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GB 2178474 A

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(54) Electromagnetic lock

(57) An electromagnetic lock 2 comprising a housing 4, a locking member 6, a shaft 8, a cam device 10, an electromagnetic clutch device 12, a coil spring clutch 14, and abutment means 16, the cam device 10 and the electromagnetic device 12 being rotatable with respect to the shaft 8, the abutment means 16 being fixed with respect to the shaft 8, the coil spring 14 having a first end portion 18 and a second end portion 20, and the electromagnetic lock 2 being such that activation of the electromagnetic device 12 causes the electromagnetic device 12 to become connected to the abutment means 16 by magnetism means. Rotation of the shaft 8 then causes rotation of the abutment means 16 and the electromagnetic device 12. The coil spring 14 then reduces in diameter and grips the cam device 10 to cause the cam device 10 to rotate and the locking member 6 to slide from the extended position to the retracted position in order to open the electromagnetic lock 2.

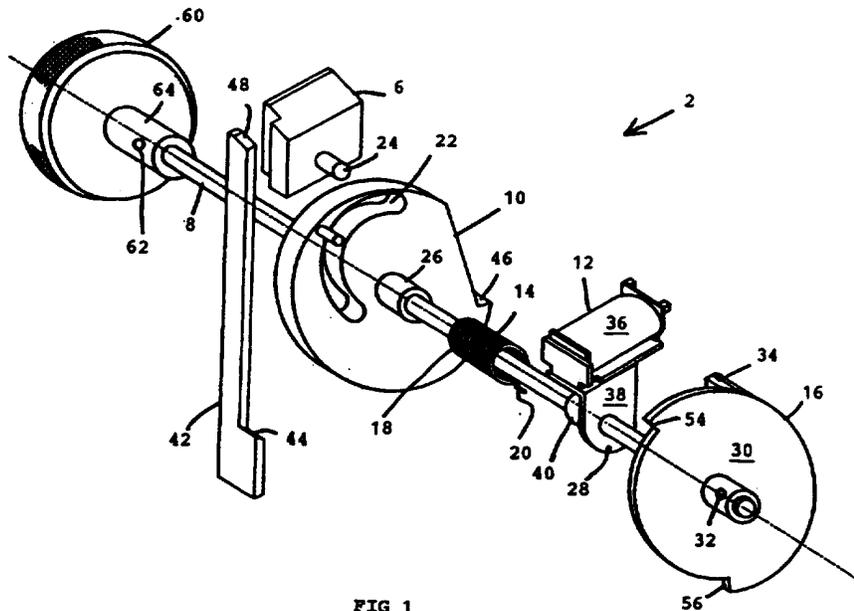


FIG 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

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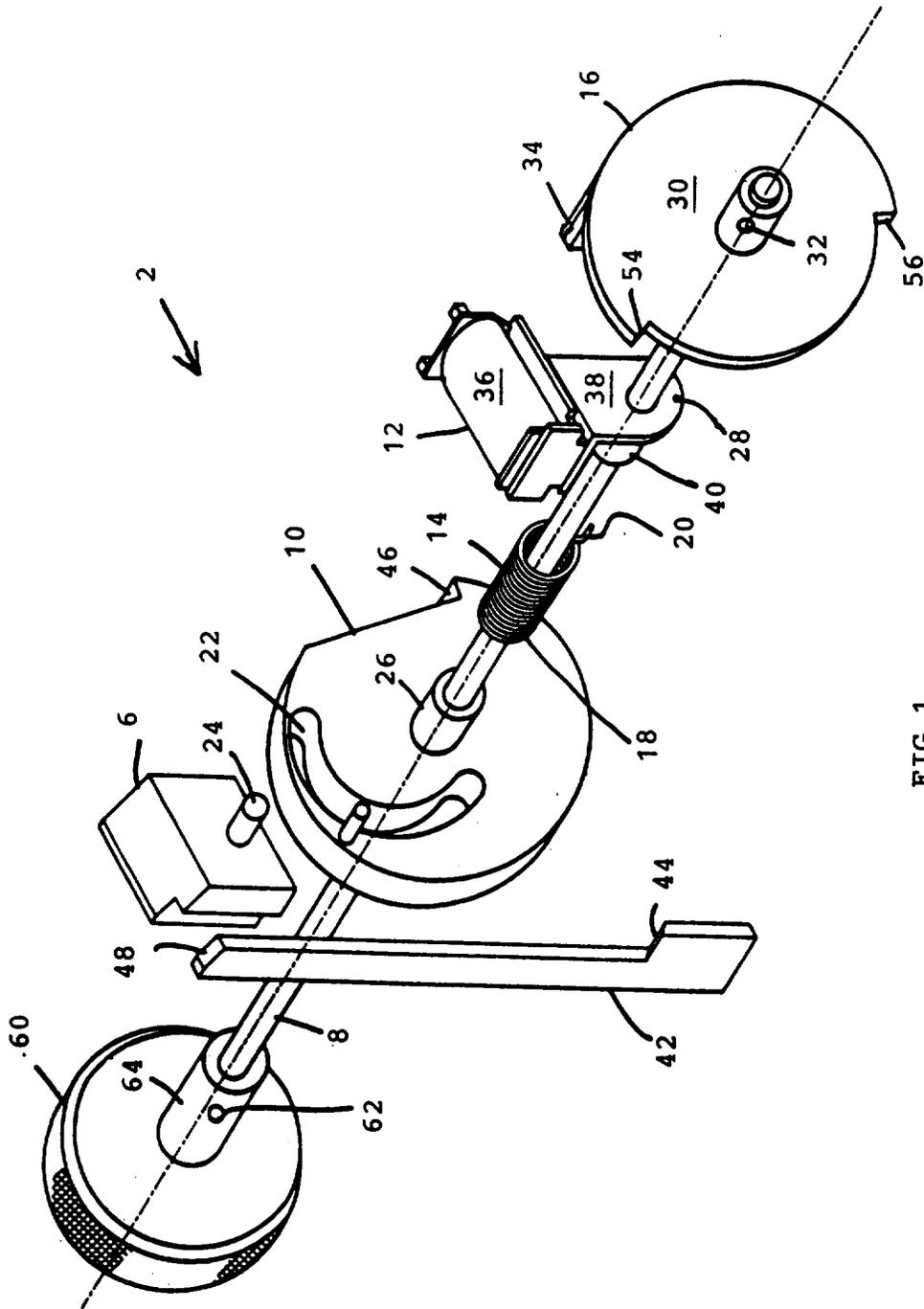


