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

(11) Publication number: **0 346 317**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **89850191.1**

(22) Date of filing: **08.06.89**

(51) Int. Cl.[4]: **E 05 B 49/00**

(30) Priority: **09.06.88 SE 8802167**

(43) Date of publication of application:
13.12.89 Bulletin 89/50

(84) Designated Contracting States:
BE CH DE FR GB IT LI

(71) Applicant: **Karlsson, Karl-Göran**
Aftonvägen 11
S-146 00 Tullinge (SE)

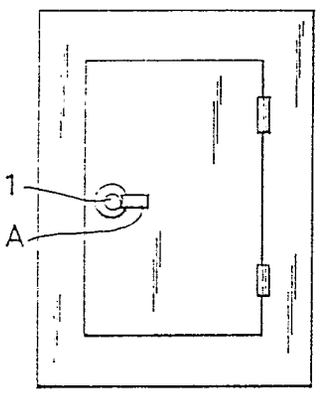
(72) Inventor: **Karlsson, Karl-Göran**
Aftonvägen 11
S-146 00 Tullinge (SE)

(74) Representative: **Norén, Per Bo Arne**
SWEDPATENT AB P.O. Box 186
S-198 00 Balsta (SE)

(54) **Device for combination locks.**

(57) Device for monitoring that a complete locking operation is carried out for a combination lock, including means (A) arranged adjacent to the dial (1) whereby the combination lock is manually manipulated, arranged to sense the rotary direction of the dial (1), and in association with a related electronical circuit to initiate counting of the number of revolutions for the dial (1) when same is rotated in a direction resulting in the release of the combination wheels within the lock, and to perform counting until a predetermined number of revolutions while the rotary direction is maintained unchanged. The means arranged adjacent to the dial (1) may include magnetical, conductive, optical or mechanical sensors for monitoring the rotary direction of the dial (1). An electric switching means is arranged to be operated when the door is closed, which is lockable by means of the combination lock, or to be influenced when the lock bolts are moved to a locked position, and to initiate the circuit for sensing rotary movement of the dial (1). A timer circuit is preferably connected at the same time, arranged to cause transmission of alarm, preferably of audio type, should the dial (1) not be rotated predetermined number of revolutions in a predetermined rotary direction within a time period monitored by the timer circuit. The entire device is preferably arranged to receive a voltage supply from a battery voltage source, preferably with a battery voltage monitoring circuit, arranged to indicate when the battery voltage drops below a predetermined lower limit.

Fig. 1



EP 0 346 317 A2

Description

The present invention relates to a device for combination locks.

In order to secure a complete locking operation for a combination lock, the rotatable dial used for input of the combination must be rotated a number of revolutions, and the required number of revolutions is related to the number of combination wheels included in the combination lock, e.g. for a lock having three combination wheels, the dial must be rotated at least three revolutions to secure completion of a locking operation. It is well known that many users only slightly turn said dial, whereby the lock appears to be locked. However, in such a case, it is extremely easy for an unauthorized person to operate the dial and thereby cause the combination wheel within the lock that has been slightly moved to return to the correct position for opening, and to gain access to the location protected by the combination lock. Combination locks do not normally include a device indicating whether or not the dial has been rotated a sufficient number of revolutions in correct rotary direction to secure a complete locking operation, and it is thus assumed that a user by its own initiative will rotate the dial in the correct direction, and with a sufficient number of revolutions.

GB-A-2 093 520 discloses a monitoring system for monitoring and electronical indication of the operative condition of a combination lock. It is based on having one side surface of the combination wheels included in a combination lock with areas that are alternately light reflecting and light non-reflecting. An optical detector is arranged adjacent to said side surface, including a light source and a light sensitive element. A part of the lock bolt mechanism is also correspondingly arranged with areas of light reflecting and non-reflecting type, and a second optical detector is arranged adjacent hereto. This makes it possible, in combination with an associated electronical circuit, to monitor the rotation of a combination wheel as well as the position of a part related to the lock bolt mechanism. However, this monitoring system is an integrated part of the combination lock, and it is thus no solution for existing installations of combination locks.

The object of the present invention is to disclose a device adapted to monitor that a complete locking operation is carried out with regard to existing installations of combination locks for safes and similar, which can be installed in a simple and rapid fashion, without demounting or modifying existing lock mechanism.

