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(72) Inventor: **Brosco, Ettore**
00040 Pomezia (RM) (IT)

(74) Representative: **Taliercio, Antonio et al**
ING. BARZANO' & ZANARDO ROMA S.p.A.
Via Piemonte, 26
00187 Roma (IT)

(71) Applicant: **Brosco, Silvia**
00040 Pomezia (RM) (IT)

(54) **Electrical plug with built-in safety switch for electrical apparatuses**

(57) This invention concerns an electrical plug with built-in safety switch for use with an electrical apparatus (3) comprising a casing (7), at least two terminals (8) and a corresponding number of power supply lines for said electrical apparatus (3), an electrically controlled switch (1) that couples two terminals (8) to said power supply lines, a sensor (4) to sense the behaviour of the current supplied to said apparatus (3), inserted between

said switch (1) and said apparatus (3), as well as an electronic control unit (5) which receives signal corresponding to said sensed behaviour from said sensor (4) and generates control signals for said switch (1), said electronic control unit (5) operating in differential mode, according to which it closes said switch (1) at power-up and opens it when the current sensed by said sensor (4) is higher than a differential threshold value.

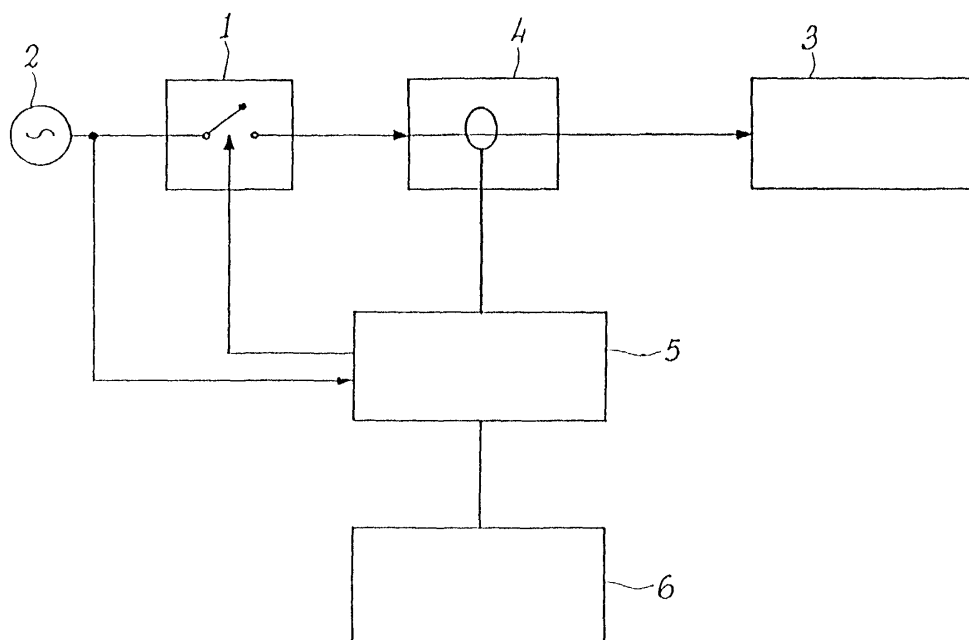


FIG. 1

Description

[0001] This invention relates to an electrical plug with built-in safety switch adapted to be used in electrical apparatuses.

[0002] More particularly, this invention relates to a plug of the above said kind which enables in simple, reliable and inexpensive way to switch off the power supply to a load connected thereto in all cases of current leakage and which is highly ergonomic.

[0003] It is known that many accidents occurring at home or on the working sites are due to electrical apparatuses and machines. Such accidents are usually caused by accidental contacts with electrically active items that causes a dangerous current flow usually supplied by the mains voltage.

[0004] The above mentioned electrically active items can be either cables or electrical devices amenable to be improperly contacted, or also electrically conductive components that, due to leakages caused by failures or short circuits, are driven to dangerous voltages.

[0005] Even if they do not result into accidents, all leakages due to improper operation of any electrical apparatus are harmful to the apparatuses themselves.

[0006] Aiming at limiting all risks for the involved people and all damages to the concerned apparatuses many solutions have been proposed; the most popular solution provides for inserting a differential switch upstream of all terminals or current sockets of the electrical circuit connected to a user apparatus. By way of illustration, in the case involving an electrical circuit of a dwelling place, said differential switch is located downstream of the current meter and upstream of all current sockets where electrical appliances and any other electrical apparatus are connected.

[0007] A differential switch senses the behaviour of the current supplied by the power supply mains to the user and responds to any sudden increase thereof higher than a pre-established threshold value by switching off the power supply to all terminals of the user electrical circuit. As it is known to those skilled in the art, such possible sudden increase in the supplied current can be caused either by accidental contact of a body or by a current leakage due to a short circuit condition. In detail, the above said threshold value is designed so as to account both for the amount and for the increase speed of the supplied current, it can be defined as a current differential threshold and it is quantitatively identified as an intervention or trigger current value.

[0008] Anyway, all safety devices based upon utilisation of differential switches have some drawbacks.

[0009] Since the differential switches have been found to be rather expensive, it is not convenient to couple a differential switch to each apparatus connected to the current socket. In this way, when a current leakage occurs, the current supply to all current sockets is switched off, so that it is no more possible to easily and immediately locate the single apparatus wherein the

current leakage occurred. This situation can be particularly critic in dwelling places during the evening hours, since it entails the interruption of the current supply to all illumination devices.

[0010] Furthermore, due to the fact that the differential switch is inserted upstream of all terminals, the differential threshold value beyond which the current supply is switched off is rather high, since it should account for a number of apparatuses that can be contemporaneously connected to the current sockets coupled downstream of said switch. As a consequence of this, some electrical user apparatuses can be anyway even partially damaged. By way of illustration, it can be mentioned that the plug associated to the defective apparatus generally burns out.

[0011] It is an object of this invention, therefore, to provide in simple, reliable and not expensive way a safety device that can be built in any apparatus connected to a current socket and is adapted to adjust the differential current threshold to any specific apparatus and to switch off the current supply to it without affecting the remaining apparatuses connected to the user electrical circuit, that enables any defective apparatus to be easily located and that, regardless of the cause itself of the failure, avoids any further damage thereof.

[0012] It is a further object of this invention is to provide a highly ergonomic electrical plug adapted to be optimally integrated with the apparatus coupled thereto and with the environment in which it is arranged.

[0013] It is a specific object of this invention to provide an electrical plug with built-in safety switch for use with an electrical apparatus comprising a casing, at least two terminals and a corresponding number of power supply lines for said electrical apparatus, an electrically controlled switch that couples two terminals to said power supply lines, a sensor to sense the behaviour of the current supplied to said apparatus, inserted between said switch and said apparatus, as well as an electronic control unit which receives power supply from said terminals and a signal corresponding to said sensed behaviour from said sensor and which generates control signals for said switch, said electronic control unit operating in differential mode, according to which it closes said switch at power-up and opens it when the current sensed by said sensor is higher than a differential threshold value.