FIG 1

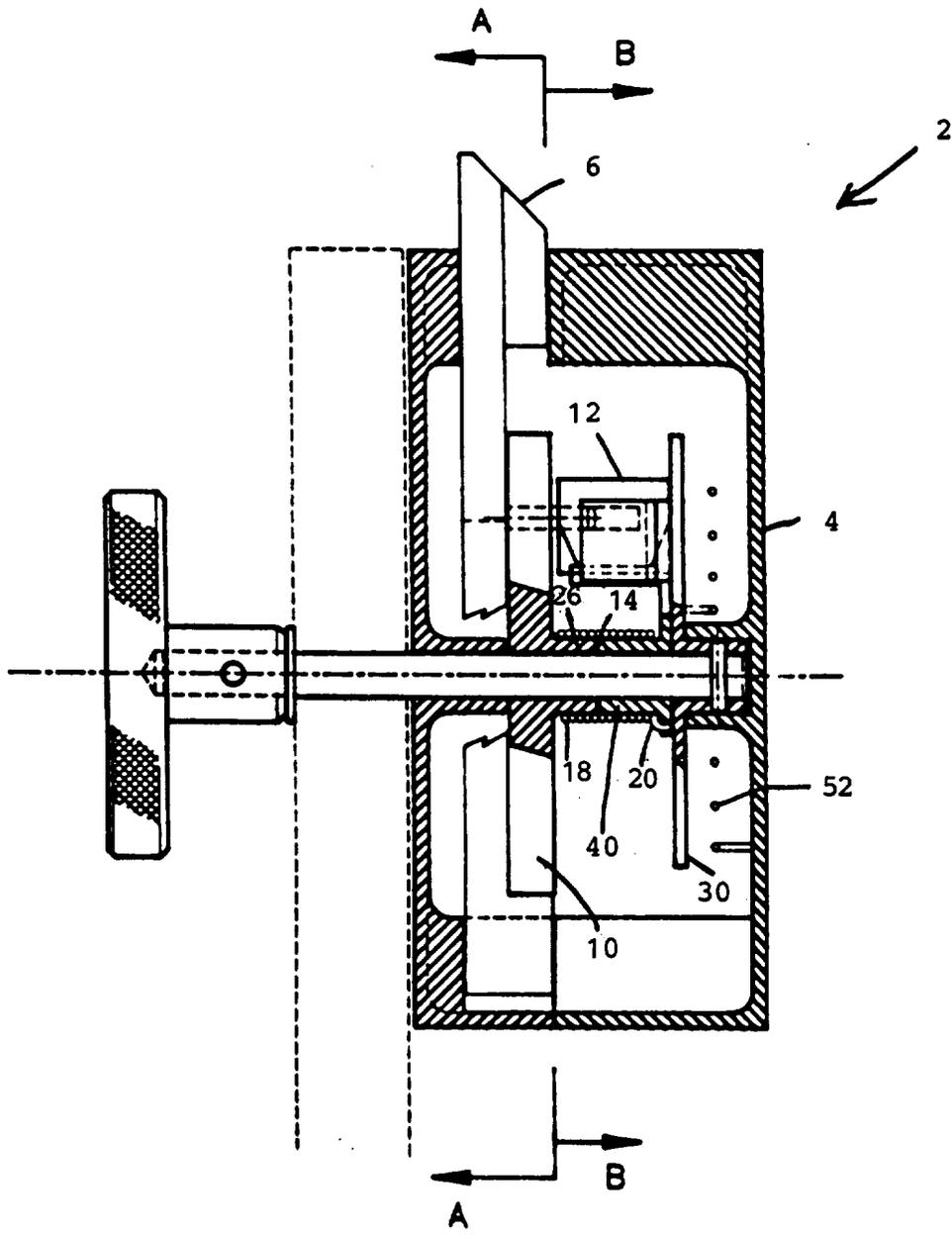
