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(54) Modular device for piezoelectric selection of control elements, such as the needles of a knitting machine or similar

Modulare Vorrichtung für Piezoelektrische Auswahl von Steuerelementen, wie die Nadeln einer Strickmaschine oder dergleiche

Dispositif modulaire pour la sélection piezoélectrique d'éléments de commande, comme les aiguilles d'un métier à tricoter ou similaire

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EP 0 964 092 B1

Description

[0001] The present invention relates to a modular device for piezoelectric selection of control elements, such as the needles of a knitting machine or similar.

[0002] Knitting machines and similar normally comprise a number of parallel needles carried by a support movable back and forth parallel to the needles. Depending on the knitting pattern, the needles are selected to move or not with the support by means of a corresponding number of selection levers. Each lever is activated by a corresponding actuator to assume either of two positions, in which an appendix of the lever is engaged or not by the respective needle; and the levers are normally arranged to form a module enclosed in a respective casing for high-density packing the levers and respective actuators.

[0003] To reduce the size and response time of the actuators, selection devices of the above type have been proposed in which the actuator is piezoelectric with one end fixed to a respective base and the other end connected in articulated manner to the respective selection lever. Each actuator carries a central electrode and two lateral electrodes, which are connected to a drive circuit via an output connector.

[0004] As piezoelectric actuators, when not supplied, assume a neutral position, a drawback of known piezoelectric needle selection devices lies in the neutral position of the selection levers not normally being aligned with the actuators, on account of the manufacturing and assembly tolerances of the components. This results in asymmetric displacement of the levers between the two limit positions, which reduces the actuating rate and may result in incorrect needle selection.

[0005] Moreover, the electric connections to the output connector of known selection devices normally take a fairly long time to produce; when servicing or repairing a module, the component parts are difficult and expensive to replace; and, finally, the module casing is still invariably bulky.

[0006] From the document EP 0 796 939 A, it is known a piezoelectric needle selection device for knitting machines, including a plurality of piezoelectric actuators, each one connected to a corresponding selection lever. Each actuator is operated by an electric control circuit to be moved between a central neutral position and two opposite operational positions. No position adjusting device between the pivots of selection levers and the actuators is provided therein.

[0007] It is an object of the invention to provide a modular device for piezoelectric selection of control elements, which is extremely straightforward and reliable, and eliminates the aforementioned drawbacks typically associated with known devices. In particular, it is an object of the invention to provide a selection device enabling maximum component miniaturization, and which is easy to produce and quick to assemble and disassemble with no special tools required.

[0008] According to the present invention, there is provided a modular device for piezoelectric selection of control elements, comprising a number of levers for selecting said control elements, said levers rotating about a corresponding number of parallel pivots; a number of piezoelectric actuators, each having one end connected to one of said levers and another end fitted to a corresponding base, each of said actuators being energizable to selectively cause the corresponding lever to effect a given travel between a rest position in which the control element is not selected, and a work position in which the control element is selected; and a casing for said levers, said actuators and said base; characterized in that said casing carries adjusting means including at least one eccentric pin adapted to be manually rotated for adjusting the relative position of the base of at least one of said actuators with respect to the pivot of the corresponding lever.

[0009] According to further aspect of the invention, each of said actuators carries a central electrode and two lateral electrodes; said electrodes being defined by rigid parallel first pins fittable to corresponding bushes carried by an adapter to electrically connect said electrodes to a drive circuit for driving said actuators. In particular, said adapter comprises a multiple connector defined by rigid parallel second pins. arranged differently from said first pins; said first pins and said second pins being connected to one another by means of at least one printed-circuit board to which said bushes are fitted.

[0010] Two preferred, non-limiting embodiments of the invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a partially sectioned front view of a first embodiment of a modular device for piezoelectric selection of control elements in accordance with the invention;

Figure 2 shows a larger-scale view along line II-II in Figure 1;

Figure 3 shows a larger-scale partial section along line III-III in Figure 1;

Figure 4 shows a partial section along line IV-IV in Figure 3;

Figures 5 and 6 show two top plan views of two printed-circuit boards of the selection device;

Figure 7 shows a partially sectioned front view of a further embodiment of a device for piezoelectric selection of control elements in accordance with the invention;

Figure 8 shows a section along line VIII-VIII in Figure 7;

Figure 9 shows a diagram of an electric circuit of a piezoelectric actuator of the selection device;

Figures 10a and 10b show the electromechanical behaviour of a piezoelectric actuator;

Figure 11 shows a graph of the electromechanical behaviour of the piezoelectric actuator.

[0011] Number 5 in Figure 1 indicates as a whole a modular device for piezoelectric selection of a number of control elements, e.g. the needles of a knitting machine or similar. Device 5 comprises a number of, e.g. eight, selection levers 6 aligned with one another and rotating about a number of parallel, equally spaced pivots 7. In particular, each lever 6 comprises a cam selection element 8 made of hardened steel and which is engaged by a corresponding needle 9 of the machine.

[0012] Each element 8 is molded to one end of a bar 10 made of plastic material, preferably thermoplastic resin with a low coefficient of friction and of high resistivity. The thermoplastic resin may be filled with glass fibers, and may comprise, for example, Nylon (registered trademark) or PPS with a Teflon (registered trademark) filler. Bar 10 has a hole 11 in which is inserted for rotation a fixed pin 12.

[0013] According to a first embodiment of the invention, device 5 comprises a metal frame 13, e.g. of light alloy or extruded aluminium, worked to comprise two top cross members 14 and two bottom cross members 15 connected by two sides 29. Pins 12 are force-fitted inside respective holes formed in cross members 14 and equally spaced 2 to 10 mm, e.g. 5 mm, apart. The end of bar 10 opposite the end fitted with element 8 comprises two fork-shaped appendixes 16, 17 between which is engaged in articulated manner one end of a piezoelectric actuator 18.

[0014] Each actuator 18 (Figures 10a and 10b) is defined by a central metal plate 19 fitted with two rectangular layers 20 and 21 of a ceramic, e.g. bimorph ceramic, which deforms when energized electrically; and the two layers 20 and 21 each have an insulating layer with an opening by which to connect layers 20 and 21 electrically, so that each actuator 18 comprises a central electrode 19' carried by an appendix 39 (see also Figure 3) of plate 19, and two lateral electrodes 20', 21' formed by the openings in the respective insulating layers of layers 20 and 21.

[0015] The end of actuator 18 opposite the end engaging appendixes 16 and 17 is inserted inside a slot 22 (Figure 4) in a base 23 made of plastic material and to which the end of the actuator is fixed, for example, by means of glue. Base 23 is prismatic in shape for high-density packing, and comprises two pairs of appendixes 24 (Figure 3) which engage respective slots 25 in two walls 26 and 28 of stainless steel or plastic material. Walls 26 and 28 are fitted to the two sides 29 by means of four screws 30 (Figure 1) to form, with frame 13, a casing 31 housing levers 6, actuators 18 and bases 23.

[0016] Casing 31 is closed at the top by a sheet metal comb 27 connected to casing 31 by means of four screws 33; comb 27 comprises a number of slots 34 in which are inserted cam elements 8 of selection levers 6; and the width of slots 34 determines the travel of elements 8 between two limit positions which may be from 1 to 3 mm apart.

[0017] In Figure 1, the first lever 6 on the left is shown by the continuous line in a work position in which element 8 engages respective needle 9, and by the dash line in a rest position in which needle 9 is not engaged by element 8; and the other seven levers 6 are shown in the central, i.e. neutral, position corresponding to the nonenergized state of actuator 18.

[0018] The bottom end of casing 31 is closed by a support or multiple connector 35 made of insulating material and having two appendixes 36 connected to sides 29 of frame 13 by means of two screws 37. The three electrodes 19' , 20', 21' of each actuator 18 are connected electrically to three rigid pins, i.e. a central pin 38 (on the left in Figure 3) welded to central electrode 19', and two lateral pins 40 and 41 (center and right in Figure 3) welded to lateral electrodes 20' and 21'. Pins 38, 40, 41 are welded in known manner to electrodes 19', 20', 21' at three openings 42 in base 23, and project from the bottom of base 23 by respective portions 43 of equal length. Therefore, the three groups of eight pins 38, 40, 41 of actuators 18 are arranged in three separate rows, the pins 38, 40 and 41 in each row being spaced with the same spacing as actuators 18.

[0019] Actuators 18 are driven by an electronic circuit 75 (Figure 9) described in detail later on, and which requires that lateral pins 40 and 41 be connected electrically to two common conductors, and that central pins 38 be electrically connected singly. Multiple connector 35 provides for connecting device 5 to the electronic drive circuit, and comprises a series of fifteen identical pins 46 (see also Figure 2) molded to the body of connector 35 so as to project upwards. Pins 46 are arranged in two rows with a predetermined or standard spacing, for example, of 2.5 to 3.5 mm, and, in each row, with a standard spacing, for example, of 2 to 3 mm, and are protected by a metal shield 45 connected to connector 35 by means of bolts 44.

[0020] Pins 38, 40, 41 are connected electrically to pins 46 by an adapter indicated as a whole by 32 and comprising at least one printed-circuit board 47 having a number of bushes 48 for receiving the ends of pins 38, 40, 41. Bushes 48 are of the type used to connect microchips on printed circuits, with an inside diameter of about 0.5 mm, and are welded individually to board 47 in known manner.

[0021] Bushes 48 corresponding to pins 40 and 41 are connected electrically by two corresponding printed-circuit conductors 49 and 50 (Figure 5), and bushes 48 corresponding to pins 38 are insulated electrically from one another. Board 47 with bushes 48 (Figures 3 and 4) is glued or ultrasonically welded to a support 51 made of plastic material and comprising a number of holes 52, each for housing a bush 48, and a bottom edge 53 for engaging an edge 54 of connector 35. Each of bushes 48 for the row of central pins 38 comprises a downward-projecting pin 55, whereas only one of bushes 48 for each row of lateral pins 40 and 41 comprises a projecting pin 55.

