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(54) Key-operated locking device.

(57) Locking device, typically for electrically actuated motor vehicle door latches and the like, uses a key (10) having a light impermeable blade (11) with at least two series of light-permeable apertures (12, 13) e.g. along its opposite edges whose positioning provides a key code. The device incorporates light transmitters (31) and receivers (32) positioned to read the apertures of each series and generate signals corresponding to the code as the key is withdrawn from a slot (24) after insertion which actuates a switch (38) which energises the transmitters. A logic circuit provides an unlocking signal in response only to a key having the correct coding.

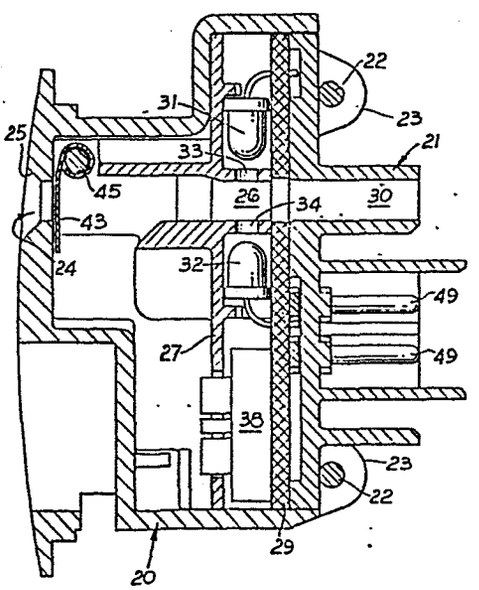

Fig. 7

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KEY-OPERATED LOCKING DEVICE

This invention relates to key-operated locking devices of the kind which include a housing having a key slot into which a key can be inserted to operate the device.

A number of proposals have been made to increase the degree of security afforded by such devices by the use of keys other than conventional metal blades formed with cuts to correspond to a particular pattern of tumblers within the device. For example, keys have been proposed in the form of plastic cards containing embedding magnetic or other metallic elements which generate appropriate magnetic or other signals when inserted within the device.

Proposals have also been made which involve the use of optical devices for sensing, for example, the pattern of a series of apertures formed in a plastic card. Such proposals have, however, not been suitable for automotive applications and have been used, for example, for permitting only approved operators to operate electrical equipment or to enter specific areas of a building.

It is accordingly an object of the invention to provide an improved form of key-operated locking device which incorporates optical means for determining the correctness or otherwise of an inserted key.

According to the present invention there is provided a key-operated locking device for operation by a key which includes a light-impermeable blade formed with at least two series of apertures, said device comprising a housing having a key slot for insertion of a key, switch means positioned for operation by an inserted key, light transmitter and receiver means associated with each of the series of apertures, and control means such that, on operation by an inserted key, the light transmitter and receiver means are actuated to generate a series of signals during withdrawal of the key in dependence on the arrangements of the apertures in the series.

The key insertion slot is preferably oepn at its rear end so that, when the key is fully inserted, it projects beyond the rear of the housing. A spring-loaded shutter will be provided to limit the entry of dust and dirt into the key slot but this open-ended arrangement will ensure that a continuous cleaning action can be obtained to avoid any build up of dirt within the key slot.

The key preferably comprises a flat metal blade of elongate rectangular form which is formed along the two longer edges thereof with cut-outs which provide the series of apertures, the metal plate being encased within a layer of a transparent plastics material which is shaped to provide a handle for the key, that part of the plastics material enclosing the blade of the key being of T-shape in cross-section over a portion of its length with the entrance to the key insertion slot of corresponding cross-section so that the key can only be inserted in the slot when in the required orientation.

The key configuration is preferably such that the portion of T-shape in cross-section is adjacent the handle and that the end of the T-shaped portion is arranged to operate the switch means. The key is preferably arranged to engage a spring-loaded lever to actuate the switch means, the position of the T-shaped portion of the key shank in relation to the series of apertures in the key blade being such that the apertures are disposed beyond the light transmitter and receiver means when the lever is engaged by the key to actuate the switch means.

Push-button operated means may also be provided for operating the lever and actuating the switch means to generate a "locking" signal as opposed to the unlocking signal which is generated when the correct key is inserted to actuate the switch means and is then removed from the key insertion slot to move the series of apertures past the light transmitter and receiver means to generate the appropriate signal pattern.