[0014] According to this invention, said switch can include an electromagnetic device adapted to impart a translatory movement to a movable member and mechanical means for interaction between said movable member and two metal contacts connected to power supply lines for said electrical apparatus, each of said metal contacts being adapted to move between a first position in which it is insulated with respect to said terminals and a second position in which it is in contact with a corresponding terminal.

[0015] Further according to this invention, each of said two metal contacts can be provided with a tablet

facing a tablet of a corresponding terminal, said facing tablets being adapted to be in contact with one another in said second position in which said metal contacts and said terminals are in contact with one another.

[0016] Preferably, according to this invention, said two metal contacts are spring contacts fixed to said casing, said electromagnetic device is a coil energised by said electronic control unit, said movable member is a plunger coaxially movable within said coil and said interaction mechanical means comprise a shaped rod rotatably coupled to said casing by means of a rotation pivot and having, in correspondence to said rotation pivot, a cam adapted to cooperate with said contacts and a pin rigidly connected to the plunger of said coil and cooperating with a corresponding slot provided in said shaped rod.

[0017] Further according to this invention, the current plug can include an optical and/or acoustical indication device coupled to said electronic control unit and comprises at least a light emitting diode or LED and/or a buzzer.

[0018] Again according to this invention, said casing has, for each of said terminals rigidly connected with one another, a slot and means for rotation of said terminals within said slots and on an axis orthogonal to the terminals, between two limit positions angularly spaced apart from one another by no more than 180°, said rotation means occluding said slots in any position of said terminals.

[0019] Preferably, according to this invention, the rotation axis of said terminals passes through their tablets.

[0020] Further according to this invention, the casing of said plug comprises a central head having a right half-shell and a left half-shell hingedly connected thereto and also having a first open configuration and a second closed configuration, coupling means being provided between said central head, said right half-shell and said left half-shell.

[0021] Again according to this invention, said slots have a width equal to the diameter of said terminals in at least two points and a smaller width at any other point.

[0022] Further features of this invention will be apparent from the dependant claims.

[0023] This invention will be now described, by way of illustration, not by way of limitation, according to its preferred embodiment, by particularly referring to the Figures of the enclosed drawings, in which:

Figure 1 shows a circuit diagram of the preferred embodiment of the electrical plug according to this invention,

Figure 2 shows a top plan view of some components of the preferred embodiment of the plug according to this invention,

Figure 3 shows a side elevation view of some components of a second embodiment of the plug according to this invention,

Figure 4 shows a front elevation view of the casing

of the plug of Figure 3, in open configuration, Figure 5 shows a side elevation view of the casing of Figure 3,

Figure 6 shows a top plan view of the clamp set of the plug of Figure 3,

Figure 7 shows a side elevation view of the clamp set of the plug of Figure 3,

Figure 8 shows a front elevation view of a second embodiment of the casing of the plug, in open configuration,

Figure 9 shows a side elevation view of the casing of Figure 8.

[0024] In all Figures, similar items are designated by similar reference numerals.

[0025] By referring now to Figure 1, it can be observed that a circuit according to the preferred embodiment of the plug of this invention comprises an electrically controlled switch 1 that connects the terminals of the plug coupled to the mains voltage 2 to an electrical apparatus 3. A sensor 4 is inserted between said switch 1 and said apparatus 3 in order to sense the current supplied by the mains 2 to said apparatus 3 and furnish a corresponding signal to a control electronic unit 5. Electronic unit 5, which is directly powered from said mains 2, transmits control signals to said switch 1 and it is also connected to an indication device, that preferably includes a light emitting diode or LED.

[0026] By referring now to Figure 2, some electrical and mechanical components of the preferred embodiment of the electrical plug can be observed. Switch 1 of Figure 1 comprises, housed within a casing 7 having two terminals 8 rigidly connected thereto, a coil 9, having a coaxially movable pin 10, which is driven by said electronic control unit, such that when said coil 9 is energised, switch 1 is closed, and when said coil 9 is de-energised, switch 1 is open. Switch 1 further comprises a shaped rod 11 rotatably connected to said casing 7 by means of a rotation pivot 12, as well as two spring metal contacts 13 fixed to said casing 7, each of which has a tablet 14 correspondingly facing a tablet 15 of said terminals 8. Preferably, such tablets 14 and 15 are silvered. In particular, said two contacts 13 are coupled to the supply lines, not shown, of the concerned electrical apparatus and such supply lines are passed through the hole of a toroidal sensor designed to sense the behaviour of the current as supplied to the apparatus. Shaped rod 11 is provided with a cam 16 corresponding to said pin 12 and adapted to cooperate with contacts 13. Plunger 10 of said coil 9 has a pin 17 that cooperates with a corresponding slot 18 of said shaped rod 11.

[0027] When coil 9 is de-energised, plunger 10 is in rest position, as it is shown in Figure 2, in which cam 16 does not interact with contacts 13, so that contacts 13 are also in rest position and tablets 14 are spaced from the corresponding tablets 15 of terminals 8.

[0028] On the other hand, when coil 9 is energised, plunger 10 is attracted within coil 9 and pin 17 cooper-

ating with slot 18 transmits a clockwise rotatory movement to said shaped rod 11 and consequently to cam 16; this causes cam 16 to interact with said two contacts 13 in such a way that tablets 14 contact tablets 15 of said terminals 8, thereby establishing an electrical connection between said terminals and the supply lines for the concerned electrical apparatus.

[0029] For a better comprehension of this invention, the operation modes of the preferred embodiment of the electrical plug will be hereinbelow described and it should be understood that similar operation modes apply to other embodiments.

[0030] When the plug is inserted into a current socket, control electronic unit 5 is energised and carries out a self-control operation aimed at ascertaining that all electrical and electronic components of the plug are correctly operating. Upon completing such self-control operation with positive outcome, said electronic unit 5 energises the LED of the indication device 6, in order to indicate a correct operation of the plug, and closes switch 1, so as to establish an electrical connection between mains 2 and the supply lines of the electrical apparatus 3. The above mentioned toroidal sensor 4 detects the behaviour of the current supplied through the supply lines to said electrical apparatus 3 and, should the maximum differential threshold value be exceeded, said electronic unit 5 de-energises said coil 9 and consequently switches off the current supply to said apparatus 3 and de-energises the LED of said indication device 6. Preferably, electronic unit 5, that operates in differential mode, namely in response to an unbalance between the two phases, has an intervention or trigger current value in the range of 8 to 10 mA, maximum current.

[0031] It is immediately possible to those skilled in the art to modify the plug according to this invention so as to make it fulfil specific requirements.

[0032] By way of illustration, the plug according to this invention can be modified so as to substitute other kinds of electromagnetic devices for said coil 9.

[0033] Furthermore, it is possible to provide a third terminal permanently connected to the ground line of the electrical apparatus 3, for instance by means of a plaited wire.