[0022] Adapter 32 also comprises a second printed-

circuit board 56 having a number of bushes 58 (Figure 3) identical to the bushes 48 with no projecting pins 55; connector 35 comprises a number of dead holes 57 for housing bushes 58; board 56 is fitted to connector 35 in the same way as board 47 to support 51; and bushes 58 of board 56 may be fifteen in number, if all the pins 46 of multiple connector 35 are to be used. In the case of a selection device with eight actuators 18, however, ten bushes 58 for receiving pins 55 of bushes 48 are sufficient.

[0023] The top ends of pins 46 fit through board 56 and are welded on top to respective pads on the printed circuit. The printed circuit comprises two conductors 59 and 61 (Figure 6) for connecting the two bushes 58 of the rows of lateral pins 40 and 41 to the pads of two corresponding pins 46; a number of conductors 62 for connecting the bushes 58 of the row of central pins 38 (at the top in Figure 6) ; and a ground pad 60 to which is welded a cable 70 (see also Figure 4) electrically contacting frame 13. Ground pad 60 is connected by a conductor 63 to the pad of a further pin 46.

[0024] The two sides 29 (Figure 1) of frame 13 are connected to walls 26 and 28 by manual adjusting means comprising an eccentric pin 64 pivoting eccentrically on one of sides 29. The eccentricity of pin 64 may be 0.1 to 1 mm, and is preferably 0.3 mm; each of the two walls 26, 28 comprises a hole 69 engaged by pin 64; pin 64 comprises a head 65 engageable by a screwdriver; and rotation of pin 64 may be partially prevented by applying adhesive resin between pin 64 and hole 69.

[0025] Two holes in sides 29 are fitted with two elements or pins 66 projecting on both sides and each engaging a pair of guide slots 67 provided on walls 26 and 28. Slots 67 enable frame 13 to be moved with respect to walls 26, 28 and perpendicularly to actuators 18 to adjust at-rest alignment of actuators 18 with respect to selection levers 6. To fix walls 26 and 28 to frame 13, walls 26 and 28 are provided with holes 68 of such a diameter as to permit adjustment before tightening screws 30.

[0026] Modular device 5 for selecting needles 9 is assembled and adjusted as follows.

[0027] To begin with, bars 10 of levers 6 are placed between top cross members 14; pins 12 are inserted inside holes 11 in bars 10 and fitted into cross members 14 of frame 13; cam elements 8 are inserted inside slots 34 on comb 27; comb 27 is fitted to frame 13 by means of screws 33; and wall 28 is fitted to sides 29 of frame 13 without tightening down respective screws 30.

[0028] Actuators 18 are then inserted inside frame 13 by engaging two appendixes 24 of each base 23 inside slots 25 in wall 28, and the free end of each actuator 18 between appendixes 16 and 17 of respective bar 10 ; wall 26 is fitted to frame 13 so that the other two appendixes 24 of each base 23 are inserted inside slots 25 in wall 26; and wall 26 is fitted to sides 29 without tightening down respective screws 30.

[0029] To assemble adapter 32, board 47 with bushes 48 is first fitted to support 51 (Figure 4); board 56 with pins 46 and bushes 58 is fitted to connector 35; shield 45 for protecting pins 46 is fitted to connector 35; and support 51 is connected to connector 35 by inserting pins 55 of bushes 48 on board 47 inside bushes 58 on board 56 so that edge 53 of support 51 mates with edge 54 of connector 35. Support 51 may also be glued or welded to connector 35.

[0030] The assembly defined by connector 35 and support 51 is then inserted between sides 29 of frame 13 by inserting pins 38, 40, 41 of actuators 18 inside bushes 48 on board 47 so that appendixes 36 of connector 35 rest against sides 29 of frame 13; and connector 35 is fitted to sides 29 by means of screws 37.

[0031] The position of actuators 18 with respect to selection levers 6 is adjusted by engaging head 65 (Figure 1) of eccentric pin 64 with a screwdriver, and appropriately rotating eccentric pin 64. As explained in detail later on, adjustment may be controlled by means of mechanical, electrical or electronic measuring devices. In which case, at least one of actuators 18 is energized to move the actuator from the neutral position to one and then the other of the two limit positions, and the displacement of element 8 is controlled on a monitor. Pin 64 must be rotated so that, as far as possible, element 8 moves by the same amount in both directions. Adjustment may also be controlled with reference to two or more actuators 18 to determine an average as similar a movement as possible of elements 8 in both directions. Once the adjustment has been made, screws 30 are tightened down to fix walls 26, 28 to frame 13.

[0032] In the Figure 7 and 8 embodiment, selection device 5 comprises a casing 31' housing sixteen piezoelectric actuators 18 equally spaced, for example, 4 mm apart. A bottom portion 76 of casing 31' houses electronic circuitry and the electric connections both to actuators 18 and to an electronic governor of the machine. In this case, each actuator 18 is connected directly to a terminal 77 contacting central electrode 19' of plate 19, and to two terminals 77 contacting lateral electrodes 20' and 21' of the two layers 20 and 21 of actuator 18, in the same way as pins 38, 40, 41 in Figure 3.

[0033] The three terminals 77 are carried by three cables 80 (Figure 8) terminating at a connector 81 welded to a printed-circuit board 82, which has drive circuits 75 (see also Figure 9), and an output connector 83 for connection to the governor of the machine. The base 23' of each actuator 18 is hinged by two pins 84 to two holes in walls 26', 28' of casing 31'.

[0034] To adjust the relative position between each actuator 18 and the corresponding selection lever 6, one end 86 of base 23' has a groove 87 housing an eccentric pin 88 rotating on walls 26' , 28' and having a head 89 engageable by a screwdriver. Each base 23' also has a lock screw 90 for securing base 23' to casing 31' following adjustment, which is made individually for each base 23' in the same way as frame 13 in the Figure 1-6 embodiment.

[0035] The distance between groove 87 and pin 84 is substantially equal to the distance between pin 84 and fork-shaped appendixes 16, 17 of bar 10 of lever 6, so that, with a 0.3 mm eccentricity of pin 88, the articulated joint between actuator 18 and lever 6 may be moved 0.3 mm, which is sufficient for any adjustment of the relative position between actuator 18 and the corresponding lever 6.

[0036] Conventional drive circuits of a piezoelectric actuator 18 are normally such that a positive voltage of predetermined value is applied, for example, to electrode 21' to the right of central electrode 19' to move the corresponding selection lever 6 into the rest position (Figure 10a), and a negative voltage of the same value is applied to electrode 20' to the left of central electrode 19' to move lever 6 into the work position (Figure 10b).

[0037] The drive circuit 75 (Figure 9) of the invention is improved with respect to conventional drive circuits, and provides for connecting the right electrode 21' of actuator 18 permanently to a positive voltage, e.g. +200VDC, while the left electrode 20' is permanently grounded and the central electrode 19' is selectively connected to the positive voltage or grounded (see also Figures 10a and 10b). In the absence of positive voltage and in the presence of a command, actuator 18 assumes a neutral position as shown by the dotted line in Figures 10a and 10b.

[0038] Drive circuit 75 comprises an input IN supplied by the control unit with a command to select needle 9; and an output OUT connected to central pin 38 (Figure 4) or central terminal 77. Input IN is connected both to a LED cathode K of a solid-state relay 91 and to a network R1, C1; one terminal of capacitor C1 is connected to a logic ground 92; resistor R1 is connected parallel to a diode D1; and the other terminal of capacitor C1 is connected both to resistor R1 and to the input of a latch 93 for regenerating the signal edge.

[0039] The output of latch 93 is connected via a resistor R2 to a voltage +Vdc (e.g. +5V) and via a resistor R3 to the base of a transistor T1, the emitter of which is grounded; the LED anode A of relay 91 is connected via a resistor R4 to voltage +Vdc; relay 91 has an output collector C connected to positive voltage +200VDC; and the emitter E of relay 91 is connected via a resistor R5 to the collector of transistor T1 and to output OUT.

[0040] When needle 9 is not selected, input IN is at a high logic level, so that transistor T1 conducts and grounds central electrode 19'; and relay 91 is open and isolates transistor T1 from voltage +200VDC as shown in Figure 10b. To select needle 9, input IN is switched to a low logic level, so that transistor T1 is disabled and relay 91 closes to connect output OUT, and hence central electrode 19', to positive voltage +200VDC. When input IN switches back to a high logic level, transistor T1 begins conducting again with a given delay with respect to the opening of relay 91 to ensure resistor R5 is disconnected from the positive voltage.

[0041] Adjusting the position of actuators 18 with respect to selection levers 6 comprises adjusting the travel of levers 6 between the rest and work positions defined by the two edges of respective slots 34 of comb 27. With reference to Figure 11, curve 74 shows the passage from 0 to +200VDC of the voltage V at central electrode 19' of actuator 18 as a function of time t; and curve 71 shows the displacement of the end of cam element 8 of lever 6 produced by energizing actuator 18, which displacement S is detected by a known, e.g. magnetic, optical or capacitive, sensor.

[0042] As of the rest position of cam element 8 of lever 6, energizing of actuator 18 commences at a first instant t1, and cam element 8 reaches the work position at a second instant t2 with a first delay t2-t1 of about 2-3 ms indicated by 72 in Figure 11. Similarly, commencing deenergizing of actuator 18 at a third instant t3, at which the voltage V at central electrode 19' passes from +200VDC to 0, cam element 8 reaches the rest position at a fourth instant t4 with a second delay t4-t3 indicated by 73 in Figure 11.

[0043] A symmetrical condition, in which first delay 72 equals second delay 73, is the preferred adjustment condition between actuator 18 and the corresponding selection lever 6. To adjust the position, therefore, eccentric pin 64 (Figure 1) and eccentric pins 88 (Figure 7) must be rotated to get as close as possible to the above symmetric condition.

[0044] The method of adjusting the relative position between at least one selection lever 6 and the corresponding piezoelectric actuator 18 comprises the following steps.

[0045] A first step wherein actuator 18 is energized as of a first instant t1 to move lever 6 from the rest to the work position; a second step wherein a first delay 72 between first instant t1 and a second instant t2, at which lever 6 reaches the work position, is detected; a third step wherein actuator 18 is deenergized as of a third instant t3 to move lever 6 from the work to the rest position; a fourth step wherein a second delay 73 between third instant t3 and a fourth instant t4, at which lever 6 reaches the rest position, is detected; and a fifth step wherein the position of actuator 18 with respect to lever 6 is adjusted so that first delay 72 equals second delay 73.