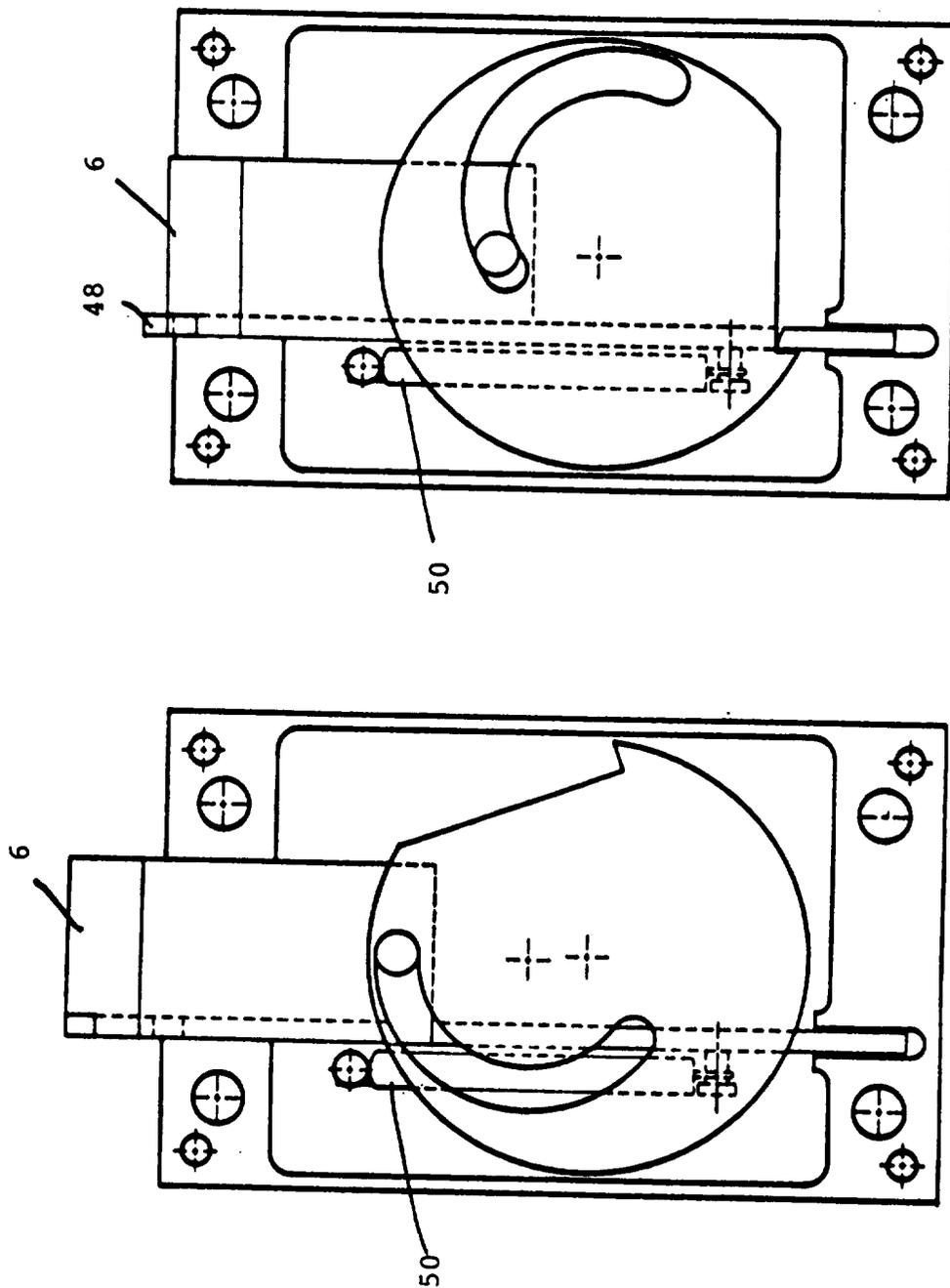
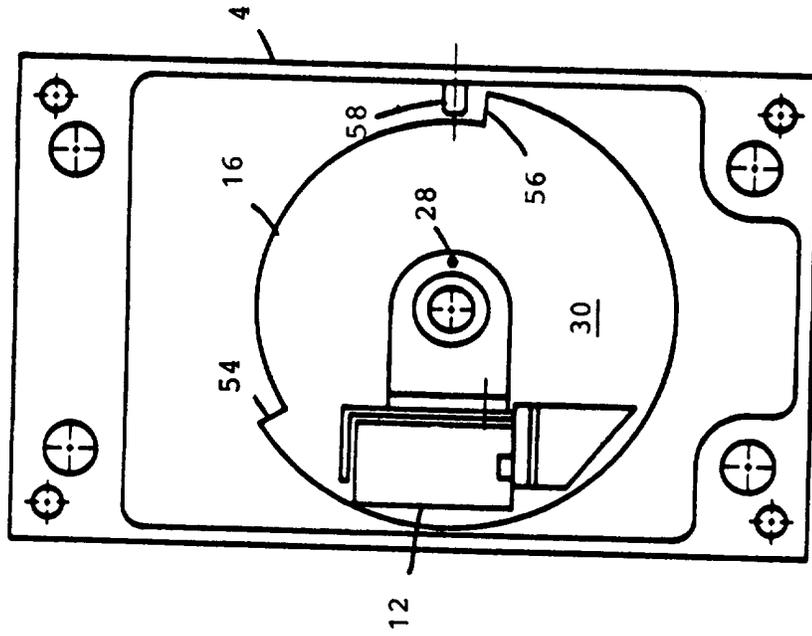