The invention will now be described by way of example with reference to the accompanying drawings in which:-

Figures 1, 2 and 3 illustrate a key,
Figures 4 to 8 illustrate a locking device, and
Figure 9 illustrates the method of installation of the device within a vehicle.

The key 10 includes a rectangular metal blade 11 which is formed with a series of apertures 12 and 13 along each of its two longer edges. As shown, there are eight aperture positions 1 to 8 along each of the two edges and each edge will either have or not have an aperture depending on the key code. Where apertures are provided opposite each other at a particular position, the signal generated can be considered as a "1" signal; when an aperture is provided at a particular position only in edge 12, the signal generated can be considered as a "2" signal; and when an aperture is provided at a particular position only in edge 13, the signal generated can be considered as a "3" signal. Thus the code for the particular aperture configuration shown in Figure 2 of the drawings is "11323112". In this respect it is to be noted that the code commences with the position furthest from the free end of the key.

The aperture metal blade 11 is encased within a layer 14 of a transparent synthetic plastics material, for example an acrylate resin, the layer 14 of plastics material being shaped to provide a handle 15 which may be of generally trapezoidal form as illustrated or of any other convenient design. That part of the plastics layer 14 which covers the main portion of the metal blade is of rectangular cross-section for the majority of its length but includes a part 16 which is of T-section in cross-section. The part 16 is adjacent the handle 15 and terminates in an inclined ramp surface 17.

Referring next to the device shown in Figures 4 to 8, this includes a housing comprising an outer housing member 20 and an inner housing member 21. The two housing members 20 and 21

are formed as plastic mouldings and, when the other components of the device have been attached to the housing members, the two housing members 20 and 21 are assembled together by means of a pair of retaining pins 22 which pass through apertures formed in lugs 23 of the housing member 20 and bear against the rear surface of the inner housing member 21. The outer housing member 20 includes a key insertion slot 24 the configuration of which is such as to provide lead-in surfaces 25 leading to a T cross-section portion of such size as to receive the T-cross-section part 16 of the key as a free sliding fit. The cross-piece of the T formation is in register with a rectangular through aperture 26 formed in a moulded plastics intermediate member 27, with an aperture 28 in a printed circuit board 29 and with an aperture 30 in the inner housing member 21.

The intermediate member 27 includes four chambers within which light-transmitting and receiving means are located. The light-transmitting and receiving means comprises two infra-red emitting diodes 31 and two phototransistors 32. Each diode 31 is arranged in register with an opening 33 communicating with the through aperture 26 and each phototransistor 32 is likewise arranged in register with an opening 34 also communicating with the through aperture 26. The twodiodes 31 are arranged one on each side of the aperture 26 so that, when the key 10 is inserted in the key slot, one diode 31 registers with the row of apertures in edge 12 of the key 10 and the other diode 31 registers with the two of apertures in edge 13 of the key 10. When one of the apertures is positioned in register with the associated diode 31, the infra-red beam will impinge on the associated phototransistor 32 to generate an appropriate signal. This signal is transmitted to a logic circuit and depending on whether both phototransistors 32 have generated signals or, if only one phototransistor has generated the signal, an output signal is generated by the logic circuit according to the key code.

The intermediate member 27 is rebated corresponding to the stem of the T of the T-shaped key insertion slot, this rebate receiving the stem of the T-shaped part 16 of the key 10. When the key 10 is inserted in the slot, the ramp surface 17 of the T-shaped part 16 of the key 10 engages the tip 35 of a spring loaded lever 36 contained within an extension of this rebate. The lever 36 is pivotally mounted at its lower end and has a curvate abutment portion 37 which is arranged to bear against the operating member of a modular disc switch 38 carried by the printed circuit board 29. The arrangement is such that, when a key 10 is inserted, the ramp surface 17 will engage the tip 35 of the lever 36 to actuate the switch 38 to operate the two diodes 31. Infra-red beams will be emitted by the two diodes 31 but these beams will both be interrupted since the key insertion position at actuation of the switch 38 is such that the rows of apertures in the key edges 12 and 13 are by then disposed inwardly of the openings 33 and 34. However, as the key 10 is withdrawn from the key slot, the rows of apertures in the edges 12 and 13 of the key 10 will come into register with the infra-red beams and the appropriate signals will be passed to the logic circuit to generate the appropriate output signals.