[0046] The advantages, as compared with known devices, of selection device 5 according to the invention will be clear from the foregoing description. In particular, adjusting the position of actuators 18 with respect to levers 6 provides for eliminating various position errors caused by assembly and manufacturing tolerances. Moreover, the method of adjustment, by determining the delays of actuator 18, eliminates the need for complex mechanical measurements.

[0047] Moreover, device 5 in Figure 1 enables use of a standard connector 35, thus simplifying electrical connection to the drive circuits; adapter 32 between pins 38, 40, 41 of actuators 18 and pins 46 of connector 35 provides for troublefree fitment/removal of adapter 32

to/from device 5; and the structure of casing 31 with frame 13 and two walls 26 and 28 provides for trouble-free assembly and disassembly of actuators 18 and levers 6, which may in fact be assembled and disassembled simply using a screwdriver.

[0048] Clearly, changes may be made to the selection device as described herein without, however, departing from the scope of the accompanying Claims. For example, changes may be made to the spacing of pins 46 of connector 35 or to the number of levers 6 and actuators 18 in the module; adapter 32 may comprise only one printed-circuit board, which in turn may comprise both circuits, one on each face, and both bushes 48 and pins 46; solid-state relay 91 of drive circuit 75 may be a transistor type or optoelectronic; actuators 18 may also be adjusted individually in the Figure 1-6 embodiment; and, finally, selection device 5 may be applied to other types of machines or equipment requiring high-frequency control element selection.

Claims

1. A modular device for piezoelectric selection of control elements, comprising a number of levers (6) for selecting said control elements (9), said levers (6) rotating about a corresponding number of parallel pivots (7); a number of relevant piezoelectric actuators (18), each having one end connected to one of said levers (6) and another end fitted to a corresponding base (23, 23'), each of said actuators (18) being energizable to effect a given travel between a rest position in which the control element (9) is not selected, and a work position in which the control element (9) is selected; and a casing (31, 31') for said levers (6), said actuators (18) and said base (23, 23'); **characterized in that** said casing (31, 31') carries adjusting means (64, 69; 87, 88) including at least one eccentric pin (64 , 68) adapted to be manually rotated for adjusting the relative position of the base (23, 23') of at least one of said actuators (18) with respect to the pivot (7) of the corresponding lever (6).

2. A device as claimed in Claim 1, **characterized in that** at least one lock screw (30, 90) is also provided for locking the relative position so adjusted.

3. A device as claimed in Claim 1 or 2, **characterized in that** each of said levers (6) comprises a bar (10) injection molded from a thermoplastic resin having a low coefficient of friction and high electric resistivity; said bar (10) having a first end molded to a metal insert (8), and a second end having two fork-shaped appendixes (16, 17) cooperating in articulated manner with the corresponding piezoelectric actuator (18).

4. A device as claimed in one of the foregoing Claims, **characterized in that** said casing (31) comprises a frame (13) carrying said pivots (7), and two opposite walls (26, 28) fitted removably to said frame (13); said bases (23) having appendixes (24) engaging corresponding slots (25) on said walls (26, 28); and said position adjusting pin (64) being provided between said frame (13) and at least one of said walls (26, 28).

5. A device as claimed in Claim 4, **characterized in that** said pin (64) is pivoted eccentrically on said frame (13) and engages a hole (69) in each said walls (26, 28) to adjust said relative position simultaneously for said number of piezoelectric actuators (18).

6. A device as claimed in Claim 5, **characterized in that** said frame (13) also carries at least one element (66) engaging a guide (67) carried by each of said walls (26, 28) to enable displacement of said walls (26, 28) perpendicularly to said actuators (18).

7. A device as claimed in Claim 6, **characterized in that** the rotation of said pin (64) is partially prevented by the application of an adhesive resin between said pin (64) and said hole (69).

8. A device as claimed in Claim 6 or 7, **characterized in that** said displacement ranges between 1 and 3 mm; and **in that** the eccentricity of said pin (64) ranges between 0.1 and 1 mm; said actuators (18) being equally spaced with a spacing ranging between 2 and 10 mm.

9. A device as claimed in any Claims from 1 to 3, **characterized in that** said adjusting means (87, 88) comprise a grove (87) formed in one end (86) of each one of said bases (23'), and a number of eccentric pins (88) each one operatively connected to a corresponding one of said grooves (87); each actuator (18) being individually adjusted by rotating the relevant pin (88) inside said relevant groove (87).

10. A device as claimed in Claims 3 and 9, **characterized in that** one said lock screw (90) is located on each of said bases (23') and provides for locking the corresponding bases (23') with respect to said casing (31').

11. A device as claimed in one of the foregoing Claims, wherein each of said actuators (18) carries a central electrode (19') and two lateral electrodes (20', 21'); connecting means (35, 46, 47, 51, 56; 77, 80-83) being provided to connect said electrodes (19', 20', 21') electrically; **characterized in that** each of said actuators (18) is energized by an electronic drive

circuit (75) for supplying a positive voltage to one of said lateral electrodes (20', 21'), a zero voltage to the other of said lateral electrodes (20', 21'), and selectively said positive voltage and said zero voltage to said central electrode (19').

12. A device as claimed in Claim 11, **characterized in that** said electronic drive circuit (75) comprises a solid-state relay (91) for selectively supplying said positive voltage to said central electrode (19').

13. A device as claimed in Claim 11 or 12, **characterized in that** said central electrode and said lateral electrodes (19', 20', 21') are connected to corresponding rigid, parallel first pins (38, 40, 41) insertable inside corresponding bushes (48); said connecting means (35, 46, 47, 51, 56) comprising an adapter (32) carrying said bushes (48).

14. A device as claimed in Claim 13, **characterized in that** said connecting means (35, 46, 47, 51, 56) also comprise a multiple connector (35) comprising rigid, parallel second pins (46) arranged differently from said first pins (38, 40, 41); said first pins (38, 40, 41) and said second pins (46) being connected to one another by means of at least one printed-circuit board (47) to which said bushes (48) are fixed.

15. A device as claimed in Claim 14, **characterized in that** the lateral said first pins (40, 41) of said actuators (18) are connected electrically to two of said second pins (46) by two common conductors (49, 50) of said printed-circuit board (47); the central said first pins (38) of said actuators (18) being connected to as many second pins (46) by individual conductors of said printed-circuit board (47).

16. A device as claimed in Claim 15, **characterized in that** said second pins (46) are arranged in two rows in said multiple connector (35); said common conductors (49, 50) electrically connecting said bushes (48) relative to said lateral first pins (40, 41).

17. A device as claimed in Claim 16, **characterized in that** said adapter (32) comprises a further printed-circuit board (56) over which said at least one printed-circuit board (47) is superimposed; at least some of said bushes (48) each comprising a pin (55); and said further printed-circuit board (56) comprising further bushes (58) for receiving said pins (55).

18. A device as claimed in Claim 17, **characterized in that** said further printed-circuit board (56) comprises conductors (59, 61, 62) for connecting the bushes (58) of said further printed-circuit board (56) to said second pins (46).

19. A device as claimed in Claim 18, **characterized in that** said bushes and said further bushes (48, 58) are welded to the respective printed-circuit boards (47, 56); said printed-circuit boards (47, 56) each being fitted to a corresponding support (51, 35).

20. A device as claimed in Claim 18 or 19, **characterized in that** said casing (31) comprises a frame (13) carrying said pivots (7), and two opposite walls (26, 28) fitted removably to said frame (13); said bases (23) having appendixes (24) engaging corresponding slots (25) on said walls (26, 28).

21. A method of adjusting the relative position between at least one selection lever (6) and a corresponding piezoelectric actuator (18) in a device (5) for piezoelectric selection of control elements (9) according to one of the foregoing claims, said lever (6) performing a given travel between a rest position in which the corresponding control element (9) is not selected, and a work position in which said control element (9) is selected; the method being **characterized by** the following steps:

- energizing said actuator (18) as of a first instant (t1) to move said lever (6) from said rest position to said work position;
- determining a first delay (72) between said first instant (t1) and a second instant (t2) at which said work position of said lever (6) is reached;
- deenergizing said actuator (18) as of a third instant (t3) to restore said lever (6) from said work position to said rest position;
- determining a second delay (73) between said third instant (t3) and a fourth instant (t4) at which said rest position of said lever (6) is reached; and
- adjusting said relative position to achieve a condition of equality between said first delay (72) and said second delay (73).

22. A method as claimed in Claim 21, **characterized in that** adjustment is made by rotating an eccentric pin (64, 88), located between a casing (31, 31') of said device (5) and a base (23, 23') of said actuator (18), to achieve said condition of equality.

23. A method as claimed in Claim 21 or 22, **characterized by** locking said relative position in said condition of equality.

Patentansprüche

1. Modulare Vorrichtung für piezoelektrische Auswahl von Steuerelementen, mit einer Anzahl von Hebeln (6) zur Auswahl der Steuerelemente (9), wobei die Hebel (6) sich um eine entsprechende Anzahl paralleler Drehgelenke (7) drehen, einer Anzahl rele-

vanter piezoelektrischer Stellglieder (18), deren eines Ende jeweils mit einem der Hebel (6) verbunden ist und deren anderes Ende an einer entsprechenden Basis (23, 23') angebracht ist, wobei jedes Stellglied (18) unter Strom gesetzt werden kann, um einen vorgegebenen Weg zwischen einer Ruhestellung, in der das Steuerelement (9) nicht ausgewählt wird, und einer Arbeitsstellung, in der das Steuerelement (9) ausgewählt wird, auszulösen, und einem Gehäuse (31, 31') für die Hebel (6), die Stellglieder (18) und die Basis (23, 23'),
dadurch gekennzeichnet, dass
das Gehäuse (31, 31') Einstellvorrichtungen (64, 69; 87, 88) mit wenigstens einem Exzenterzapfen (64, 68) aufweist, der zur Einstellung der Relativposition der Basis (23, 23') wenigstens eines Stellglieds (18) in Bezug auf das Drehgelenk (7) des entsprechenden Hebels (6) manuell gedreht werden kann.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** wenigstens eine Feststellschraube (30, 90) zum Feststellen der so eingestellten Relativposition vorgesehen ist.

3. Vorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** jeder der Hebel (6) eine Stange (10) aufweist, die aus einem thermoplastischen Harz mit niedrigem Reibungskoeffizienten und hohem elektrischem Widerstand spritzgegossen ist, wobei ein erstes Ende der Stange (10) an einen Metalleinsatz (8) gegossen ist und ein zweites Ende zwei gabelförmige Ansatzstücke (16, 17) aufweist, die gelenkig mit dem entsprechenden piezoelektrischen Stellglied (18) zusammenwirken.

4. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Gehäuse (31) einen Rahmen (13) aufweist, der die Drehgelenke (7) trägt, und zwei gegenüberliegende Wände (26, 28), die an dem Rahmen (13) abnehmbar angebracht sind, wobei die Basis (23) Ansatzstücke (24) ausweist, die in entsprechende Schlitze (25) in den Wänden (26, 28) eingreifen, und wobei der die Position einstellende Zapfen (64) zwischen dem Rahmen (13) und wenigstens einer der Wände (26, 28) vorgesehen ist.

5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** der Zapfen (64) an dem Rahmen (13) exzentrisch verschwenkt wird und in ein Loch (69) in jeder der Wände (26, 28) eingreift, um die Relativposition gleichzeitig für die Anzahl piezoelektrischer Stellglieder (18) einzustellen.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** der Rahmen (13) auch wenigstens ein Element (66) aufweist, das in eine Führung (67) eingreift, an jeder Wand (26, 28) angebracht ist, um eine Verschiebung der Wände (26, 28) senkrecht zu den Stellgliedern (18) zu ermöglichen.

7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** die Drehung des Zapfens (64) teilweise durch das Anbringen eines Klebeharzes zwischen dem Zapfen (64) und dem Loch (69) verhindert wird.

8. Vorrichtung nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** sich die Verschiebung im Bereich von 1 und 3 mm bewegt, und dass die Exzentrizität des Zapfens (64) zwischen 0,1 und 1 mm beträgt, wobei die Stellglieder (18) in gleichem Abstand voneinander angeordnet sind und der Abstand zwischen 2 und 10 mm beträgt.

9. Vorrichtung nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Einstellvorrichtungen (87, 88) eine Ausnehmung (87) an einem Ende (86) jeder Basis (23') aufweisen, und eine Anzahl von Exzenterzapfen (88), die jeweils mit einer entsprechenden Ausnehmung (87) operativ verbunden sind, wobei jedes Stellglied (18) durch Drehung des relevanten Zapfens (88) in der relevanten Ausnehmung (87) individuell eingestellt wird.

10. Vorrichtung nach den Ansprüchen 3 und 9, **dadurch gekennzeichnet, dass** sich auf jeder Basis (23') eine Feststellschraube (90) befindet, um die entsprechende Basis (23') in Bezug auf das Gehäuse (31') festzustellen.

11. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei jedes Stellglied (18) eine mittige Elektrode (19') und zwei seitliche Elektroden (20', 21') aufweist, wobei Verbindungsvorrichtungen (35, 46, 47, 51, 56; 77, 80-83) zur elektrischen Verbindung der Elektroden (19', 20', 21') vorgesehen sind, **dadurch gekennzeichnet, dass** jedes Stellglied (18) von einer elektronischen Treiberschaltung (75) unter Strom gesetzt wird, um eine der seitlichen Elektroden (20', 21') mit positiver Spannung zu versorgen, die andere der seitlichen Elektroden (20', 21') mit Nullspannung, und die mittige Elektrode (19') wahlweise mit positiver Spannung und mit Nullspannung.

12. Vorrichtung nach Anspruch 11, **dadurch gekennzeichnet, dass** die elektronische Treiberschaltung (75) ein Festkörperrelais (91) zur wahlweisen Versorgung der mittigen Elektrode (19') mit positiver Spannung aufweist.

13. Vorrichtung nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass** die mittige Elektrode und die seitlichen Elektroden (19', 20', 21') mit entspre-

chenden starren, parallelen ersten Stiften (38, 40, 41), die in entsprechende Durchführungen (48) einführbar sind, verbunden sind, wobei die Verbindungsvorrichtungen (35, 46, 47, 51, 56) einen Adapter (32) aufweisen, der die Durchführungen (48) aufweist.

14. Vorrichtung nach Anspruch 13, **dadurch gekennzeichnet, dass** die Verbindungsvorrichtungen (35, 46, 47, 51, 56) auch einen Vielfachschalter (35) aufweisen, der starre, parallele zweite Stifte (46) enthält, die unterschiedlich zu den ersten Stiften (38, 40, 41) angeordnet sind, wobei die ersten Stifte (38, 40, 41) und die zweiten Stifte (46) durch wenigstens eine gedruckte Leiterplatte (47), an der die Durchführungen (48) angebracht sind, miteinander verbunden sind.

15. Vorrichtung nach Anspruch 14, **dadurch gekennzeichnet, dass** die seitlichen ersten Stifte (40, 41) der Stellglieder (18) mit zweien der zweiten Stifte (46) durch zwei gemeinsame Leiter (49, 50) der gedruckten Leiterplatte (47) verbunden sind, wobei die mittigen ersten Stifte (38) der Stellglieder (18) mit ebenso vielen zweiten Stiften (46) durch einzelne Leiter der gedruckten Leiterplatte (47) verbunden sind.

16. Vorrichtung nach Anspruch 15, **dadurch gekennzeichnet, dass** die zweiten Stifte (46) in dem Vielfachschalter (35) in zwei Reihen angeordnet sind, wobei die gemeinsamen Leiter (49, 50) die Durchführungen (48) in Bezug auf die seitlichen ersten Stifte (40, 41) elektrisch verbinden.

17. Vorrichtung nach Anspruch 16, **dadurch gekennzeichnet, dass** der Adapter (32) eine weitere gedruckte Leiterplatte (56) aufweist, die die wenigstens eine gedruckte Leiterplatte (47) überlagern, wobei wenigstens einige der Durchführungen jeweils einen Stift (55) enthalten, und die weitere gedruckte Leiterplatte (58) weitere Durchführungen (56) zur Aufnahme der Stifte (55) enthält.

18. Vorrichtung nach Anspruch 17, **dadurch gekennzeichnet, dass** die weitere gedruckte Leiterplatte (56) Leiter (59, 61, 62) zum Verbinden der Durchführungen (58) der weiteren gedruckten Leiterplatte (56) mit den zweiten Stiften (46) aufweist.

19. Vorrichtung nach Anspruch 18, **dadurch gekennzeichnet, dass** die Durchführungen und die weiteren Durchführungen (48, 58) an die jeweiligen gedruckten Leiterplatten (47, 56) angeschweißt sind, wobei die gedruckten Leiterplatten (47, 56) jeweils an einem entsprechenden Stützteil (51 35) angebracht sind.

20. Vorrichtung nach Anspruch 18 oder 19, **dadurch gekennzeichnet, dass** das Gehäuse (31) einen Rahmen (13) aufweist, der die Drehgelenke (7) trägt, und zwei gegenüberliegende Wände (26, 28), die abnehmbar an dem Rahmen (13) angebracht sind, wobei die Basis (23) Ansatzstücke (24) aufweist, die in entsprechende Schlitze (25) in den Wänden (26, 28) eingreifen.

21. Verfahren zum Einstellen der Relativposition zwischen wenigstens einem Auswahlhebel (6) und einem entsprechenden piezoelektrischen Stellglied (18) in einer Vorrichtung (5) zur piezoelektrischen Auswahl von Steuerelementen (9) nach einem der vorhergehenden Ansprüche, wobei der Hebel (6) einen vorgegebenen Weg zwischen einer Ruhestellung, in der das entsprechende Steuerelement (9) nicht ausgewählt wird, und einer Arbeitsstellung, in der das Steuerelement (9) ausgewählt wird, zurücklegt, wobei das Verfahren durch die folgenden Schritte gekennzeichnet ist:

- unter Strom setzen des Stellglieds (18) zu einem ersten Zeitpunkt (t1), um den Hebel (6) aus der Ruhestellung in die Arbeitsstellung zu bewegen;
- Feststellen einer ersten Verzögerung (72) zwischen dem ersten Zeitpunkt (t1) und einem zweiten Zeitpunkt (t2), zu dem die Arbeitsstellung des Hebels (6) erreicht ist;
- außer Strom setzen des Stellglieds (18) zu einem dritten Zeitpunkt (t3), um den Hebel (6) aus der Arbeitsstellung in die Ruhestellung zurückzuführen;
- Feststellen einer zweiten Verzögerung (73) zwischen dem dritten Zeitpunkt (t3) und einem vierten Zeitpunkt (t4), in dem die Ruhestellung des Hebels (6) erreicht ist; und
- Einstellen der Relativposition, um einen Zustand der Gleichheit zwischen der ersten Verzögerung (72) und der zweiten Verzögerung (73) zu erreichen..

22. Verfahren nach Anspruch 21, **dadurch gekennzeichnet, dass** durch Drehung eines Exzenterzapfens (64, 88), der zwischen einem Gehäuse (31, 31') der Vorrichtung (5) und einer Basis (23, 23') des Stellglieds (18) angeordnet ist, eine Einstellung herbeigeführt wird, um den Zustand der Gleichheit zu erreichen.

23. Verfahren nach Anspruch 21 oder 22, **dadurch gekennzeichnet, dass** die Relativposition im Zustand der Gleichheit festgestellt wird.