FIG 2

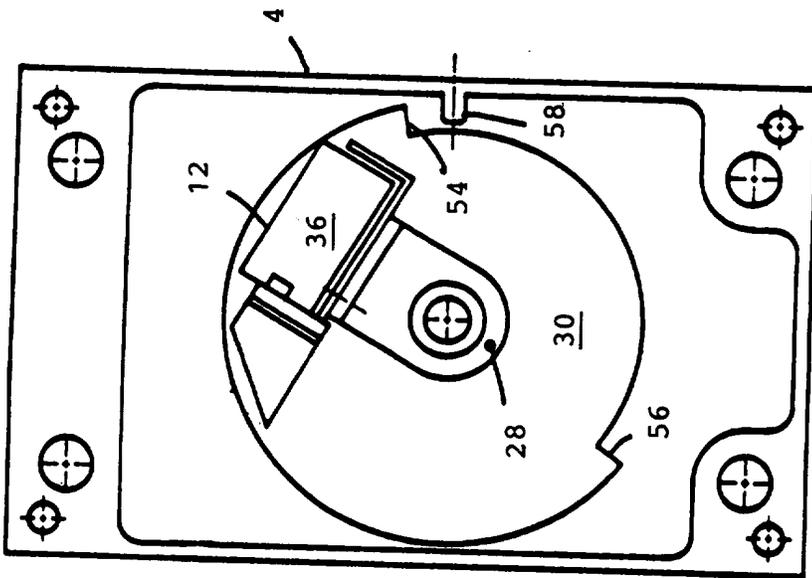


OPEN
FIG 4

CLOSED
FIG 3



OPEN
FIG 6



CLOSED
FIG 5

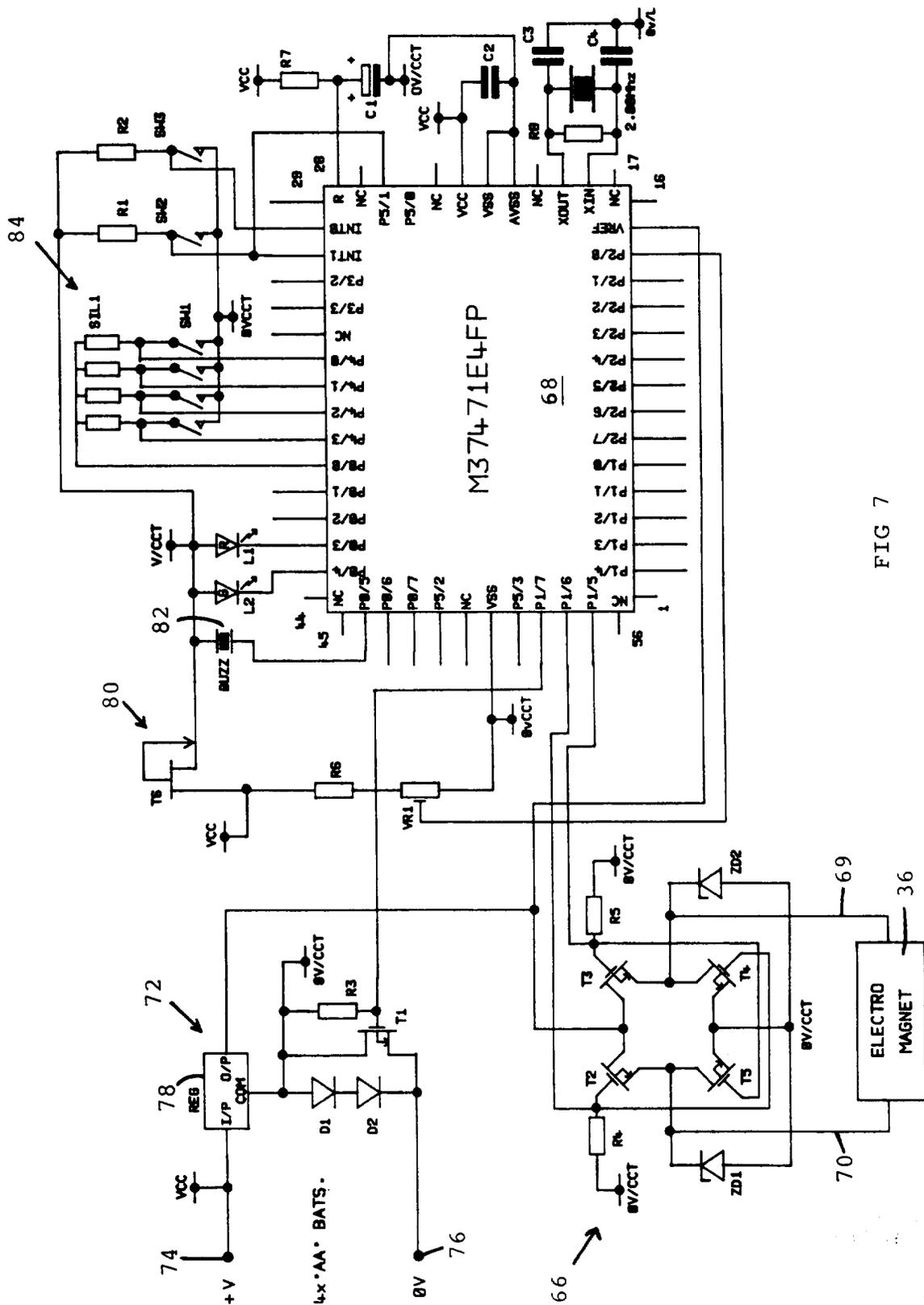


FIG 7

AN ELECTROMAGNETIC LOCK

This invention relates to an electromagnetic lock.

In accordance with one non-limiting embodiment of the present invention, there is provided an electromagnetic lock comprising a housing, a locking member which is slidable with respect to the housing between an extended position in which the electromagnetic lock is closed and a retracted position in which the electromagnetic lock is open, a shaft, a cam device on the shaft, an electromagnetic device on the shaft, a coil spring on the shaft, and abutment means on the shaft, the cam device and the electromagnetic device being rotatable with respect to the shaft, the abutment means being fixed with respect to the shaft, the coil spring having a first end portion which is engageable with the cam device and a second end portion which is connected to the electromagnetic device, and the electromagnetic lock being such that activation of the electromagnetic device causes the electromagnetic device to become connected to the abutment means due to magnetism, whereby rotation of the shaft then causes rotation of the abutment means and the electromagnetic device, whereby rotation of the electromagnetic device then

causes the coil spring to reduce in diameter and grip the cam device such that the cam device is caused to rotate, and whereby rotation of the cam device then causes the locking member to slide from the extended position to the retracted position in order to open the electromagnetic lock.