[0034] In particular, in respect both of their shape and of their dimensions and applied voltage, terminals 8 can be of modified type with respect to the ones shown in Figure 2, that are of typical Italian standard, and they can be realised according to any other standard, such as U.S. or U.K. standard.

[0035] It should also be understood that the indication device can be comprised of more than one optical and/or acoustical indicator; for instance, it can comprise a first green LED to indicate a correct operation of the plug, a second red LED to indicate the open condition of switch 1 and a buzzer designed to be energised when the electronic control unit 5 causes said switch 1 to be opened.

[0036] The embodiment of Figure 2 minimises the vol-

ume of said switch 1. However, the mechanical components of switch 1 by which the double conversion of the movement is carried out, namely from a translatory to a rotatory movement and from a rotatory to a translatory movement, that is to say the shaped rod 11 and the spring contacts 13, could also be replaced by different mechanical elements adapted to directly utilise the translatory movement of said plunger 10 to establish or to interrupt the connection between terminals 8 and the supply lines of said apparatus 3.

[0037] Furthermore, the mechanical components of said switch 1, specifically the coil 9, the shaped rod 11 and the spring contacts 13 could also be replaced by power logic gates operating under control of said electronic unit 5.

[0038] Furthermore, said toroidal sensor can be replaced by any current sensor adapted to operate in differential mode.

[0039] Said electronic control unit 5, that is realised by analogue components, in the preferred embodiment, can also be realised by digital components, and it can comprise a digital signal processor and/or a microprocessor and/or a circuit programmed for this specific application or ASIC (Application Specific Integrated Circuit).

[0040] It is also possible to enable the differential threshold to be programmed at which said electronic control unit 5 triggers the switch to be opened; in particular, this can be realised in factory or directly by the user, for instance by setting suitable microswitches or dip-switches.

[0041] Additionally, said electronic control unit 5 can be operated so as to permanently open said switch 1 after said differential threshold has been exceeded a number of times.

[0042] For instance, when switch 1 is maintained in open condition after said differential threshold has been exceeded only once, electronic control unit 5 can be arranged in such a way that coil 9 is enabled by the charge stored in a capacitor that, by way of illustration, could drive the gate terminal of a suitable power MOS transistor, charged at power up of said electronic unit 5; in this case, the signal indicating that the differential threshold has been exceeded as generated by sensor 4 could energise a circuit for rapid discharge of said capacitor, so as to no more enable a current flow to energise said coil 9. If it is desired to again close said switch 1, it will be necessary to withdraw said plug from the socket, thereby switching off power supply to said electronic unit 5, and reinsert it into said socket, so as to re-charge said capacitor.

[0043] Correspondingly, when said switch 1 is maintained in open condition after said differential threshold has been exceeded two or three times, said electronic unit 5 could be realised by means of digital components. Should a short circuit condition be established in said electrical apparatus 3, said electronic unit 5 would detect the failure condition and would open said switch 1,

thereby switching off any current flow into said supply lines; consequently, sensor 4 would no more detect any failure condition and said electronic unit 5 would no more recognise any short circuit condition and would again close said switch by detecting a failure condition a second time and would permanently open switch 1, when the maximum allowed number of times the differential threshold can be exceeded is two; when closure if switch 1 is to be again enabled, also in this case, it will be necessary to withdraw the plug so as to switch off current supply to electronic unit 5 and to reinsert it into the current socket.

[0044] A second embodiment of the plug according to this invention is illustrated in Figures 3 to 7, in which only those mechanical components have been shown that are different with respect to those provided in the embodiment of Figures 1 and 2.

[0045] In the arrangement of this second embodiment, terminals 8 also comprising a third central ground terminal coupled by a plaited wire to the ground frame of the electrical apparatus 3 are rigidly coupled to one another, by means of a base member 19, and can rotate on an axis orthogonal thereto passing through said tablets 15, between two limit positions spaced apart by 90° from one another.

[0046] As it is particularly shown in Figures 6 and 7, base member 19 of said terminal set 8 has two laterally arranged shaped plates 20, whose cross section shape orthogonal to the rotation axis of said terminals 8 has a symmetry axis parallel to the axes of terminals 8 and can be obtained from a circular shape from which substantially an angular sector of 90° has been removed. Each of said shaped plates is externally provided with a protruding disc member 21.

[0047] As it has been particularly shown in Figures 4 and 5, the casing 7 of the concerned plug comprises a central head 22 having a right half-shell 23 and a left half-shell 24 hinged thereto. Each of the two end walls of head 22 has a semicircular outline 25 ending with two side pawls 26 that, when casing 7 is in closed configuration shown in Figure 3, are inserted into corresponding recesses 27 of the symmetrical outlines of the side walls of said right 23 and left 24 half-shells. In particular, the side walls of each of said half-shells 23 and 24 have a quarter of circumference outline 28 adjacent to the corresponding recess 27, so that, when casing 7 is in closed configuration incorporating said terminal set 8, they form together with the semicircular outline 25 of the wall of head 22 the edge of a circular hole which is received in a corresponding groove 29 of the associated protruding disc member 21.

[0048] Furthermore, for each terminal 8, casing 7 is provided with a slot 30 partially extending along head 22 and along said right half-shell 23.

[0049] Casing 7 is additionally provided with means for coupling the right half-shell 23 and the left half-shell 24 in their closed configuration, for instance screws inserted into corresponding holes 31 of the left half-shell

24 and cooperating with the right half-shell 23.

[0050] As it is particularly shown in Figure 3, in both limit positions that can be reached by said terminal set 8 in view of its rotation, said shaped plates 20 assure the occlusion of the slots 30, so as to guarantee non-accessibility to the inner room of the plug.

[0051] This can be realised in view of the fact that said slots 30 have vertical walls, not shown, protruding inwardly of casing 7 and having a quarter of circumference outline complementary to the outline of said shaped plates 20 of terminal set 8.

[0052] In a different embodiment, base member 19 of said terminal set 8 can also have an internally hollow, cylindrical side surface, that couples together said two shaped plates 20, so that said slots 30 enable access to an internal chamber not communicating with the internal room of the plug.

[0053] In particular, said two limit positions can be made stable by shaping the slots 30 in such a way that they have a width smaller than the internal diameter of terminals 8, with exception for the two ends, where the width of said slots 30 is equal to the diameter of terminals 8.

[0054] Casing 7 that, in the embodiments shown in Figures 3 - 7, can be repeatedly opened and closed a number of times, also for maintenance purposes, could also be realised by only two half-shells each of which incorporates one half of head 22: said half-shells could be permanently closed after having been firstly assembled, for instance by welding together the contact surfaces of said half-shells.

[0055] By referring to Figures 8 and 9, it can be observed that, in a further embodiment according to this invention, said casing 7, that can be repeatedly opened and closed, comprises a first half-shell 32, that incorporates the head of the casing, and a second half-shell 33. Said two half-shells 32 and 33 could be hingedly connected with one another and/or could be provided with coupling means, for instance screws inserted into corresponding holes, not shown, in one of the two half-shells and cooperating with the other half-shell. Said two half-shells could also be permanently closed after having been firstly assembled, for instance by welding together the contact surfaces of the half-shells.