A push-button 39 is located beneath the key insertion slot and includes a stem 40 which passes through a guide cylinder 41 forming part of the outer housing member 20. The push-button 39 is biassed into its normal, non-operated position by means of a resilient sleeve 42 which fits over the guide cylinder 41 and also acts as a seal. The stem 40 of the push-button 39 is held against displacement from the outer housing member 20 by means of a clip 42a and the arrangement is such that, when the push-button 39 is pressed, the end of the stem 40 will move inwardly to displace the lever 36 and actuate the switch 38. The push-button 39 is employed to generate a "locking" signal in that, when the button 39 is depressed to actuate the switch 38 and cause energisation of the two diodes 31, the infra-red beams emitted by the diodes 31 will not be interrupted since there will then be no key in the key slot. Both phototransistors will emit signals and, on receipt

of these, the logic circuit will generate a "locking" signal which will be transmitted to the actuating mechanisms of the vehicle door latches and to any other mechanisms incorporated in the vehicle security system.

A shutter 43 is contained within the outer housing member 20 and is acted on by a spring 44 so as to be biassed into engagement with the surrounds of the key slot. The shutter 43 and spring 44 are mounted by means of a spindle 45 with the arrangenent such that the shutter 43 will serve to prevent the entry of most dust and dirt into the key slot. However, because the key slot is open at its rear end, any dirt which does happen to enter the slot will be pushed out of the rear thereof and there will be no accumulation of dirt within the slot.

The inner housing member 21 includes coupling formations 46 and 47 for engagement with an electric coupling element 48 (Figure 9), the electric coupling element 48 including socket connectors for electrical connection to pins 49 connected to the printed circuit board 29 and passing through apertures in the inner housing member 21.

The device illustrated in the drawings is intended to be mounted in the B post of a motor vehicle, with one device mounted on the driver's side of the vehicle and another on the opposite of the vehicle. The two devices form part of a vehicle security system which includes the vehicle door latches and boot or tailgate latch and may also include the steering column lock. The vehicle latches will include electrical actuators, e.g. motors or solenoids which can be operated to effect locking or unlocking of the latches in response to appropriate signals from a microprocessor. When a key is inserted into a device to operate the switch 38, the two diodes 31 will be energised for a predetermined period and then, as the key is removed from the key slot, a series of signals will be generated in dependence on the patterns of the apertures along the two edges 12 and 13 of the key. The signal received by the microprocessor will then be compared with a standard programme

previously fed into the microprocessor. With a key code as discussed above i.e., two rows of eight aperture positions with three possibilities concerning the provision of apertures at each position, the number of different codes will be 3^8, i.e. 6561. If a larger number of different key codes is required, the number of aperture positions along each edge of the key can be increased, either by lengthening the key or by reducing the size either of the apertures or the spaces between them. As a further alternative, a further series of apertures could be provided along the centre line of the key for registry with a third diode and phototransistor. There would then be seven possible aperture selections at each position so that, for eight aperture positions, there would be a total of 7^8 key codes, i.e., 5,764,801 possible codes.

If the code fed into the microprocessor on removal of a key is correct, i.e. it corresponds to that which has been programmed into the microprocessor, an "unlock" signal will be generated by the microprocessor to effect unlocking of the vehicle latches. If, however, when the code generated upon removal of the key does not correspond to the code previously programmed into the microprocessor, provision may be made for reintroduction of another code with the arrangement such that, if two incorrect codes are introduced into the microprocessor, a warning light, alarm buzzer or other indicator is actuated.

CLAIMS

1. A key-operated locking device for operation by a key having a light-impermeable blade formed with at least two series of light-permeable apertures, said device comprising a housing having a key slot for insertion of a key, switch means positioned for operation by an inserted key, light transmitter and receiver means associated with each of the series of apertures, and control means such that, on operation of the switch means by an inserted key, the light transmitter and receiver means are actuated to generate a series of key reading signals during withdrawal of the key in dependence on the arrangements of the apertures in the series of that key.

2. A device as in Claim 1 wherein the light transmitter and receiver means include a light emitter and a coacting light responsive receiver positioned on opposite sides of the slot to read each respective series of apertures.

3. A device as in Claim 2 wherein each light emitter is an infra-red emitting diode and each receiver is a phototransistor.

4. A device as in Claim 1, 2 or 3 wherein the control means includes a logic circuit responsive to the key reading signals to generate an unlocking signal for actuation of a security system in use to release one or more security devices only if a predetermined correct series of key reading signals has been generated.

