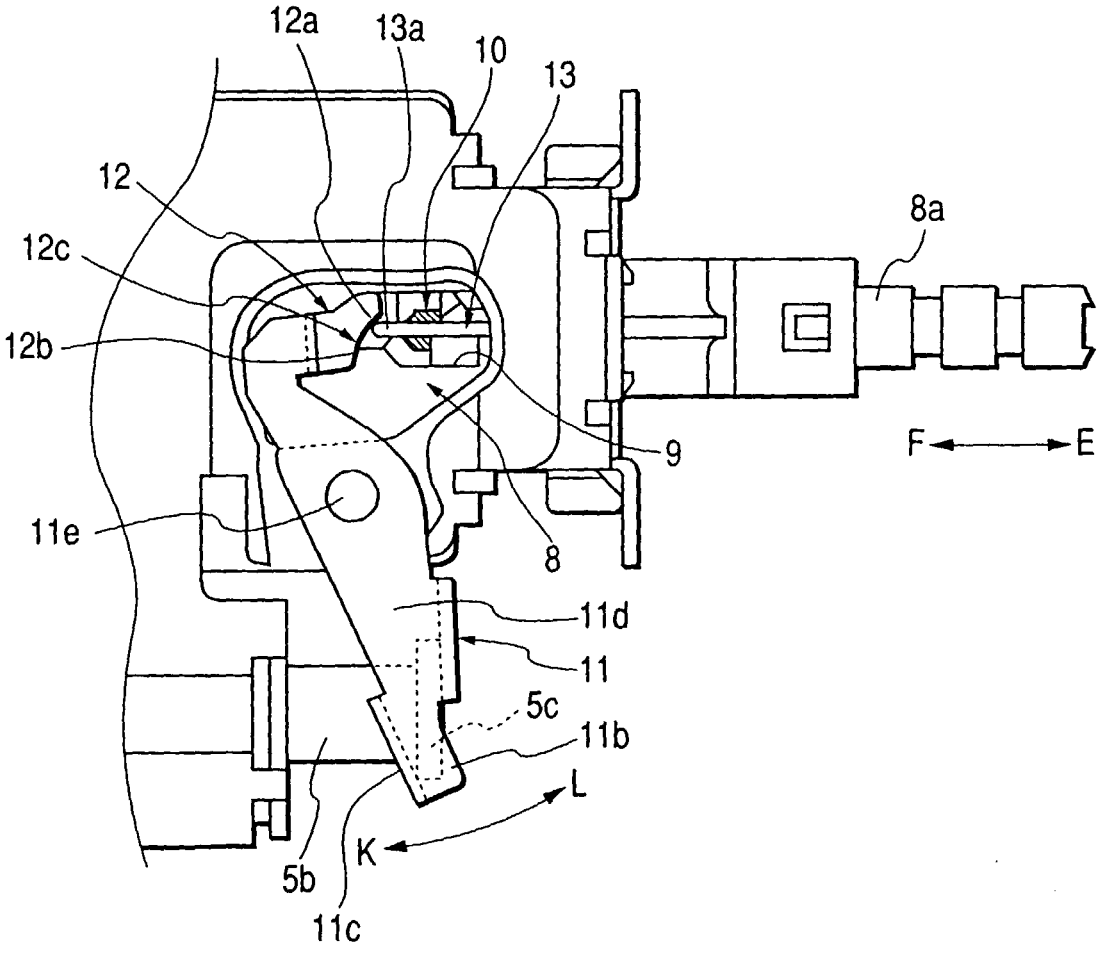


FIG. 8

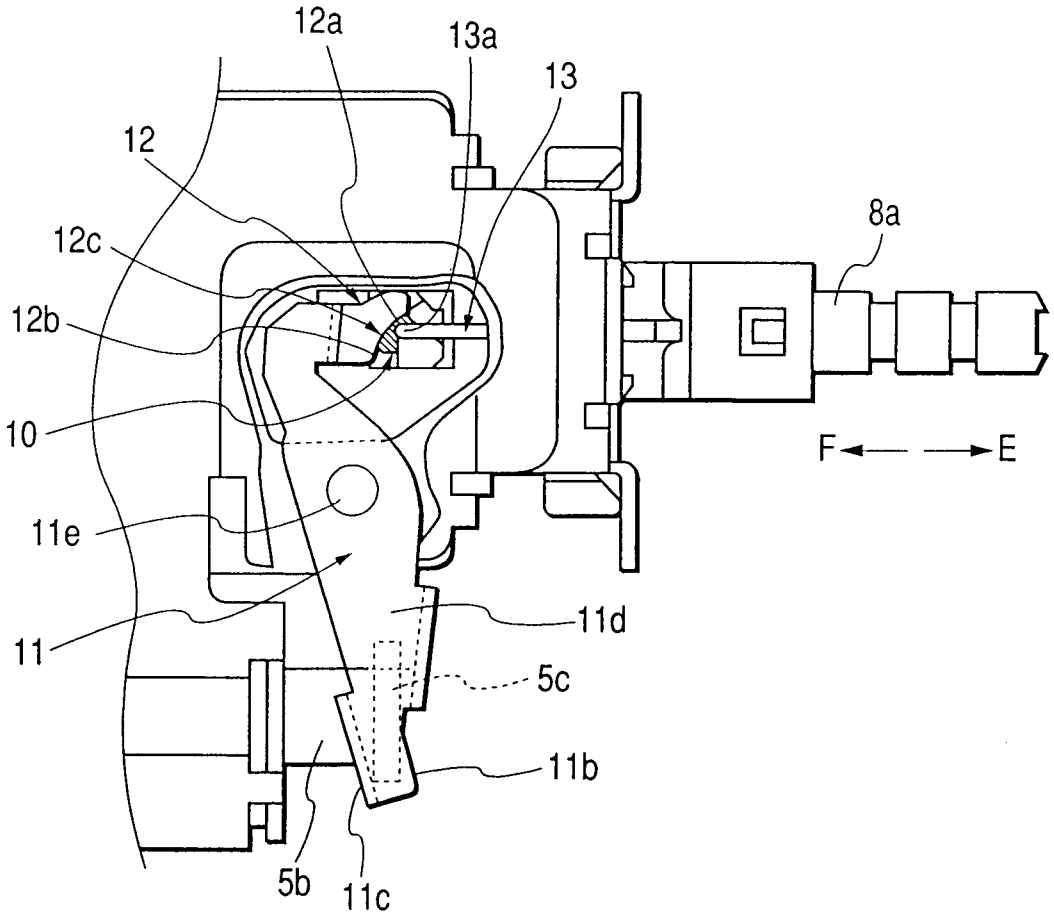


FIG. 9

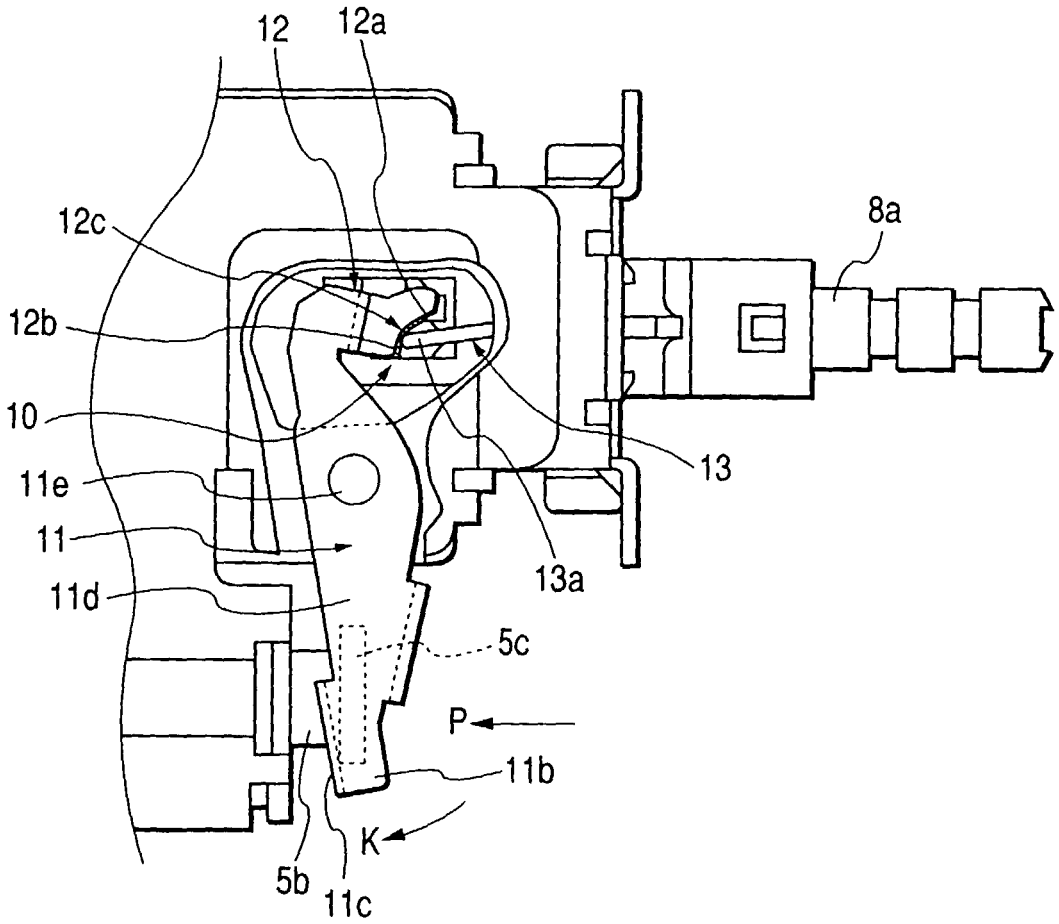


FIG. 10