[0056] Furthermore, said terminal set 8 as shown in Figures 3 - 7 can be provided with only two rigidly interconnected terminals 8. In this case, said two terminals 8 can be rotated between two limit positions, angularly spaced apart by 180° from one another (and, if desired, three stable positions), when said shaped plates 20 have a circular cross-section orthogonal to the rotation axis of terminals 8.

[0057] This invention has been described by way of illustration, but not by way of limitation, according to its preferred embodiment, but it should be understood that variations and/or changes can be made by those skilled in the art without departing from the scope of this invention as defined by the attached claims.

Claims

1. An electrical plug with built-in safety switch for use with an electrical apparatus (3) comprising a casing (7), at least two terminals (8) and a corresponding number of power supply lines for said electrical apparatus (3), an electrically controlled switch (1) that couples two terminals (8) to said power supply lines, a sensor (4) to sense the behaviour of the current supplied to said apparatus (3), inserted between said switch (1) and said apparatus (3), as well as an electronic control unit (5) which receives power supply from said terminals (8) and a signal corresponding to said sensed behaviour from said sensor (4) and which generates control signals for said switch (1), said electronic control unit (5) operating in differential mode, according to which it closes said switch (1) at power-up and opens it when the current sensed by said sensor (4) is higher than a differential threshold value.
2. An electrical plug according to claim 1, **characterised in that** said switch (1) includes an electromagnetic device (9) adapted to impart a translatory movement to a movable member (10) and mechanical means (11,12,16,17,18) for interaction between said movable member (10) and two metal contacts (13) connected to power supply lines for said electrical apparatus (3), each of said metal contacts (13) being adapted to move between a first position in which it is insulated with respect to said terminals (8) and a second position in which it is in contact with a corresponding terminal (8).
3. An electrical plug according to claim 2, **characterised in that** each of said two metal contacts (13) has a tablet (14) facing a tablet (15) of a corresponding terminal (8), said facing tablets (14,15) being adapted to be in contact with one another in said second position in which said metal contacts (13) and said terminals (8) are in contact with one another.
4. An electrical plug according to claim 3, **characterised in that** the tablets (14,15) of said two metal contacts (13) and of said terminals (8) are silvered.
5. An electrical plug according to any one of claims 2 to 4, **characterised in that** said two metal contacts (13) are spring contacts fixed to said casing (7), **in that** said electromagnetic device is a coil (9) energised by said electronic control unit (5), **in that** said movable member is a plunger (10) coaxially movable within said coil (9), and **in that** said interaction mechanical means (11,12,13,16,17,18) comprise a shaped rod (11) rotatably coupled to said casing (7) by means of a rotation pivot (12) and having, in correspondence to said rotation pivot (12), a cam (16) adapted to cooperate with said contacts (13), and a pin (17) rigidly connected to the plunger (10) of said coil (9) and cooperating with a corresponding slot (18) provided in said shaped rod (11).
6. An electrical plug according to claim 1, **characterised in that** said switch (1) includes power logic gates driven by said electronic control unit (5).
7. An electrical plug according to any one of the preceding claims, **characterised in that** said sensor for sensing the behaviour of the current supplied to said electric apparatus (3) is a toroidal sensor (4) into which the supply lines for said electrical apparatus (3) are inserted.
8. An electrical plug according to any one of the preceding claims, **characterised in that** said differential threshold is programmable.
9. An electrical plug according to claim 8, **characterised in that** said differential threshold is programmable by setting microswitches or dip-switches.
10. An electrical plug according to any one of the preceding claims, **characterised in that** said electronic control unit (5) sends commands for permanent opening of said switch (1) after said differential threshold has been exceeded a pre-established number of times as long as said unit (5) is connected to power supply by said terminals (8).
11. An electrical plug according to claim 10, **characterised in that** said electronic control unit (5) includes a capacitor that is charged at power-up of said electronic control unit (5) and that, in charged condition, drives the gate terminal of a power MOS transistor in order to enable said switch (1) to be closed, and **in that**, when said differential threshold is exceeded, a circuit for rapid discharge of said capacitor is activated in order to disable said gate terminal of said power MOS transistor.
12. An electrical plug according to any one of claims 1 to 10, **characterised in that** said electronic control unit (5) comprises a digital signal processor and/or a microprocessor and/or a circuit programmed for this specific application or ASIC (Application Specific Integrated Circuit).
13. An electrical plug according to any one of the preceding claims, **characterised in that** it further includes an optical and/or acoustical indication device (6) coupled to said electronic control unit (5).
14. An electrical plug according to claim 13, **characterised in that** said indication device (6) comprises at least a light emitting diode or LED and/or a buzzer.

15. An electrical plug according to any one of the preceding claims, **characterised in that** it operates with a trigger current in the range of 8 to 10 mA.
16. An electrical plug according to any one of the preceding claims, **characterised in that** it includes a third terminal (8) permanently connected to a supply line for said electrical apparatus (3).
17. An electrical plug according to any one of claims 1 to 15, **characterised in that** said casing (7) has, for each of said terminals (8) rigidly connected with one another, a slot (30) and means (20,21,25,28,29) for rotation of said terminals (8) within said slots (30) and on an axis orthogonal to the terminals, between two limit positions angularly spaced apart from one another by no more than 180°, said rotation means (20, 21, 25, 28,29) occluding said slots (30) in any position of said terminals (8).
18. An electrical plug according to claims 3 and 17, **characterised in that** the rotation axis of said terminals (8) passes through their tablets (15).
19. An electrical plug according to claim 17 or 18, **characterised in that** said rotation means (20, 21, 25, 28,29) for said terminals (8) comprise two shaped lateral plates (20) rigidly connected to said terminals (8) and having an outwardly protruding disc (21) provided with a groove (29) into which the edge (25,28) of a circular hole is inserted, said edge being rigidly connected to said casing (7).
20. An electrical plug according to claim 19, **characterised in that** it is provided with two terminals (8) rotatably movable between two limit positions angularly spaced apart by 180° from one another, said shaped plates (20) having a circular cross-section orthogonal to the rotation axis of said terminals (8).
21. An electrical plug according to claim 19, **characterised in that** it is provided with three terminals (8), one of which is permanently coupled to the power supply line of said electrical apparatus (3), said terminals (8) being rotatably movable between two limit positions angularly spaced apart by 90° from one another, the cross-section shape of said shaped plates (20) orthogonal to the rotation axis of said terminals (8) having a symmetry axis parallel to the axes of said terminals and being obtained from a circular shape from which substantially an angular sector of 90° has been removed.
22. An electrical plug according to any one of claims 17 to 21, **characterised in that** the casing (7) of said plug comprises a central head (22) having a right half-shell (23) and a left half-shell (24) hingedly connected thereto and also having a first open configuration and a second closed configuration, coupling means (26,27) being provided between said central head (22), said right half-shell (23) and said left half-shell (24).
23. An electrical plug according to any one of claims 19 to 21 and claim 22, **characterised in that** the edge of said circular hole rigidly connected to said casing (7) is formed, when said casing is in closed configuration, by the side walls of said central head (22), of said right half-shell (23) and of said left half-shell (24), said coupling means between said central head (22) and said right (23) and left (24) half-shells comprising two side pawls (26) arranged on each of said two side walls of said head (22), said pawls cooperating with corresponding recesses (27) provided in the side walls of said right (24) and left (24) half-shells.
24. An electrical plug according to any one of claims 17 to 21, **characterised in that** the casing (7) of said plug comprises a first half-shell (32) that incorporates the head of the casing, a second half-shell (33) and coupling means between said half-shells (32,33).
25. An electrical plug according to claim 24, **characterised in that** said half-shells (32,33) are hingedly connected to one another.
26. An electrical plug according to any one of claims 17 to 25, **characterised in that** said slots (30) have a width equal to the diameter of said terminals (8) in at least two points and a smaller width at any other point.