5. A device as in Claim 4 wherein the logic circuit is responsive to the key reading signals to generate an alarm signal if incorrect series of key reading signals have been generated.

6. A device as in Claim 4 or 5 wherein the control means includes selectively actuable means for operating the logic circuit to generate a locking signal independently of insertion of the key to secure one or more security devices in use.

7. A device as in Claim 6 wherein the selectively actuable means includes a push button for actuating the light transmitter and receiver means and so causing said operation of the logic circuit.

8. A device as in any preceding claim wherein the key slot is open at its rear end so that a fully inserted key projects therebeyond.

9. A device as in any preceding claim including a spring-loaded shutter at the mouth of the key slot.

10. The combination of a device as in any preceding claim and a key having a light impermeable blade formed with at least two series of light-permeable apertures.

11. A combination as in Claim 10 wherein the key comprises an elongate flat metal blade having cut-outs in opposite longitudinal edges constituting the two series of apertures.

12. A combination as in Claim 11 wherein the blade is encased in transparent material.

13. A combination as in Claim 12 wherein said material is a plastics material shaped to provide a handle of the key.

14. A combination as in any one of Claims 10 to 13 wherein the key and the slot are shaped so that the key can only be fully inserted in one predetermined

orientation.

15. A combination as in Claim 14 wherein the key is T-shaped in cross-section over a portion of its length and the mouth of the slot is of complementary cross section.

16. A combination as in Claim 15 wherein the T-shaped portion is adjacent a handle of the key and the inner end of that portion is arranged to operate the switch means.

17. A combination as in Claim 16 including a resiliently loaded element operated by said inner end for actuating the switch means.

18. A combination as in Claim 16 so far as dependent on Claim 7 wherein said element is also operated by the push button.