Revendications

1. Un dispositif modulaire pour la sélection piézoélectrique d'éléments de contrôle, comprenant un certain nombre de leviers (6) destinés à la sélection desdits éléments de contrôle (9), lesdits leviers (6) pivotant autour d'un nombre correspondant de pivots parallèles (7) ; une pluralité d'actionneurs piézoélectriques appropriés (18) ayant chacun une extrémité connectée à l'un desdits leviers (6) et l'autre extrémité adaptée à une base correspondante (23, 23'), chacun desdits actionneurs (18) pouvant être excité de manière à exécuter un trajet donné entre une position de repos dans laquelle l'élément de contrôle (9) n'est pas sélectionné et une position de travail dans laquelle l'élément de contrôle (9) est sélectionné ; et un boîtier (31, 31') pour ledit levier (6), lesdits actionneurs (18) et ladite base (23, 23'), dispositif **caractérisé en ce que** ledit boîtier (31, 31') porte des moyens de réglage (64, 69 ; 87, 88) comprenant au moins une broche excentrique (64, 68) destinée à être mise en rotation manuellement en vue de régler la position relative de la base (23, 23') d'au moins l'un desdits actionneurs (18) par rapport au pivot (7) du levier correspondant (6).

2. Un dispositif selon la revendication 1, **caractérisé en ce que** au moins une vis de verrouillage (30, 90) est également prévue en vue de verrouiller la position relative ainsi réglée.

3. Un dispositif selon l'une des revendications 1 ou 2, **caractérisé en ce que** chacun desdits leviers (6) se compose d'une barre (10) moulée par injection en une résine thermoplastique possédant un bas coefficient de frottement et une résistivité électrique élevée, ladite barre (10) présentant une première extrémité moulée sur un insert métallique (8) et une seconde extrémité présentant deux appendices en forme de fourche (16, 17), coopérant de manière articulée avec l'actionneur piézoélectrique correspondant (18).

4. Un dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit boîtier (31) comprend un châssis (13) portant lesdits pivots (7) et deux parois opposées (26, 28) montées détachables sur ledit châssis (13), lesdites bases (23) possédant des appendices (24) traversant des fentes correspondantes (25) pratiquées dans lesdites parois (26, 28) et ladite broche de réglage (64) étant prévue entre ledit châssis (13) et au moins l'une desdits parois (26, 28).

5. Un dispositif selon la revendication 4, **caractérisé en ce que** ladite broche (64) est montée pivotante excentriquement sur ledit châssis (13) et traverse un trou (69) pratiqué dans chacune desdites parois (26, 28) de manière à régler ladite position relative simultanément pour ladite pluralité d'actionneurs piézoélectriques (18).

6. Un dispositif selon la revendication 5, **caractérisé en ce que** ledit châssis (13) porte également au moins un élément (66) coopérant avec un guide (67) porté par chacune desdites parois (26, 28) de manière à permettre le déplacement desdits parois (26, 28) perpendiculairement auxdits actionneurs (18).

7. Un dispositif selon la revendication 6, **caractérisé en ce que** la rotation de ladite broche (64) est partiellement empêchée par l'application d'une résine adhésive entre ladite roche (64) et ledit trou (69).

8. Un dispositif selon l'une des revendications 6 ou 7, **caractérisé en ce que** ledit déplacement est compris entre 1 et 3 mm et **en ce que** l'excentricité de ladite broche (64) est comprise entre 0,1 et 1 mm, lesdits actionneurs (18) étant équidistants d'un espacement compris entre 2 et 10 mm.

9. Un dispositif selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** lesdits moyens de réglage (87, 88) consistent en une rainure (87) pratiquée dans une extrémité (86) de chacune desdites bases (23') et une pluralité de broches excentriques (88) dont chacune est connectée positivement à l'une desdites rainures (87) correspondantes, chaque actionneur (18) étant réglé individuellement par rotation de la broche correspondante (88) à l'intérieur de la rainure correspondante (87).

10. Un dispositif selon l'une quelconque des revendications 3 et 9, **caractérisé en ce que** l'une desdites vis de verrouillage (90) est disposée sur chacune desdites bases (23') et assure le verrouillage desdites bases correspondantes (23') par rapport audit boîtier (31').

11. Un dispositif selon l'une quelconque des revendications précédentes dans lequel chacun desdits actionneurs (18) porte une électrode centrale (19') et deux électrodes latérales (20', 21'), des moyens de connexion (35, 46, 47, 51, 56, 77, 80-83) étant prévus de manière à connecter lesdites électrodes (19', 20', 21') électriquement, **caractérisé en ce que** chacun desdits actionneurs (18) est excité par un circuit d'excitation électronique (75) fournissant une tension positive à l'une desdites électrodes latérales (20', 21'), une tension nulle à l'autre desdites électrodes latérales (20', 21') et sélectivement ladite tension positive et ladite tension nulle à ladite électrode centrale (19').

12. Un dispositif selon la revendication 11, **caractérisé**

en ce que ledit circuit d'excitation électronique (75) comprend un relais à circuit intégré (91) en vue de fournir sélectivement ladite tension positive à ladite électrode centrale (19').

13. Un dispositif selon l'une des revendications 11 ou 12, **caractérisé en ce que** ladite électrode centrale et lesdites électrodes latérales (19', 20', 21') sont connectées à de premières broches parallèles rigides correspondantes (38, 40, 41) pouvant être insérées à l'intérieur de bagues correspondantes (48), lesdits moyens de connexion (35, 46, 47, 51, 56) consistant en un adaptateur (32) portant lesdites bagues (48):

14. Un dispositif selon la revendication 13, **caractérisé en ce que** lesdits moyens de connexion (35, 46, 47, 51, 56) comprennent également un connecteur multiple (35) se composant de secondes broches parallèles rigides (46) disposées différemment desdites premières broches (38, 40, 41), lesdites premières broches (38, 40, 41) et lesdites secondes broches (46) étant connectées les unes aux autres au moyen d'au moins un circuit intégré (47) auquel lesdites bagues (48) sont fixées.

15. Un dispositif selon la revendication 14, **caractérisé en ce que** lesdites premières broches latérales (40, 41) desdits actionneurs (18) sont électriquement connectées à deux desdites secondes broches (46) par deux conducteurs communs (49, 50) dudit circuit imprimé (47), lesdites premières broches centrales (38) desdits actionneurs (18) étant connectées à autant de secondes broches (46) que de conducteurs individuels dudit circuit imprimé (47).

16. Un dispositif selon la revendication 15, **caractérisé en ce que** lesdites secondes broches (46) sont disposées en deux rangées dans ledit connecteur multiple (35), lesdits conducteurs communs (49, 50) connectant électriquement lesdites bagues (48) par rapport auxdites premières broches latérales (40, 41).

17. Un dispositif selon la revendication 16, **caractérisé en ce que** ledit adaptateur (32) se compose d'un premier circuit imprimé (56) sur lequel est superposé au moins un circuit imprimé (47), au moins certaines desdites bagues (48) comprenant chacune une broche (55) et ledit circuit imprimé complémentaire (56) comprenant d'autres bagues (58) destinées à recevoir lesdites broches (55).

18. Un dispositif selon la revendication 17, **caractérisé en ce que** ledit circuit imprimé complémentaire (56) comprend des conducteurs (59, 61, 62) destinés à connecter les bagues (58) dudit circuit imprimé complémentaire (56) auxdites secondes broches (46).

19. Un dispositif selon la revendication 18, **caractérisé en ce que** lesdites bagues et lesdites bagues complémentaires (48, 58) sont soudées auxdits circuits imprimés respectifs (47, 56), lesdits circuits imprimés (47, 56) étant chacun adapté à un support correspondant (51, 35).

20. Un dispositif selon l'une des revendications 18 ou 19, **caractérisé en ce que** ledit boîtier (31) comprend un châssis (13) portant lesdits pivots (7) et deux parois opposées (26, 28) montées détachables sur ledit châssis (13), lesdites bases (23) comportant des appendices (24) traversant des fentes correspondantes (25) pratiquées sur lesdites parois (26, 28).

21. Une méthode pour régler la position relative entre au moins un levier de sélection (6) et un actionneur piézoélectrique correspondant (18) dans un dispositif (5) destiné à la sélection piézoélectrique d'éléments de contrôle (9) selon l'une quelconque des revendications précédentes, ledit levier (6) exécutant un trajet donné entre une position de repos dans laquelle l'élément de contrôle correspondant (9) n'est pas sélectionné et une position de travail dans laquelle ledit élément de contrôle (9) est sélectionné, cette méthode étant **caractérisée par** les étapes consistant à :

- exciter ledit actionneur (18) à un premier instant (t1) de manière à déplacer ledit levier (6) depuis ladite position de repos jusqu'à ladite position de travail ;
- déterminer un premier délai (72) entre ledit premier instant (t1) et un second instant (t2) auquel ladite position de travail dudit levier (6) est atteinte ;
- désexciter ledit actionneur (18) à un troisième instant (t3) de manière à ramener ledit levier (6) depuis ladite position de travail jusqu'à ladite position de repos ;
- déterminer un second délai (73) entre ledit troisième instant (t3) et un quatrième instant (t4) auquel ladite position de repos dudit levier (6) est atteinte et ;
- ajuster ladite position relative de manière à atteindre une condition d'égalité entre ledit premier délai (72) et ledit second délai (73).

22. Une méthode selon la revendication 21, **caractérisée en ce que** ledit réglage est effectué en faisant tourner une broche excentrique (64, 88) située entre un boîtier (31, 31') dudit dispositif (5) et une base (23, 23') dudit actionneur (18) de manière à remplir ladite condition d'égalité.

23. Une méthode selon la revendication 21 ou 22, **caractérisée en ce que** l'on verrouille ladite position relative dans ladite condition d'égalité.