The device is arranged to monitor that a combination lock is completely locked, and it is mainly characterised in that it includes a means arranged adjacent to the dial whereby input of the combination is performed, arranged to monitor the rotary direction of the dial, and in combination with an associated electronical circuit initiate counting of the revolutions of the dial when same is rotated in a direction arranged to release the combination wheels of the lock, and to perform counting for a predetermined number of revolutions when the rotary direction is maintained unchanged.

A number of examples of embodiments according to the present invention will be more fully described below with reference to the accompanying drawings, in which:-

Fig. 1 is a plan view of a safe door with combination lock, and with a device according to the present invention attached adjacent to the dial whereby the combination lock is operated;

Fig. 2 is a plan view corresponding to Fig. 1, showing an alternative embodiment of the device according to the present invention;

Fig. 3 is a view, partly in cross-section, showing the dial whereby a combination lock is operated in combination with a first embodiment of a device for monitoring the rotary movement of the dial;

Fig. 4 is a view corresponding to Fig. 3, showing a second embodiment;

Fig. 5 is a view corresponding to Figs. 3 and 4, showing a third embodiment;

Fig. 6 is a perspective view of the dial whereby a combination lock is operated, arranged to facilitate monitoring of executed rotary movements in accordance with a fourth embodiment;

Fig. 7 is a view corresponding to Figs. 3 - 5, showing a fifth embodiment; and

Fig. 8 is an example of an electric circuit diagram for the device according to the present invention.

Fig. 1 is intended to serve as an example of how a device according to the present invention, as a complete unit denominated A, can be located in relation to the dial 1 whereby input of the combination of a combination lock is performed. As shown, the device A is attached to the same outside surface of a safe door or similar as the dial 1, and adjacent to the dial 1.

According to an alternative embodiment, as exemplified in Fig. 2, the device according to the present invention can also be arranged with only a smaller part B of the device attached adjacent to the dial 1, electrically connected by means of a wired circuit C to a second part D of the device, the second part D including associated electronical circuits and electric power supply, whereas the first part B includes means for monitoring the rotary movements of the dial 1.

An example of how such monitoring can be accomplished is shown in Fig. 3. In a peripheral portion of the dial 1, a permanent magnet 2 has been arranged located attached within a surrounding hole, and adjacent to the dial 1 are two tongue elements or Reed relays 3, 3′ arranged, which are operated successively in relation to each other when the dial 1 is rotated in any desired rotary direction. Based on the sequence of order in which the tongue elements

3, 3′ are operated, the present rotary direction can thus be decided, and counting of the number of rotary revolutions can also be initiated and carried out when rotation is performed in the rotary direction that results in locking of the combination lock, i.e. releases the combination wheels included in the combination lock.

A further example of how such monitoring can be carried out is shown in Fig. 4. The tongue elements 3, 3′ have been replaced by two coils 4, 4′, which, when the dial is rotated, cause an electric current pulse, whereby the sequence of order of generated current pulses on one hand facilitate monitoring of the rotary direction for the dial, and on the other hand also facilitate initation and counting of each other successively following rotary revolutions in a pre-determined rotary direction.

A modification of the embodiment of Fig. 4 is shown in Fig. 5. According to this embodiment, two permanent magnets 2, 2′ are arranged in successively following positions in relation to each other by the peripheral portion of the dial, and with the north and south pole of the permanent magnets 2, 2′ arranged in an opposed relationship to each other. Only one coil 4 is now required to monitor the rotary direction, and the number of revolutions, since the direction of the current for two each other successively following current pulses from the coil 4 indicate the rotary direction of the dial 1. When these current pulses indicate that the dial is rotated in a predetermined rotary direction, a counting circuit can be initiated, which counts the number of rotary revolutions while the pulse sequence is maintained in the same order.

The examplary embodiment of Fig. 5 can obviously be further modified, e.g. by arranging the two permanent magnets 2, 2′ to influence one or a number of magnetically operable switch means, which make it possible to receive an output signal representative for the order in which the permanent magnets 2, 2′ pass during the rotary movement of the dial 1, thus indicating rotary direction and facilitating count of each other successively following revolutions in a certain and predetermined rotary direction.