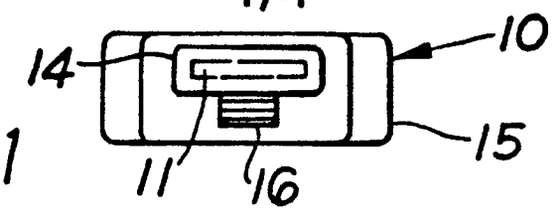


Fig. 1

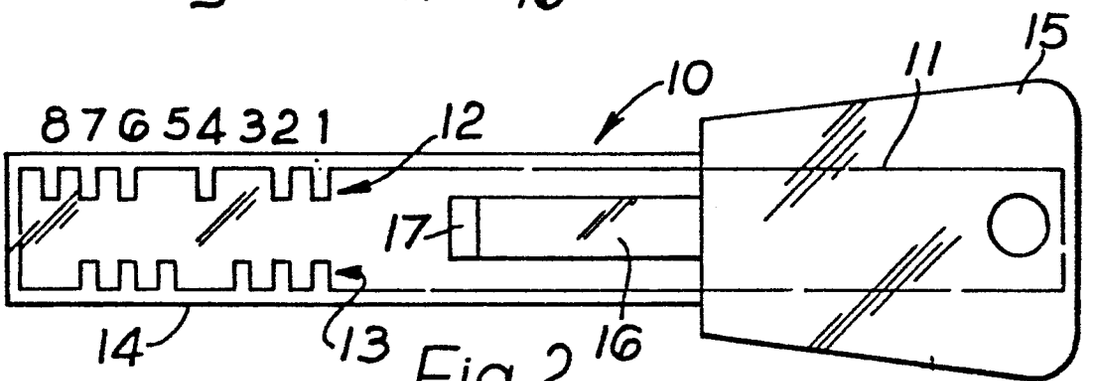


Fig. 2

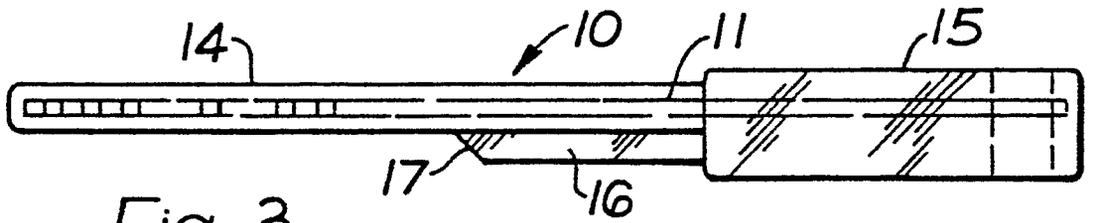