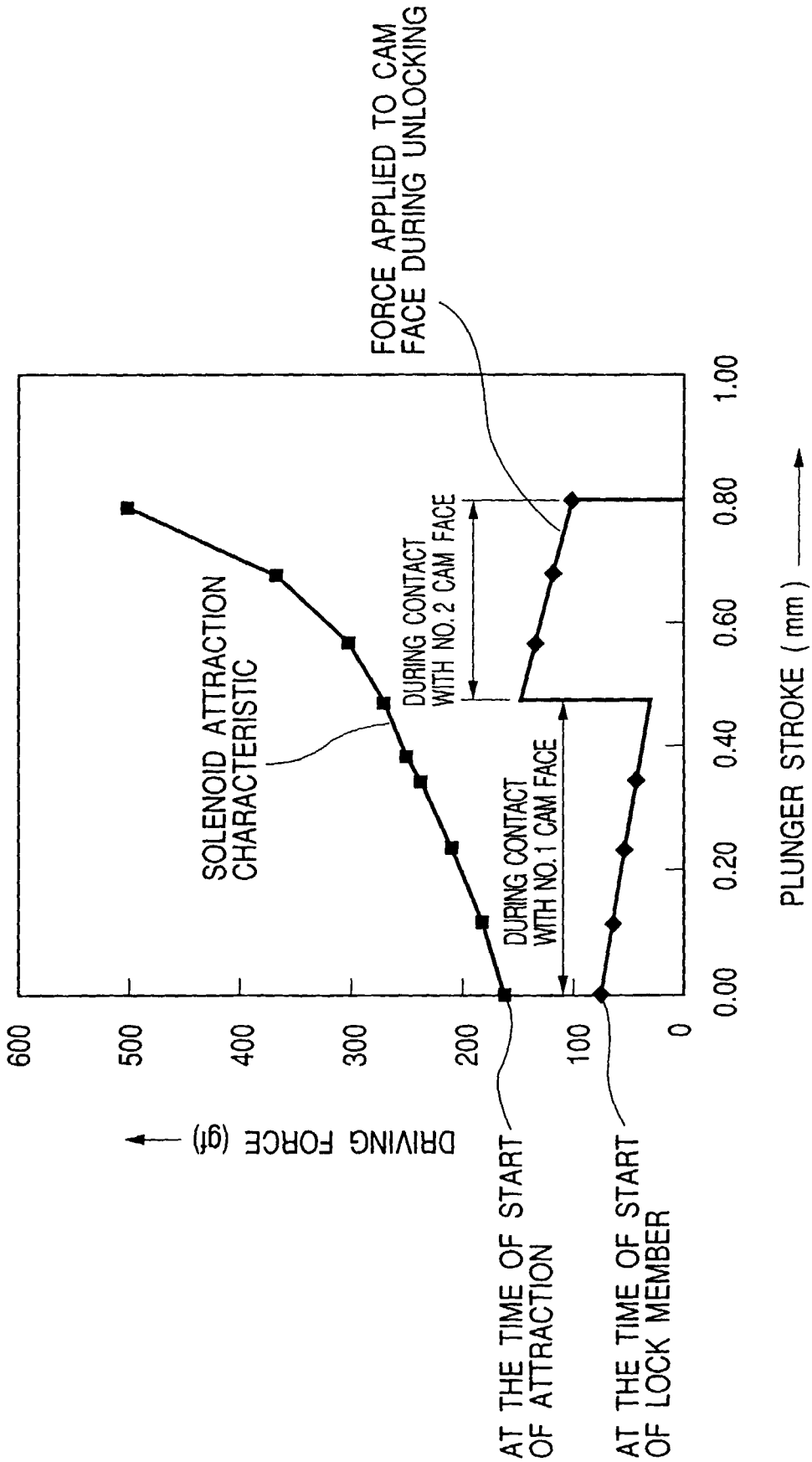

FORCE APPLIED TO CAM FACE DURING UNLOCKING
SOLENOID ATTRACTION CHARACTERISTIC
DURING CONTACT WITH NO. 2 CAM FACE
DURING CONTACT WITH NO. 1 CAM FACE
AT THE TIME OF START OF ATTRACTION
AT THE TIME OF START OF LOCK MEMBER
DRIVING FORCE (gf)
600
500
400
300
200
100
0
0.00
0.20
0.40
0.60
0.80
1.00
PLUNGER STROKE (mm)