A further alternative embodiment is shown in Fig. 6. A visually readable marking 5 has now been applied by an outer portion of the dial 1, e.g. a tape attachable against the dial and having bar code markings of previously known type. Such bar code markings include lines spaced from each other, having a varied width, extending in a transverse relationship to the rotary direction. An optical reader 6, including a light source, e.g. a LED, and a light sensitive element, e.g. a photo transistor, is arranged to read the marking 5 by the dial 1, and can thus initiate a counter circuit when the reading of the marking 5 indicates that the dial 1 is rotated in a predetermined direction. Each completed revolution is thereafter counted, provided that the reading indicates that rotation is still performed in the same predetermined direction.

Reading of the rotary direction can obviously also be carried out by means of mechanical sensing, and an example of this is shown in Fig. 7. A wheel 7 is arranged in contact with a peripheral portion of the dial 1, and its rotary direction, and the number of revolutions, make it possible to monitor in which direction the dial 1 is rotated, and to count the number of successively following revolutions in a predetermined rotary direction. The method by which the rotation of the wheel 7 is sensed with regard to rotary direction/revolutions may be varied in a number of ways using known prior art, e.g. by arranging the wheel 7 to operate an electrical switching means for each completed revolution but only provided that rotation is performed in a certain direction. If rotation is performed in the opposed direction, a second switching means can be operated, which will reset a counter circuit connected to the first switching means.

The above described examples of embodiments for montoring the rotary direction of the dial 1, and for counting the number of revolutions in a predetermined rotary direction, are according to the present invention combined with a counter circuit, and a circuit for sensing whether or not the dial 1 is rotated in the predetermined direction. An example of such a circuit is shown more in detail in Fig. 8, adapted, for example, to be used with the embodiment described with reference to Fig. 3. Since desired functions can be accomplished with a number of alternative circuits, the circuit shown in Fig. 8 is only intended to serve as a non-restricting example.

Monitoring and sensing of the rotary direction of the dial 1 is carried out as briefly described below:-

a) A counter circuit is initiated when a predetermined rotary direction resulting in release of the combination wheels is indicated.

b) Provided that a successively following indication confirms correct rotary direction, the counter circuit is increased by one step; should a different rotary direction be indicated, the counter circuit is reset.

c) Operation b) is repeated a predetermined number of times, until the counter circuit has counted that the dial has been rotated, for example, four revolutions.

The above described operations (a - c) are initiated only when a safe door or similar, intended to be locked, has been moved to a closed position. This can be accomplished by a magnetic switch or other type of switching means, which is influenced when a closing operation is performed, or when the lock bolts are moved to an interconnecting position. When the switching means indicates that a closing operation has been performed, a voltage feed is applied to a timer circuit. Should the dial 1 of the combination lock not be rotated a predetermined number of revolutions, for example four, in one direction only and within the time period monitored by the timer circuit, e.g. 10 seconds, the counter is reset, and the dial must again be rotated four revolutions. Should the counter circuit not be influenced during the time period monitored, an acoustic signal source is connected, which will indicate to the user that a correct locking sequence has not been performed.

The device may also advantageously be arranged with a terminal for connection to an alarm system.

This would result in the advantage, that when switching on the alarm system, it is checked whether or not the combination lock has been locked with the correct number of revolutions. Furthermore, when the alarm system is switched on, the dial of the combination lock can not be manipulated, without causing alarm transmission.

The device can obviously further include one or a number of optical signalling sources, e.g. of LED type, intended to indicate status. Accordingly, for example, a green LED may be lit when the lock is completely locked, whereas a red indicates when the lock is in an open position, or only partly locked. Obviously, for example, the latter may be arranged to be connected when the aforementioned timer circuit is connected, and to be switched off or replaced by another optical signalling source when a complete locking operation has been performed.

The device according to the present invention is advantageously arranged to be fed from one or a number of electrical batteries enclosed within the device, whereby voltage feed from a mains voltage source is not required. As a suitable battery voltage source can be stated a 9 volt battery, and the device may also advantageously include a voltage monitoring circuit, arranged to acoustically or optically indicate when the battery voltage has been reduced below a predetermined limit, and when a change of battery thus should be performed.