Fig. 3

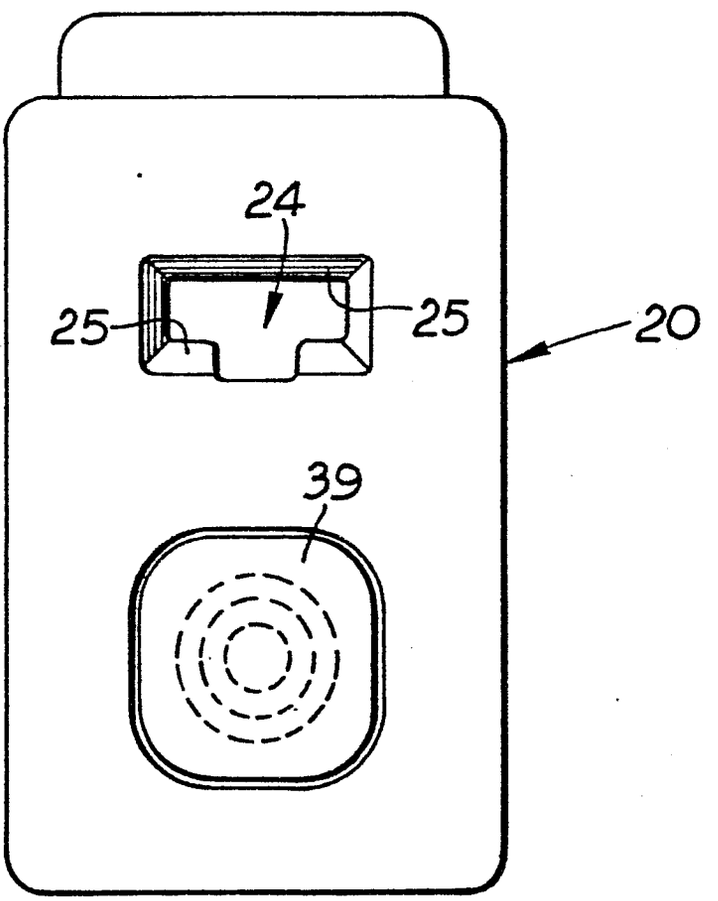


Fig. 4

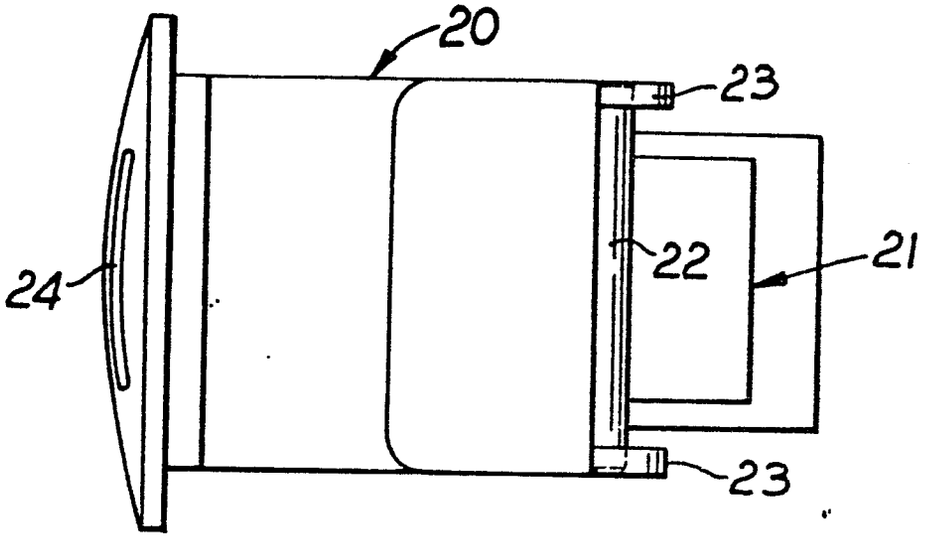


Fig. 5