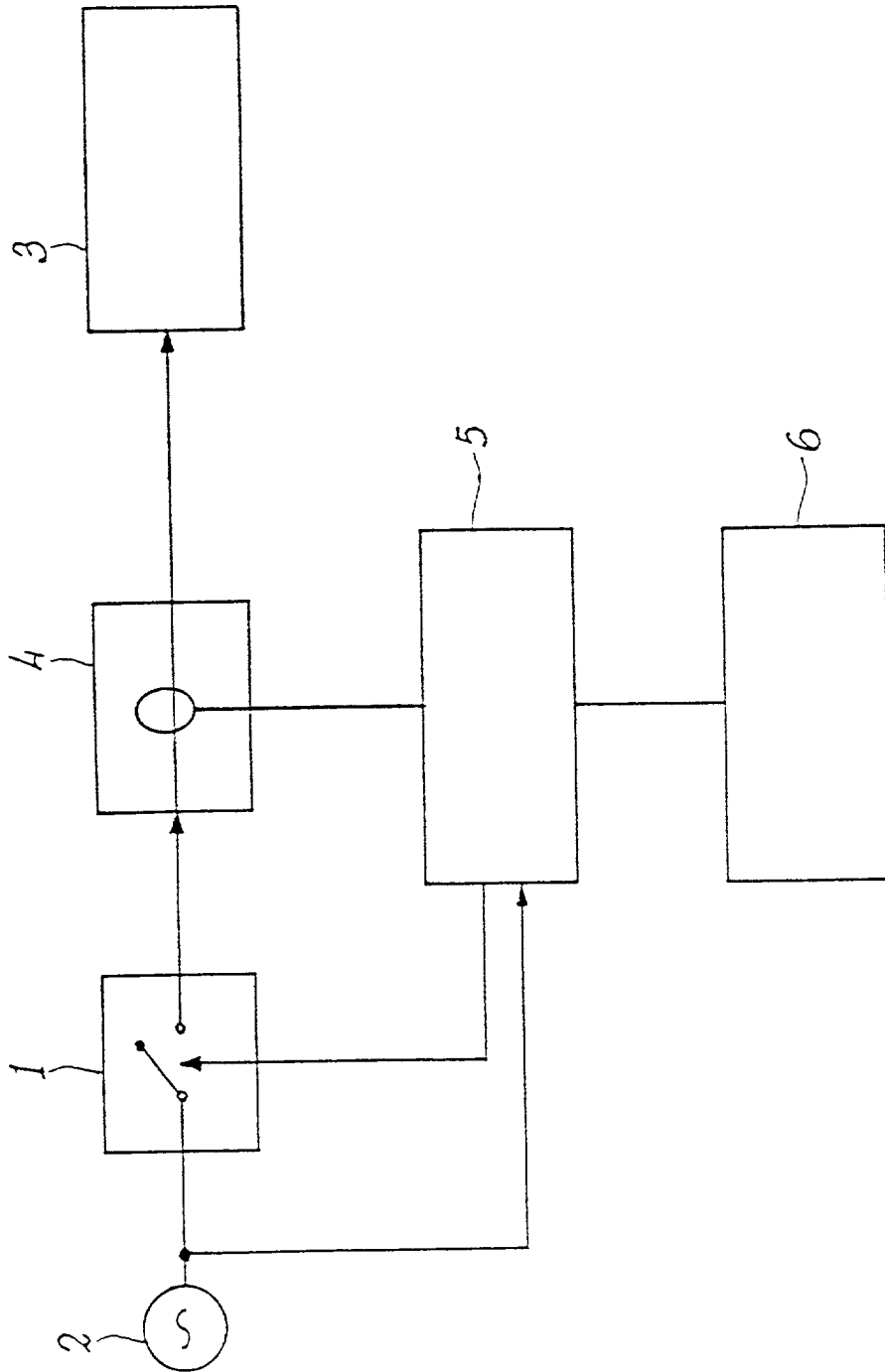


FIG. 1

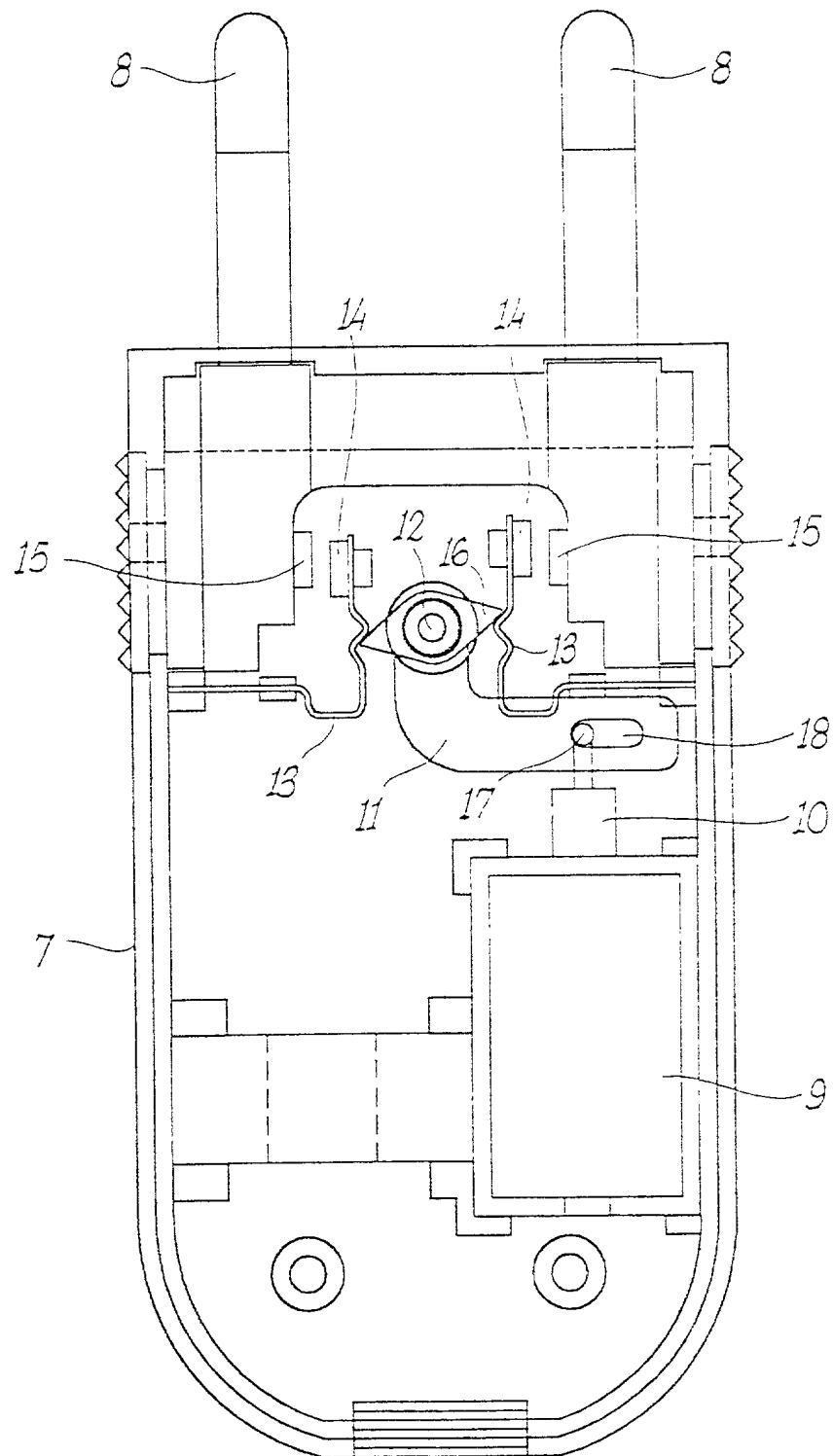


FIG. 2

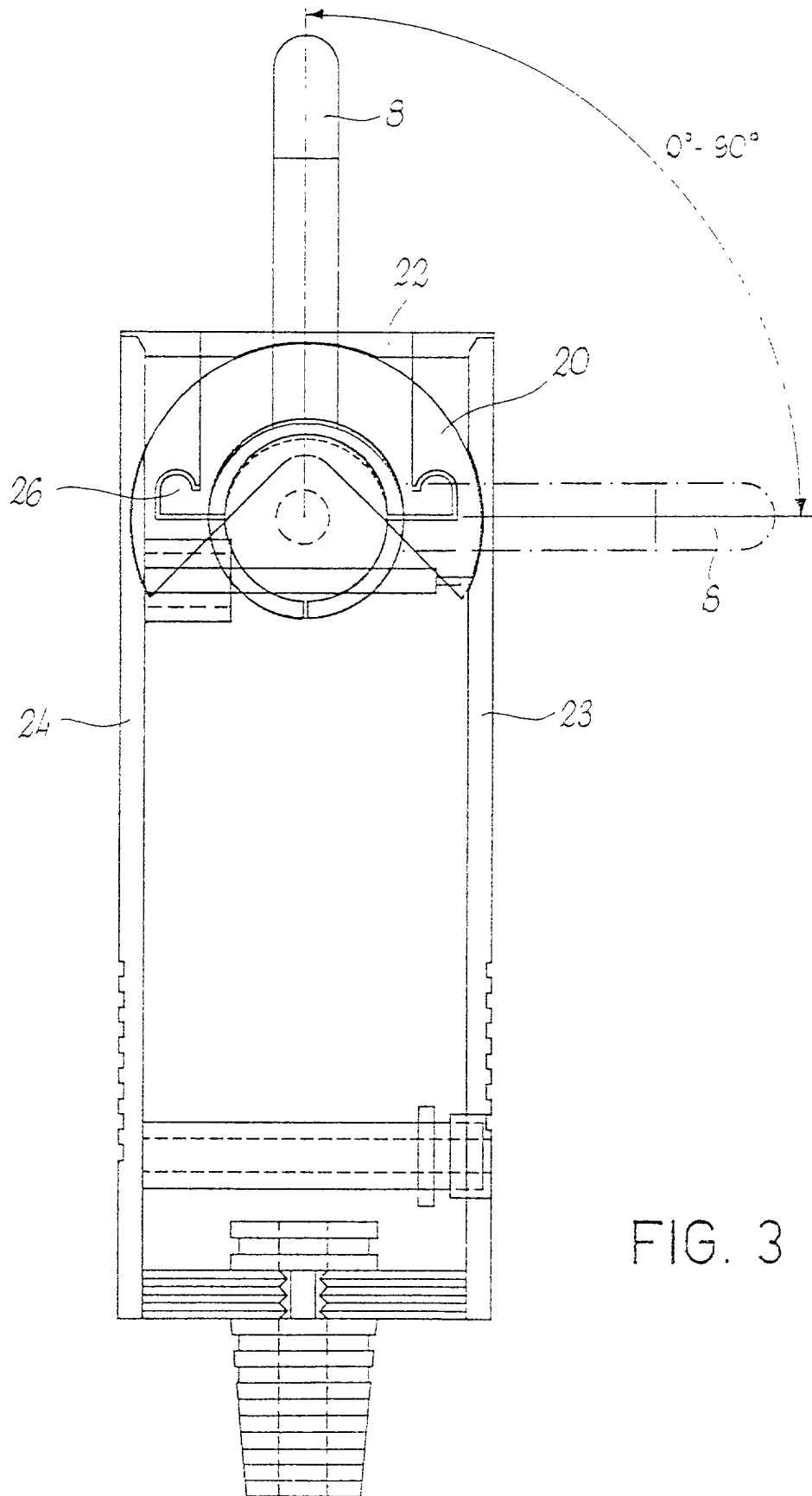


FIG. 3

FIG. 4

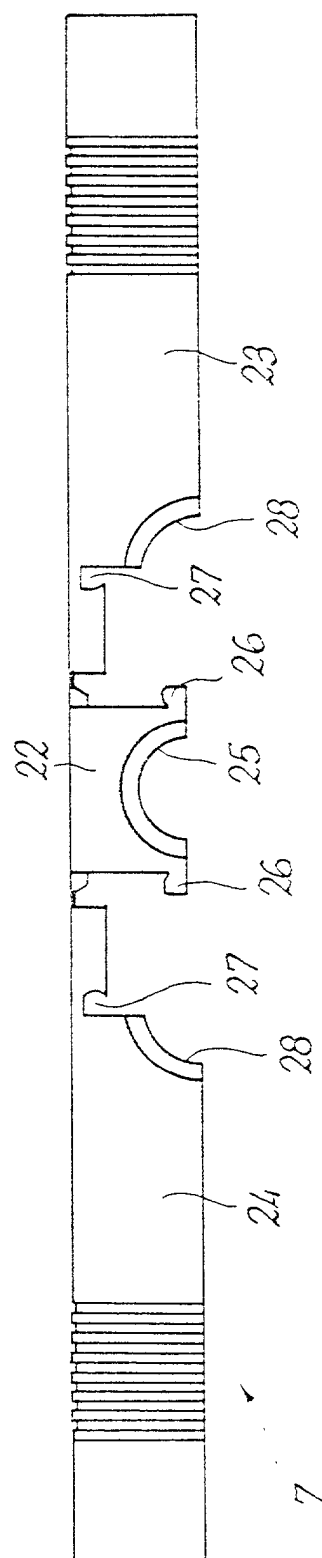