The above described examples of embodiments are only intended to serve as examples of embodiments, and may thus be combined as desired, as well as modified within the scope of the inventive thought and the following claims.

Claims

1. Device for monitoring that a combination lock is completely locked, characterised in that it includes a means (2, 2′; 3, 3′; 4, 4′; 5, 6; 7) arranged adjacent to the dial (1) whereby input of the combination is performed, arranged to monitor the rotary direction of the dial (1), and in combination with an associated electronical circuit initiate counting of the revolutions of the dial (1) when same is rotated in a direction arranged to release the combination wheels of the lock, and to perform counting for a predetermined number of revolutions when the rotary direction is maintained unchanged.

2. Device according to claim 1, characterised in that the means arranged adjacent to the dial (1) comprises of two tongue elements (3, 3′) arranged successively following each other in the rotary direction of the dial (1), arranged to be influenced by means of a permanent magnet (2) attached to the dial (1).

3. Device according to claim 1, characterised in that the means arranged adjacent to the dial (1) comprises of two conductive sensors arranged successively following each other in the rotary direction of the dial (1), comprising for example two coils (4, 4′), arranged to be influenced by means of a permanent magnet (2) attached to the dial (1).

4. Device according to claim 1, characterised in that the means arranged adjacent to the dial (1) comprises of a coil (4) located adjacent to the dial (1), arranged to be influenced by means of two permanent magnets (2, 2′) attached to the dial (1) successively following each other in the rotary direction, arranged with the magnetical north and south poles in an opposed relationship to each other.

5. Device according to claim 1, characterised in that the means arranged adjacent to the dial (1) comprises at least one magnetically operated electric switching means located adjacent to the dial (1), arranged to be influenced by means of two permanent magnets (2, 2′) attached to the dial (1) successively following each other in the rotary direction, arranged with the magnetical north and south poles in an opposed relationship to each other, said switching mean/switching means being arranged to be influenced in a different fashion based on the sequence of order whereby the permanent magnets (2, 2′) perform a bypassing movement.

6. Device according to claim 1, characterised in that the means arranged adjacent to the dial (1) comprises of an optically readable member (5) including markings having in relation to each other different character and arranged by the dial, and an optical reader (6) located adjacent to the dial (1).

7. Device according to claim 1, characterised in that the means arranged adjacent to the dial (1) comprises of a rotary member (7) in contact with the dial (1), arranged to perform a rotary movement when the dial (1) is rotated, and with means arranged to transform said rotary movement into signals which on one hand indicate rotary direction, and on the other hand the number of revolutions of the dial (1) in at least one predetermined rotary direction.

8. Device according to any one of claims 1 - 7, characterised in that an electric switching means is arranged to be operated when the door is closed which is lockable by means of the combination lock, or to be operated when the lock bolts are moved to a locked position, and that the monitoring circuit for the rotary direction of the dial (1) is activated for monitoring when said switching means is operated.

9. Device according to claim 8, characterised in that a timer circuit is arranged to be connected when the electric switching means is operated, and to transmit an alarm signal, preferably of audio type, should a predetermined number of successively following revolutions of the dial (1) not be performed in a predetermined rotary direction during a time period monitored by the timer circuit, said device further advantageously comprising a terminal for connection to an alarm system, arranged to facilitate indication whether or not a complete locking operation has been performed, and preferably also being arranged to

cause alarm when the dial (1) is rotated and the alarm system is switched on.

10.Device according to any one of claims 1 - 9, characterised in that the device as a complete unit receives a current feed from a battery voltage source, and that the device also preferably includes a battery voltage monitoring circuit, arranged to cause a visual or optical type of indication when the battery voltage has dropped below a predetermined lower limit.