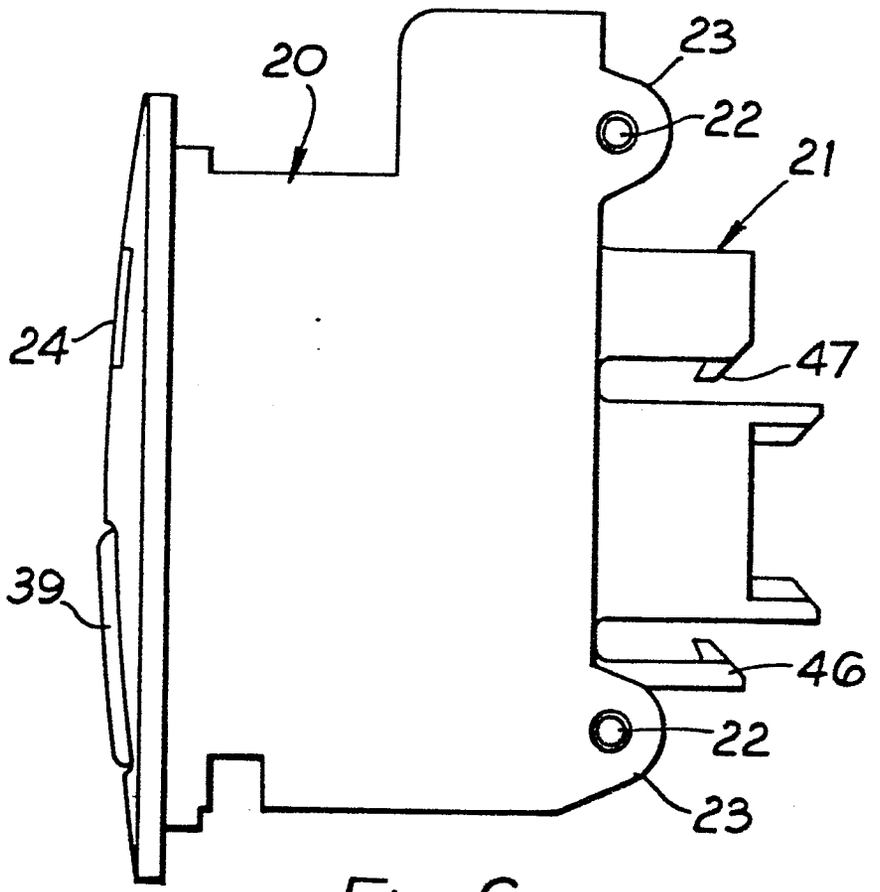


Fig. 6

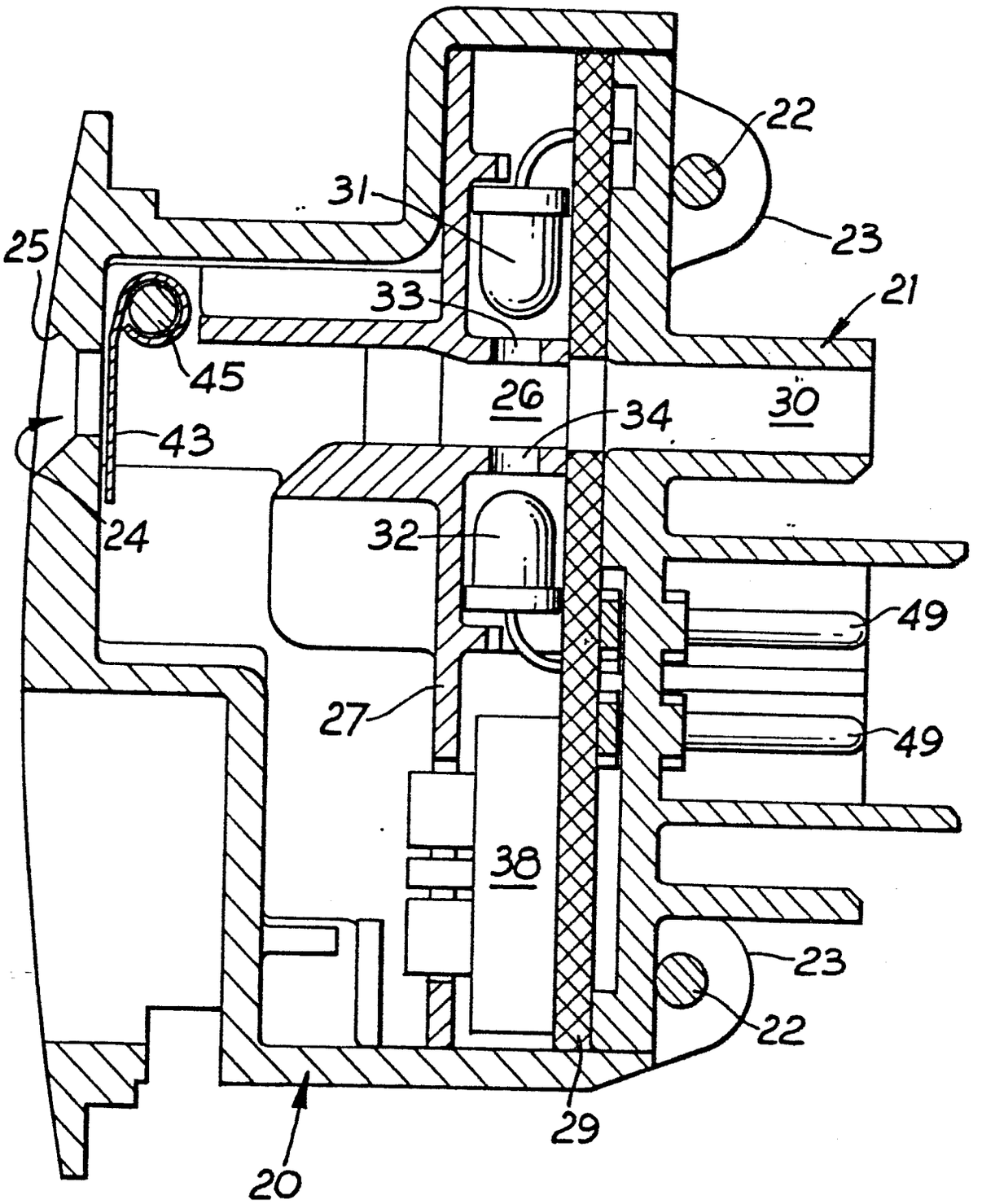
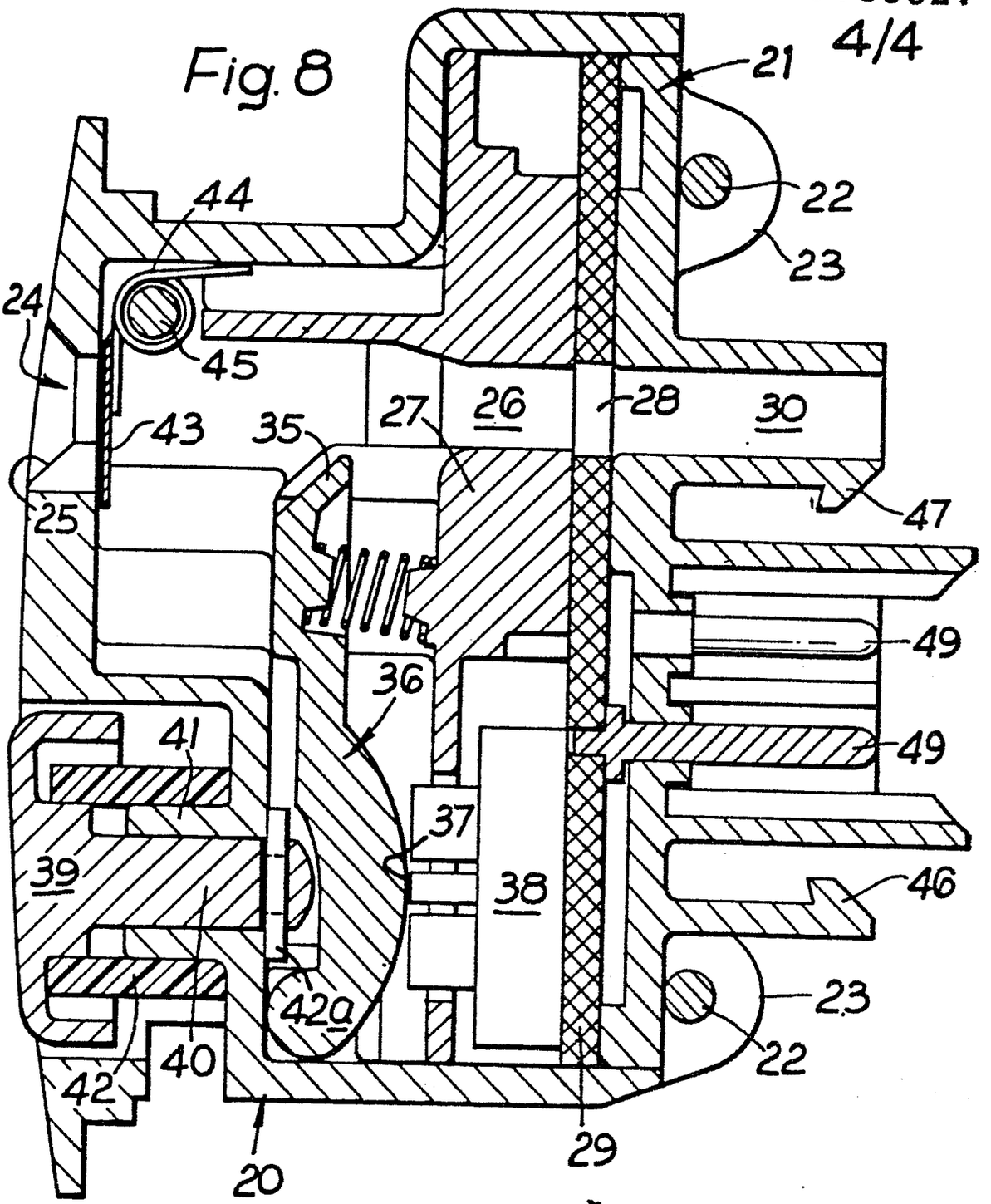