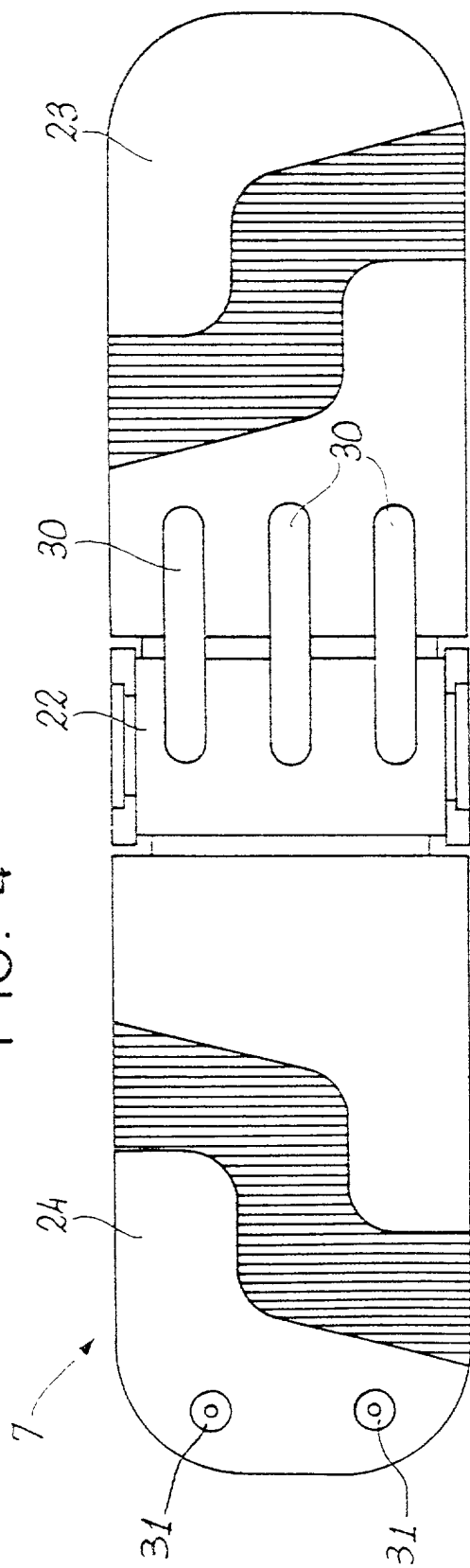
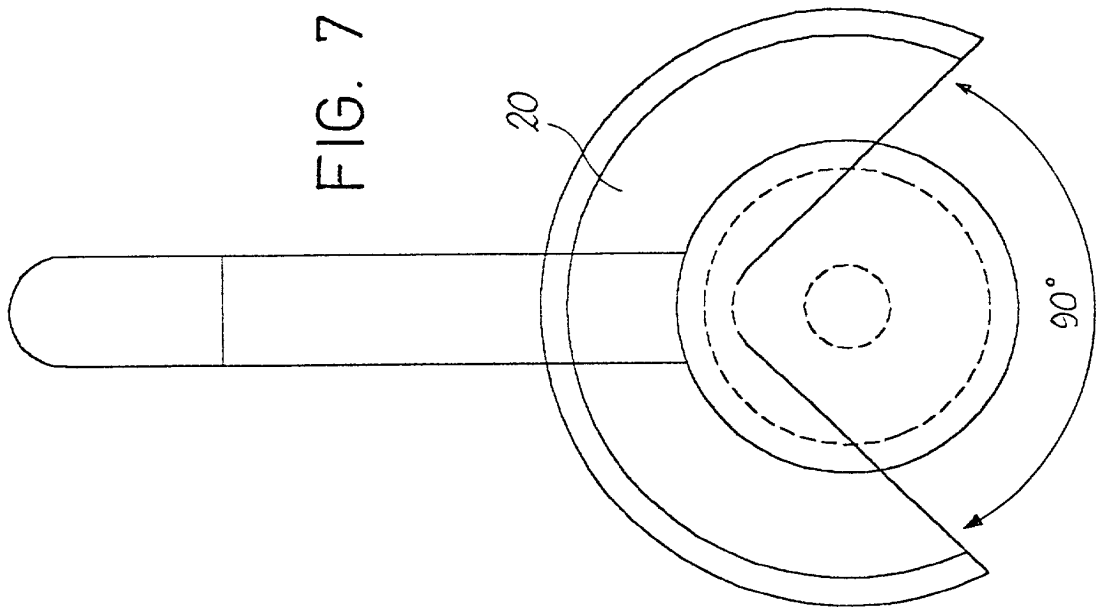
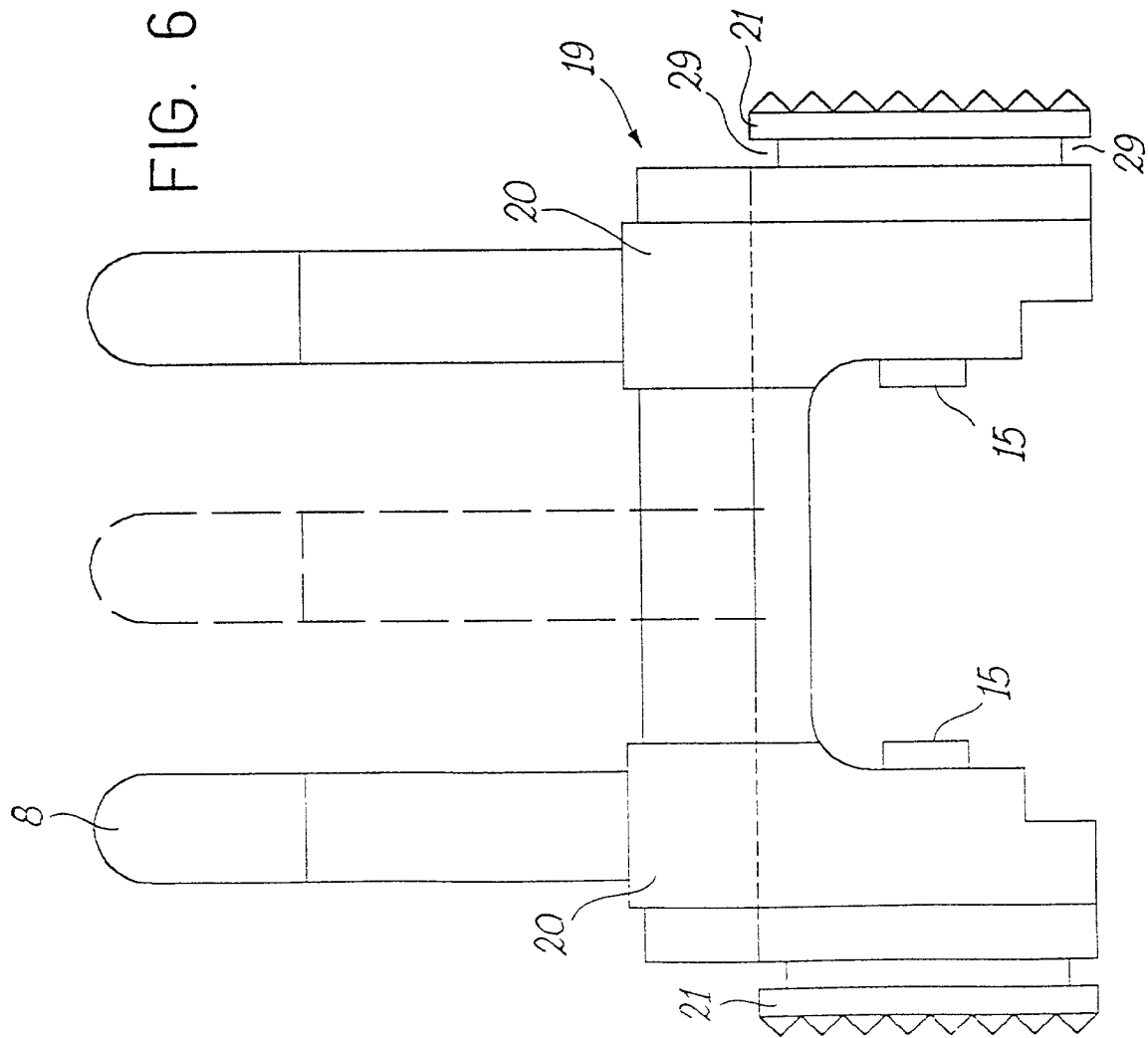
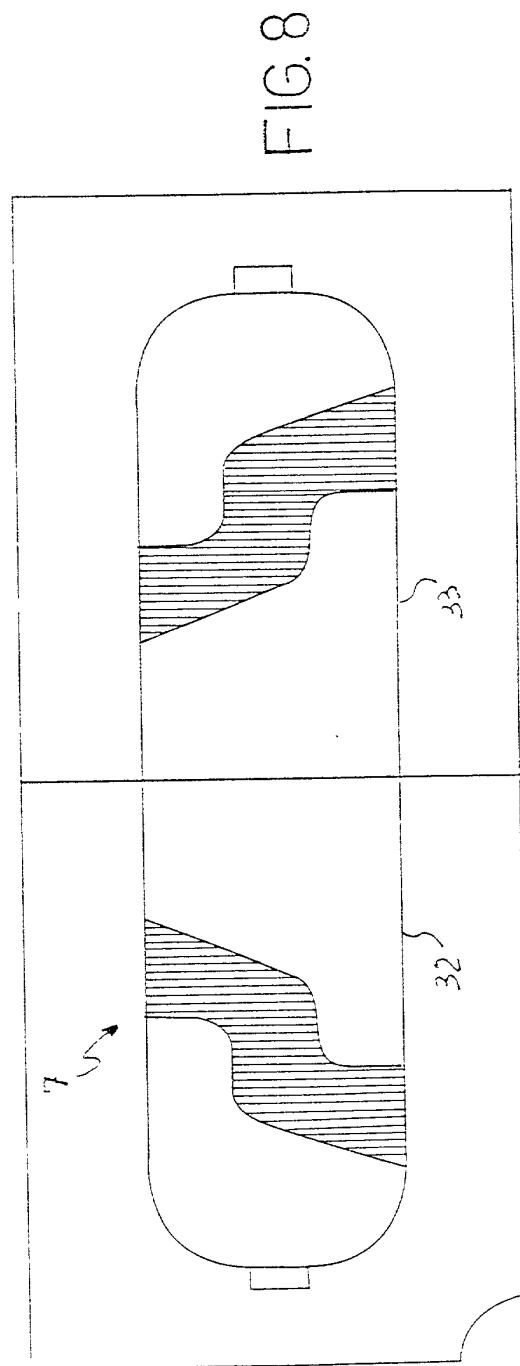