Fig. 1

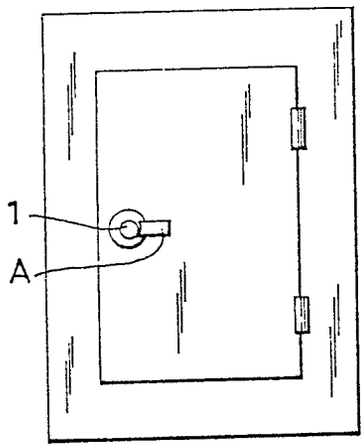


Fig. 2

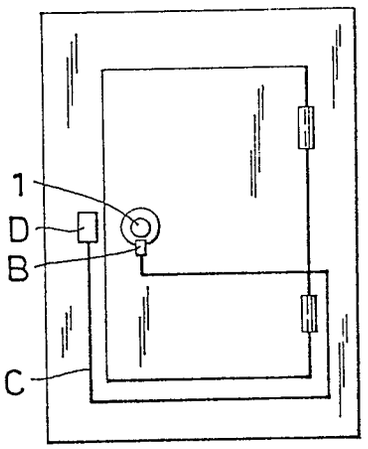


Fig. 3

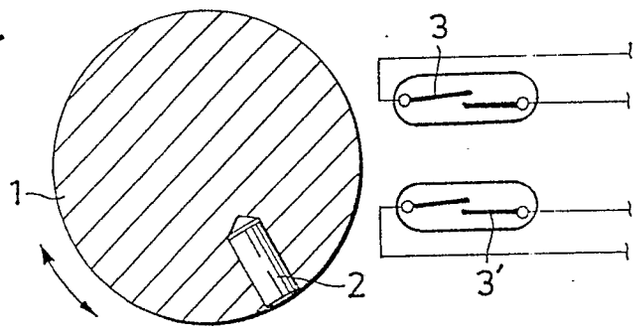


Fig. 4

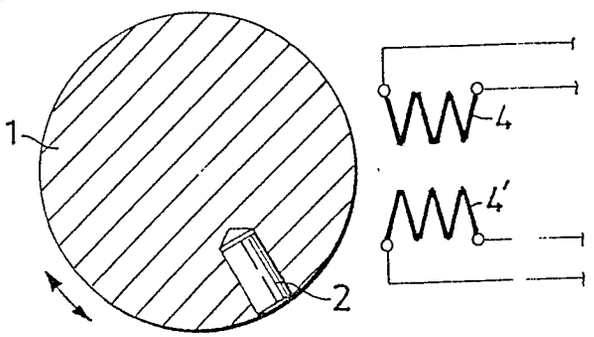


Fig. 5

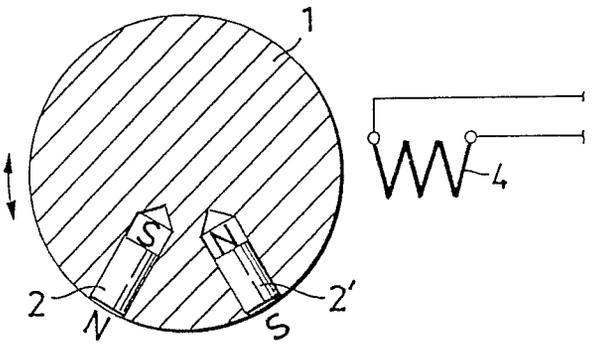


Fig. 6

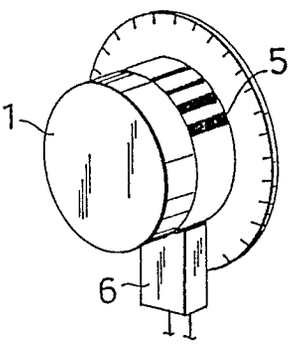
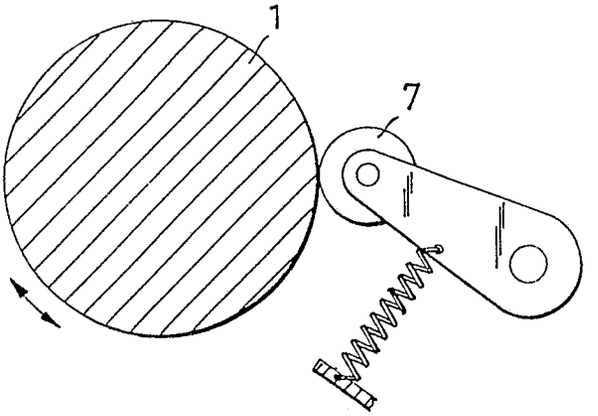