Fig. 7

Fig. 8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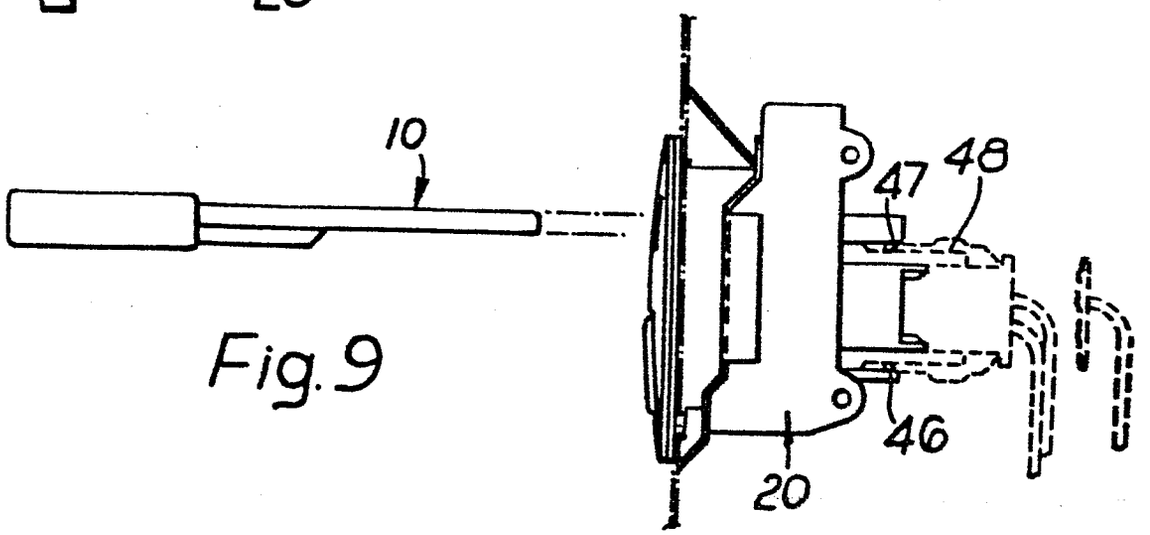
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Fig. 9

European Patent Office

EUROPEAN SEARCH REPORT

0130021
Application number

EP 84 30 4070

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	US-A-3 845 362 (ROE) * figures 1-4; column 2, line 38 - column 5, line 44 *	1-3,10	E 05 B 49/00
Y	US-A-3 947 666 (CARLSON) * figures 1-4; column 2, line 4 - column 3, line 42 *	1-3,10	
A	US-A-3 688 269 (MILLER) * figures 1,2; column 1, line 66 - column 3, line 64 *	1-5,10,14	
A	FR-A-2 160 024 (YMOS-METALLWERKE WOLF & BECKER) * figure 1; page 2, lines 12-34 *	1,9	
A	FR-A-2 137 279 (CROUZET) * figure 6; page 2, lines 23-30 *	1,11,13	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) E 05 B
A	BE-A- 886 293 (ISEO SERRATURE S.P.A.) * figure 1; page 3, lines 22-29 *	1,14,15	
A	LU-A- 80 434 (BATAILLE)	1-5	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-09-1984	HERBELET J.C.

CATEGORY OF CITED DOCUMENTS

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