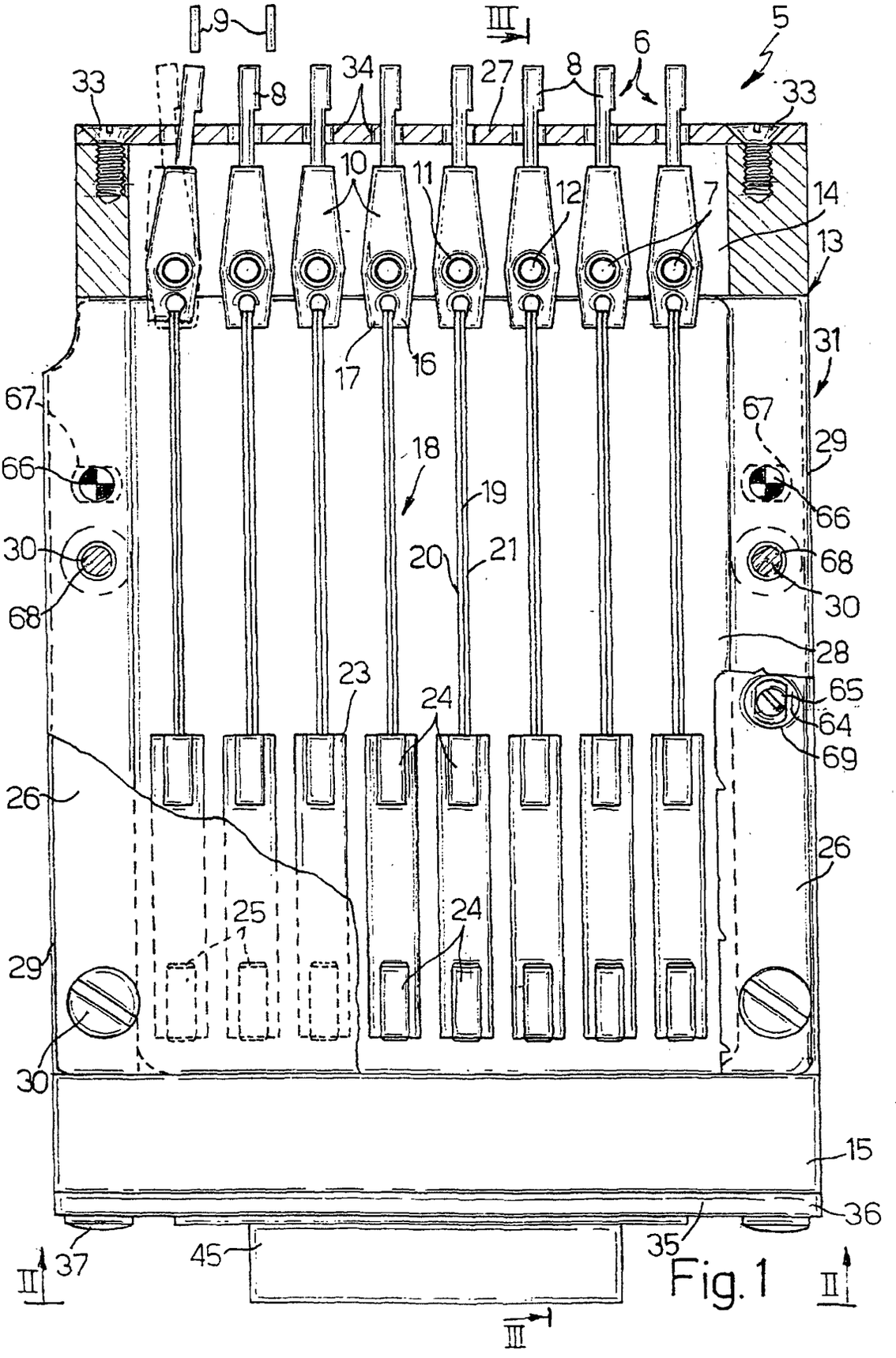
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Fig. 1

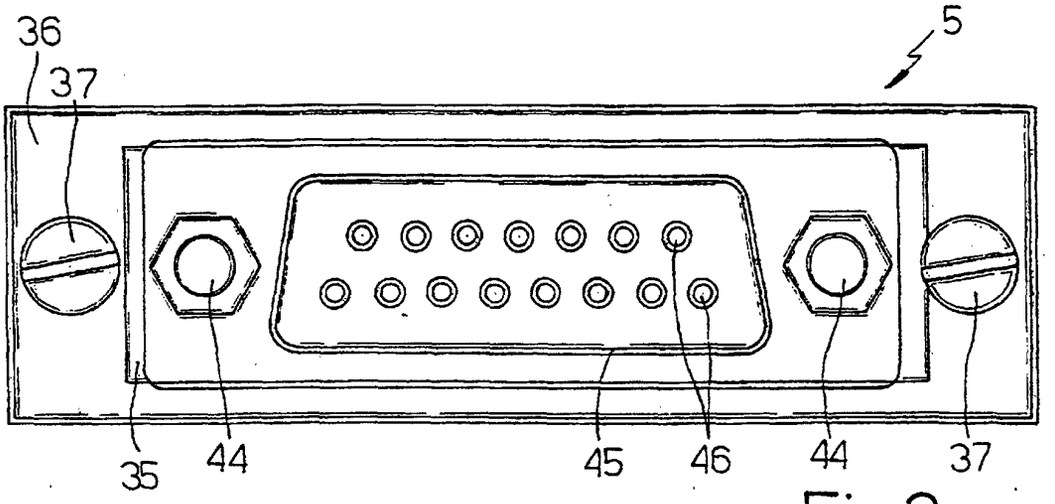
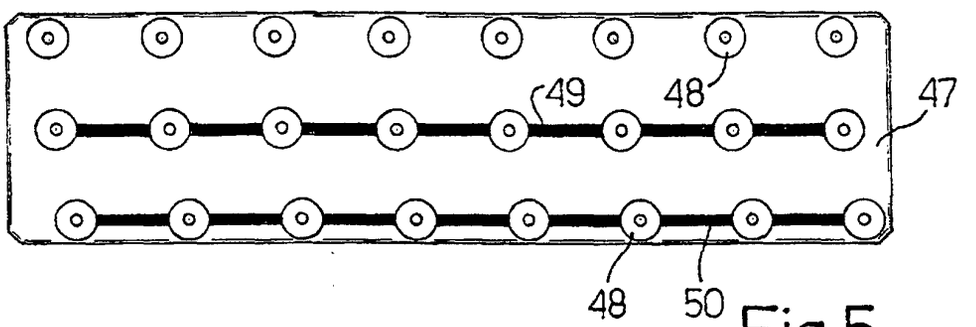


Fig.2



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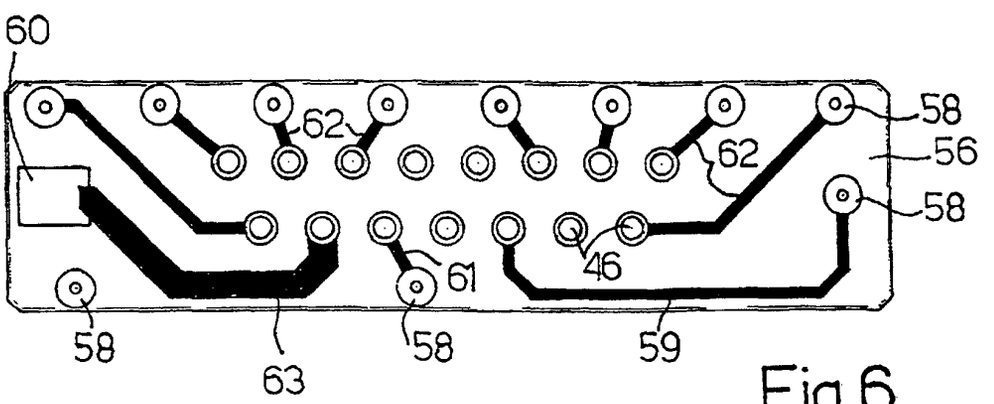
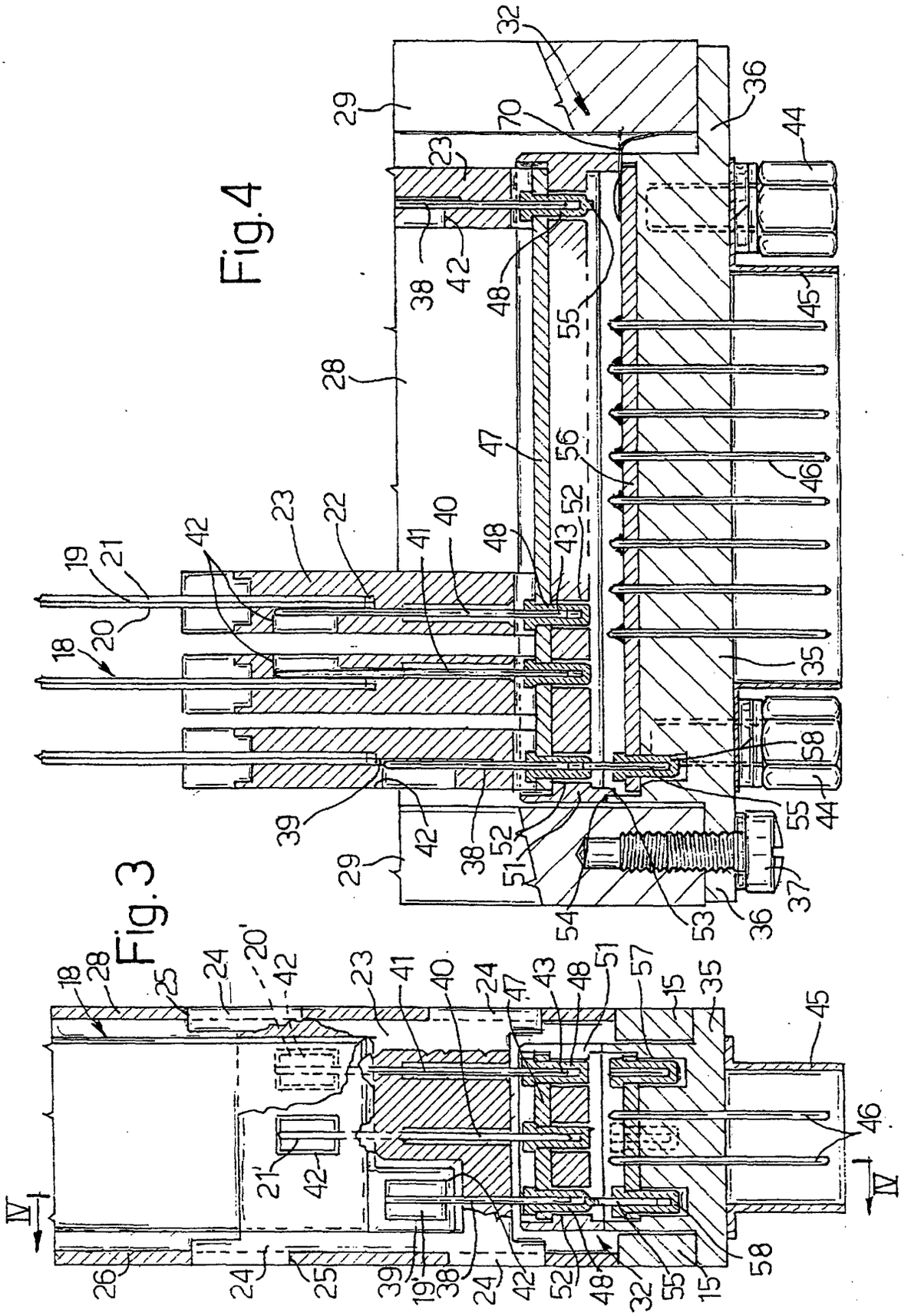