Fig. 7



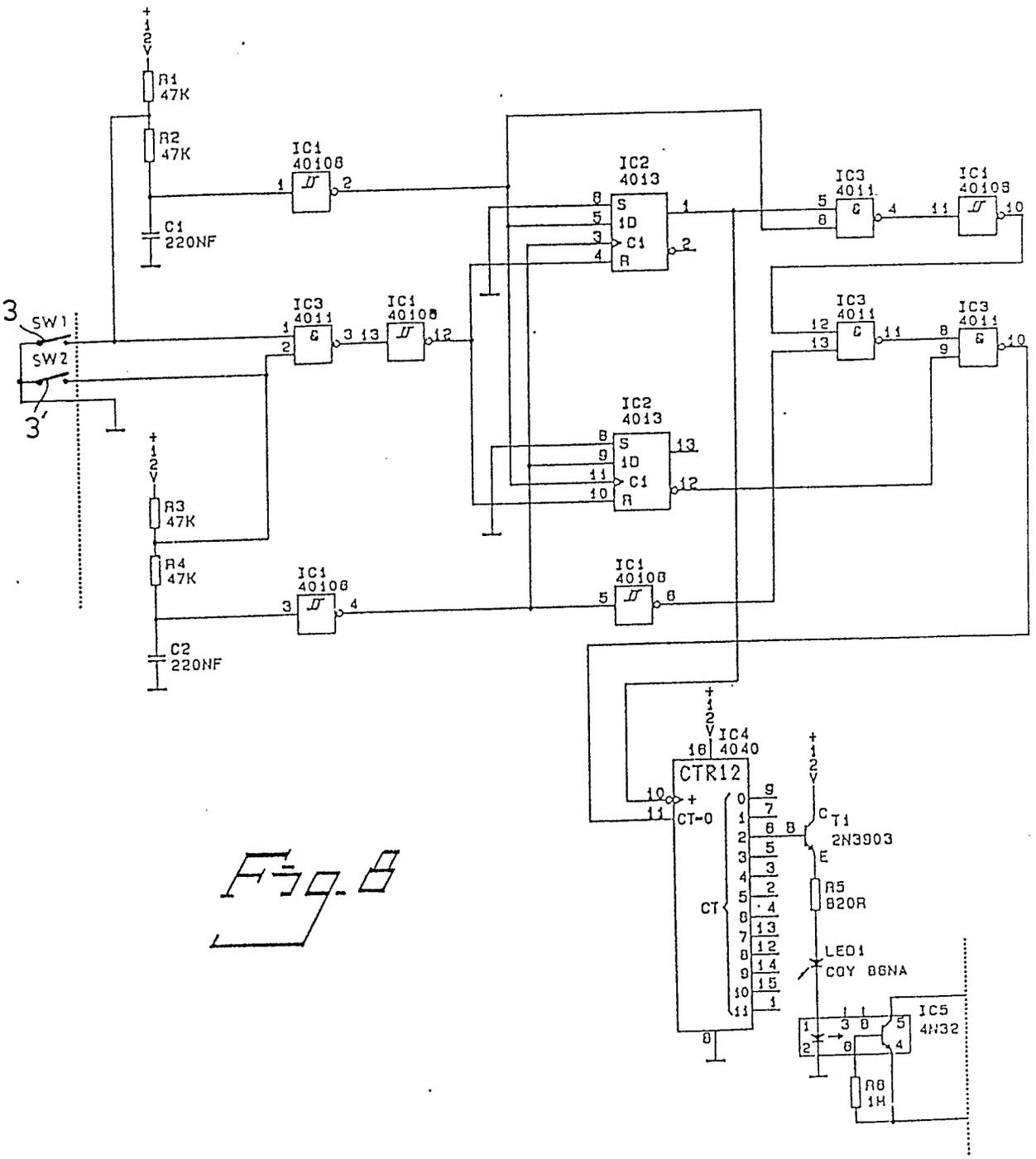

+12V
R1
47K
R2
47K
C1
220NF
IC1
40106
IC2
4013
S
1D
C1
R
IC3
4011
SW1
SW2
3
3'
R3
47K
R4
47K
C2
220NF
IC4
4040
CTR12
CT-0
CT
IC5
4N32
T1
2N3903
R5
820R
LED1
COY 86NA
R6
1M

Fig. 8