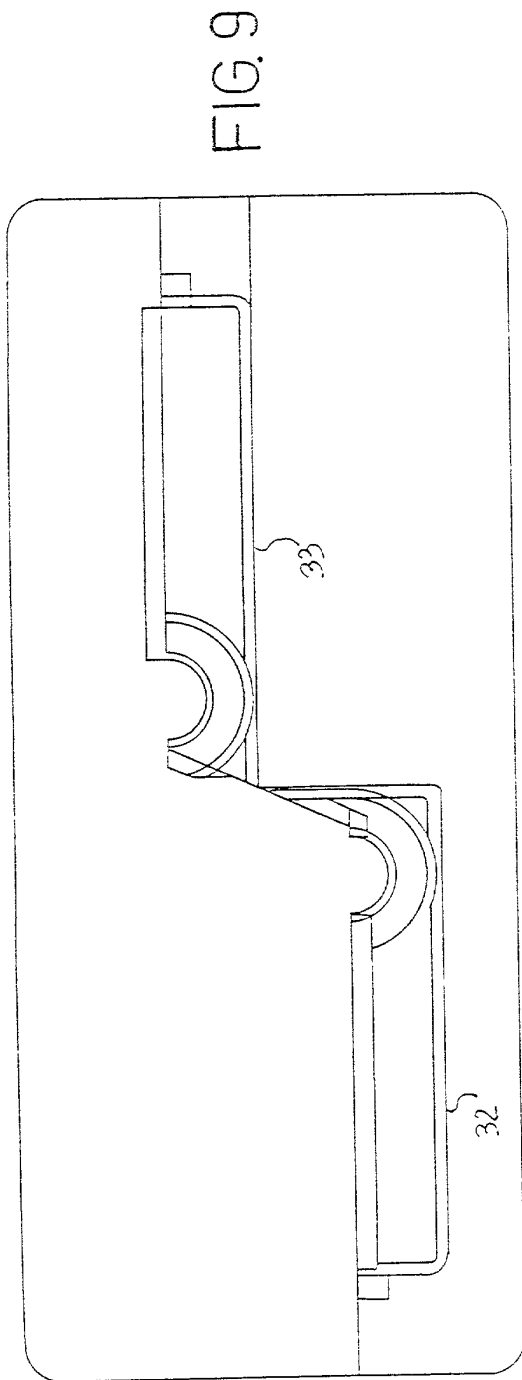


FIG. 5







European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0702

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Place of search THE HAGUE		Date of completion of the search 18 January 2001	Examiner Waern, G
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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