Fig.6



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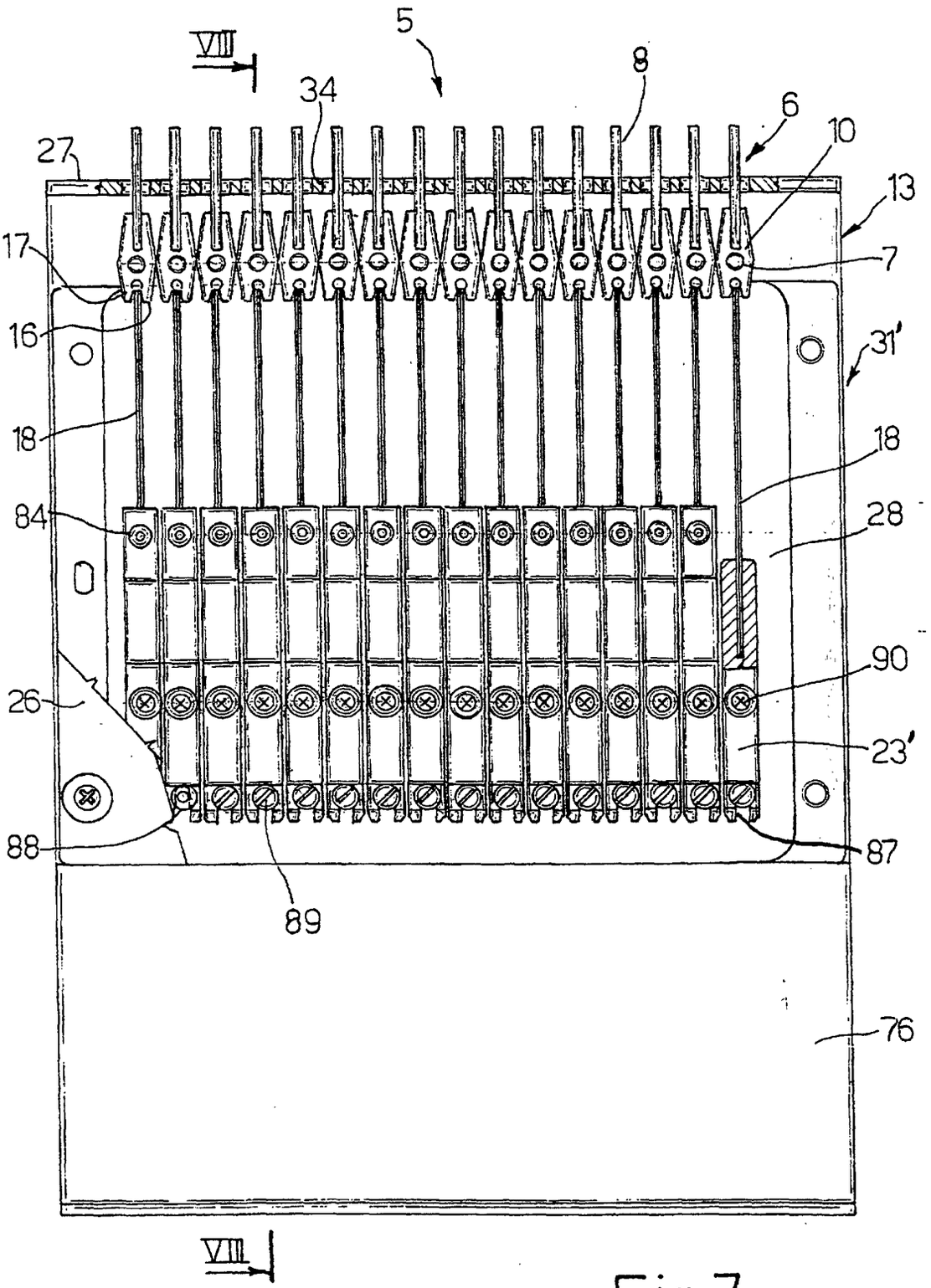

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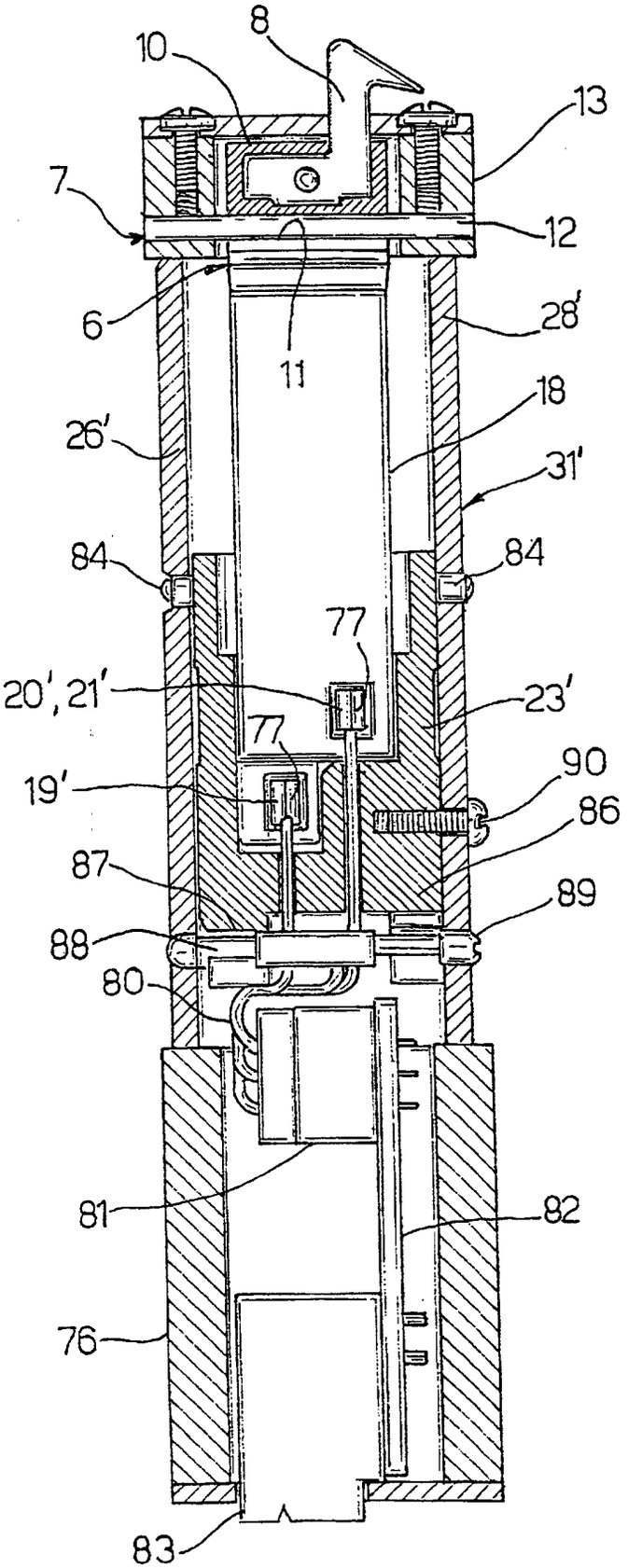
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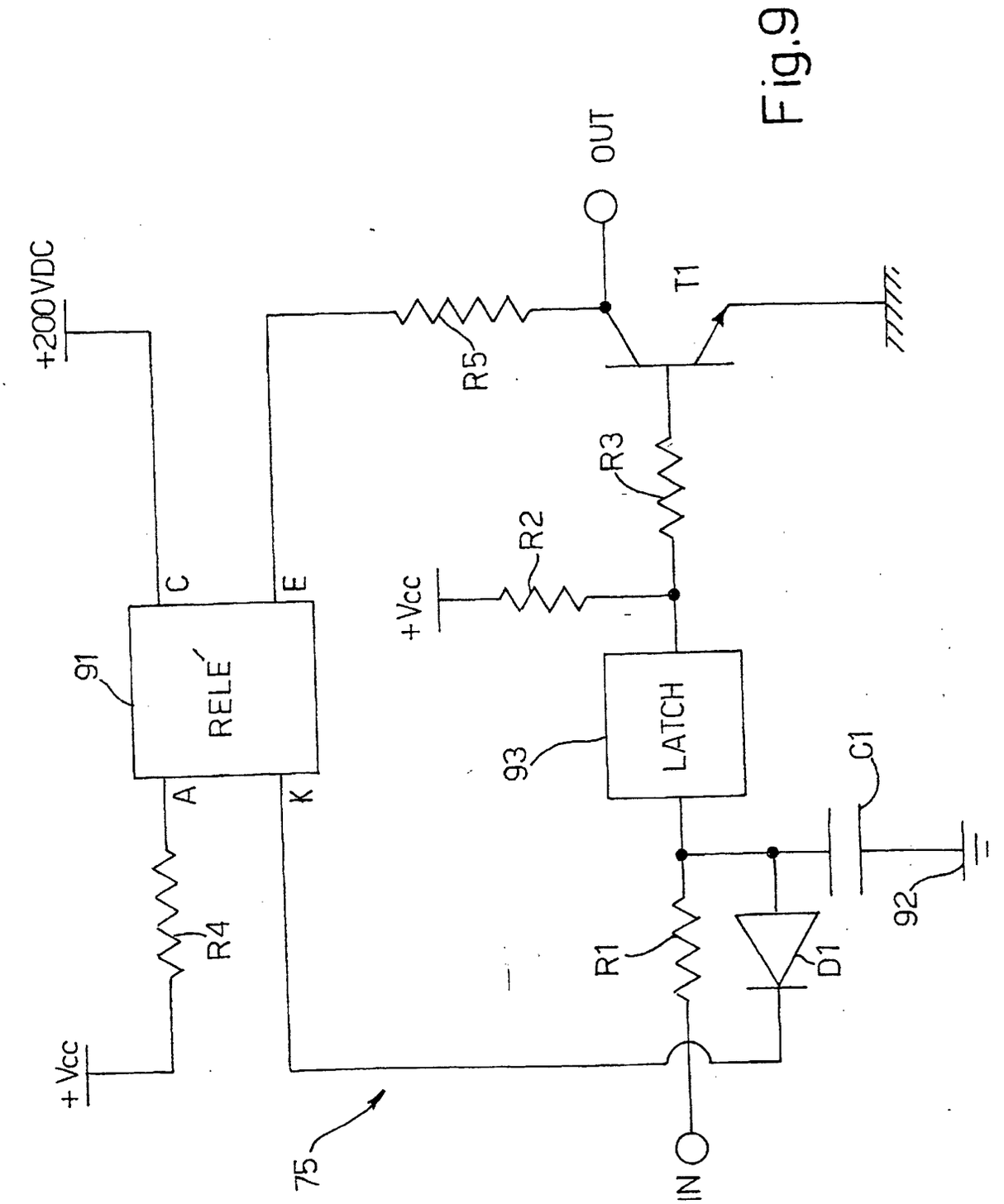
Fig.8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K
93
LATCH
C1
R4
R1
D1
92
+Vcc
75
IN