FIG. 11

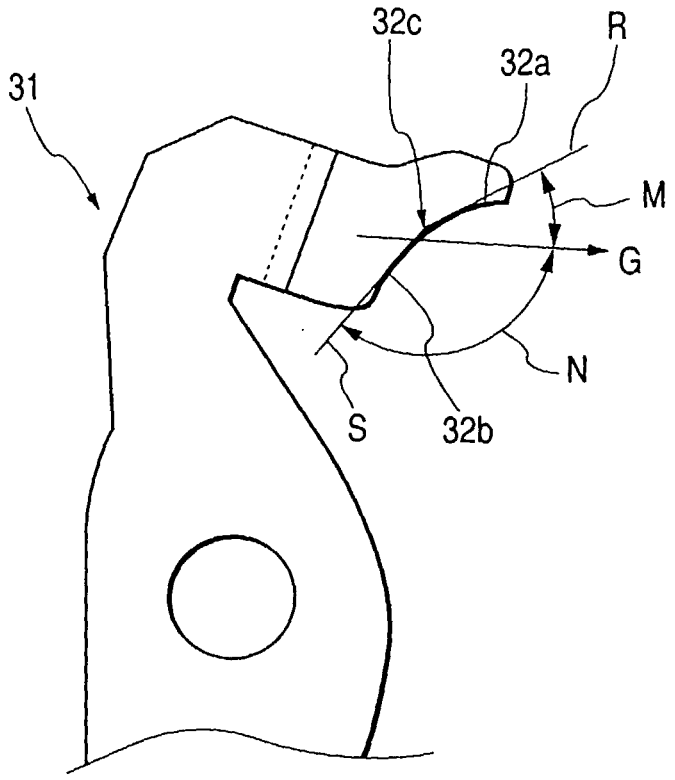


FIG. 12 PRIOR ART

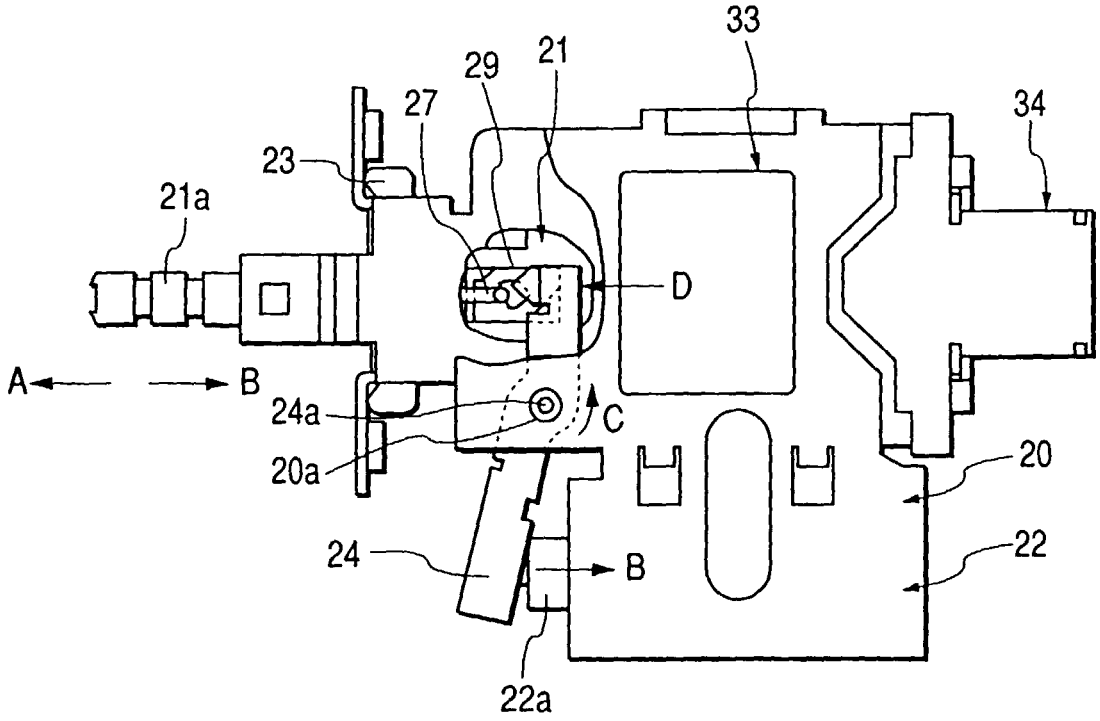


FIG. 13A PRIOR ART

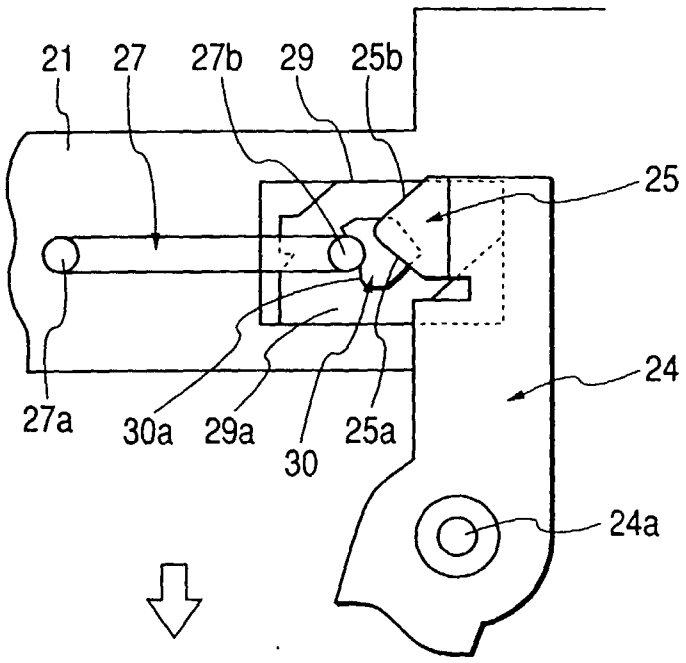


FIG. 13B PRIOR ART

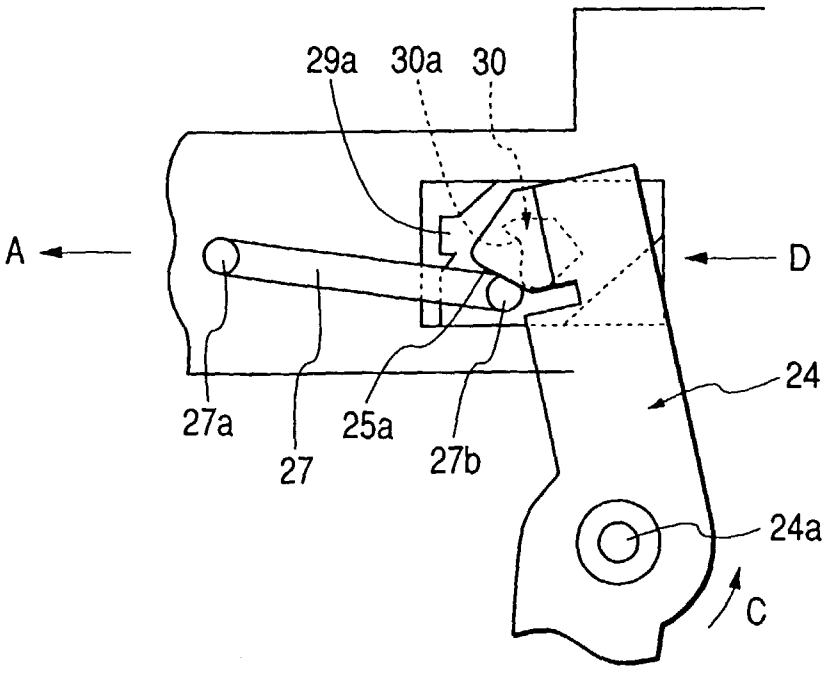
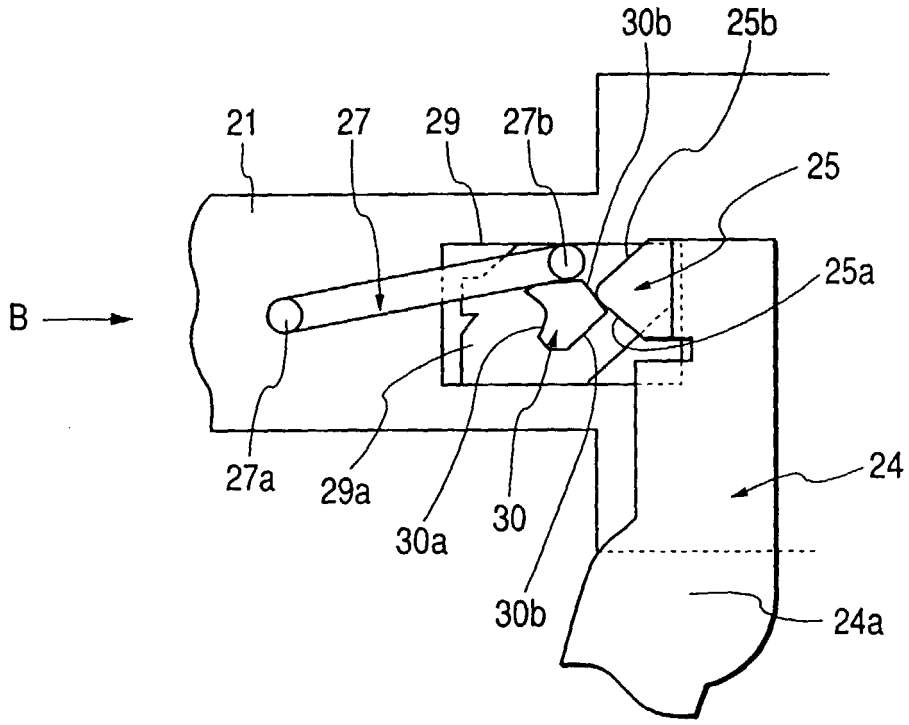


FIG. 14 PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 12 2327

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 195 19 181 A (ALPS ELECTRIC CO LTD) 30 November 1995 (1995-11-30) * the whole document *	1-4	H01H13/56

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	16 February 2000	Mausser, T

CATEGORY OF CITED DOCUMENTS

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16-02-2000

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		CN 1117198 A,B	21-02-1996
		KR 156046 B	16-11-1998

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82