Fig.9

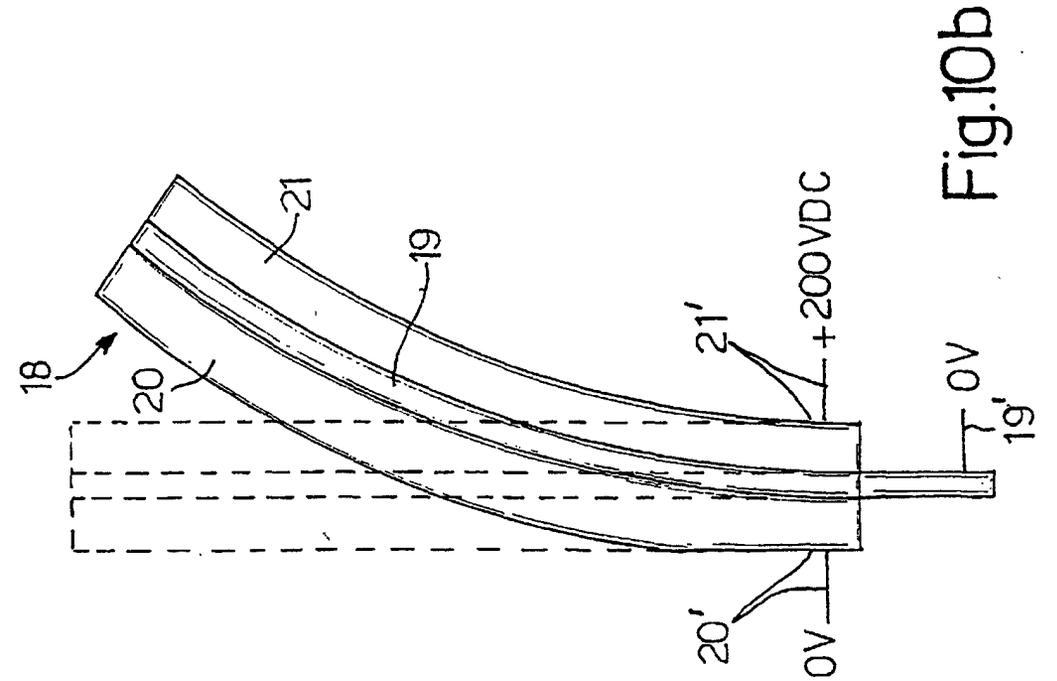

Fig.10b

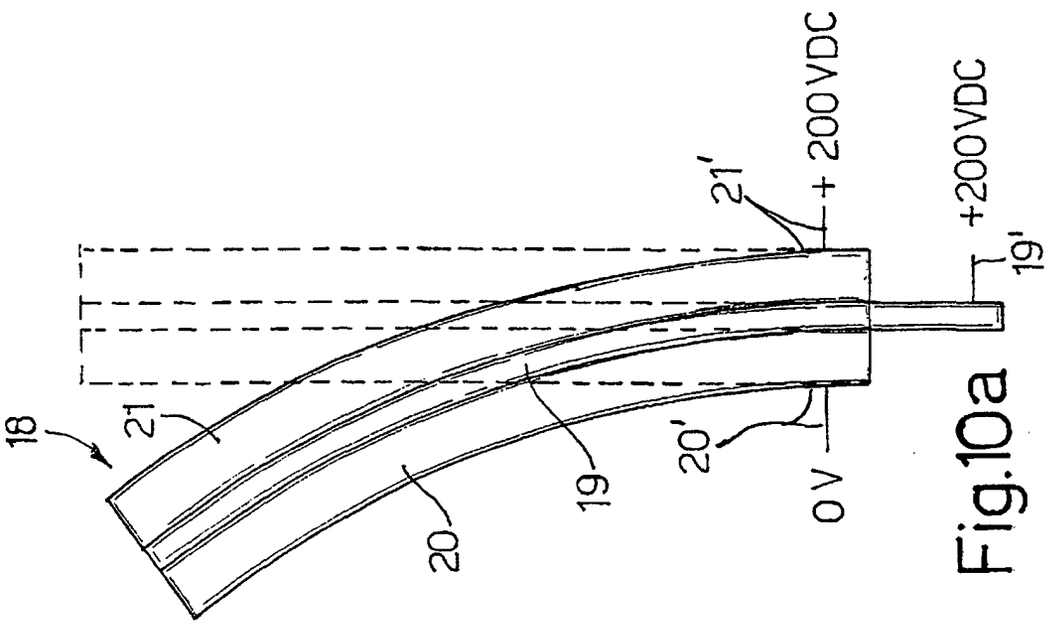

Fig.10a

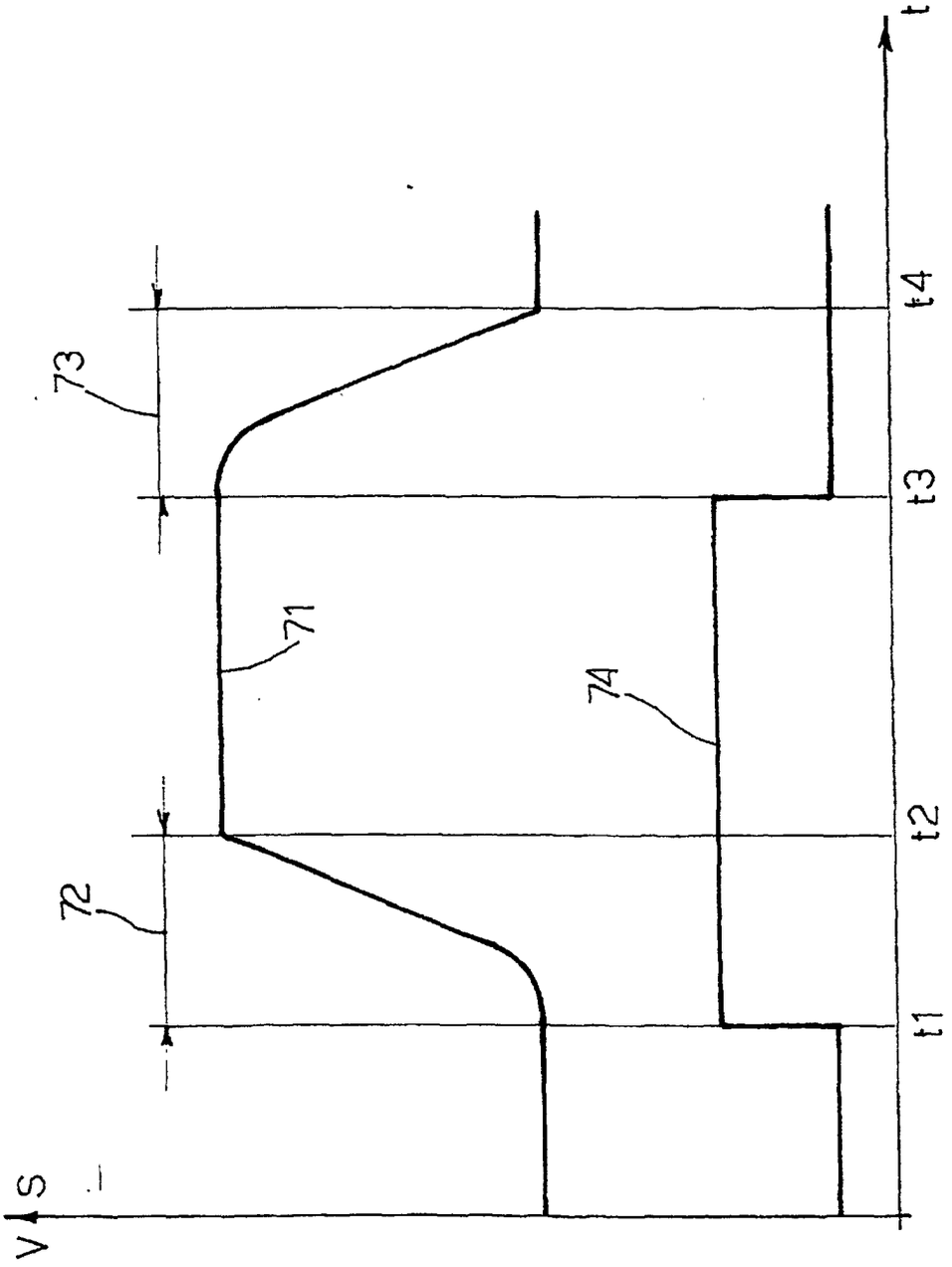

Fig.11