The electromagnetic lock of the present invention may be used on any suitable and appropriate type of container including safes, cash tills and office cupboards. The safes may be hotel safes.

The cam lock may be one in which the cam device has a curved slot which receives a pin on the locking member.

The cam device preferably has a central boss which extends into the first end portion of the coil spring and which is gripped by the coil spring when it reduces in diameter. Arrangements other than a central boss may be employed if desired.

Preferably, the second end portion of the coil spring is a pointed portion which extends into an aperture in the electromagnetic device. Arrangements other than a pointed end portion may be employed if desired.

The abutment means is preferably a disc which is secured to the shaft and which has an abutment plate extending outwardly of the disc for engagement with

the electromagnetic device. The abutment means may generally be of any suitable and appropriate shape.

The electromagnetic lock may include hold means for holding the electromagnetic lock in the open condition when the electromagnetic lock is de-activated. Thus, for example, the electromagnetic lock may be de-activated as soon as possible in order to conserve electricity, this being especially important if the electromagnetic lock is battery operated rather than mains operated.

The hold means is preferably a cam lock which locks the cam in a position in which the locking member is in the retracted position. The cam lock is preferably a lever which has a shoulder portion for engaging with a shoulder portion on the cam to effect the locking of the cam device.

Advantageously, the electromagnetic lock is one in which the lever extends proud of the housing in the locking position of the lever, in which closing of the electromagnetic lock causes the lever automatically to move and the two shoulder portions to come out of engagement, and in which the electromagnetic lock includes first spring biasing means for biasing the lever to a position ready for a next rotation of the cam device.

The lock may include second spring biasing means for biasing the cam device to a position in which the electromagnetic lock is closed.

The abutment means may have first and second stop members for restricting clockwise and anti-clockwise rotation of the abutment means by the shaft.

The electromagnetic lock may include handle means for enabling the shaft manually to be rotated. The handle means may then be a knob or a lever. In an alternative embodiment of the invention, the electromagnetic lock may include drive means for enabling the shaft automatically to be rotated. The drive means is preferably an electric motor but other types of drive means may be employed.

The locking means may be a rectilinear locking member having an inclined face. Other types of locking member may be employed.

The electromagnetic lock may include an energizer circuit for energizing the electromagnetic lock.

Preferably, the energizer circuit comprises an oscillator arrangement for causing an electric current to pass through an electromagnet of the electromagnetic lock in alternating directions and for increasingly shorter periods of time thereby to de-energize the electromagnet. The use of such an energizer circuit provides a very swift de-

energization of the magnetic connection between the electromagnetic device and the abutment means. This in turn means that the locking member is able to swiftly and easily be returned to its locking position, for example by the first spring biasing means.

The oscillator arrangement may comprise two pairs of field effect transistors and a switching circuit for causing alternate operation of the field effect transistors.

The energizer circuit may be d.c. powered and it may include a level changing circuit for reducing and effecting a controlled take-off of available power from a battery power source. The battery power source may be one or more batteries. The energizer circuit may give very low power consumption. The energizer circuit will normally be such that when the electromagnetic lock is in a locked condition, then the energizer circuit will be in a sleep mode using minimal power.

The energizer circuit may be operated by a switch. The switch may be a push button switch or a lever switch.

When the energizer circuit is energized by a switch, then the electromagnetic lock may include time delay means for providing a time delay before the

electromagnetic lock can be opened. Such an arrangement may be especially suitable for Post Offices and similar establishments where a time delay function may be required in order to thwart raiders. Any known suitable and appropriate time delay means may be employed. The time delay means may give a time delay of, for example, one to ten minutes.

In an alternative embodiment of the invention, the energizer circuit may be operated by an unlocking combination from a key pad. With such an arrangement, the electromagnetic lock may include time delay means operable consequent upon an incorrect unlocking combination being entered. The incorrect unlocking combination being entered may be a first received such combination or it may be a second or any other predetermined received incorrect unlocking combination, thereby giving an operator a chance to correct a mistake prior to causing operation of the time delay means.

An embodiment of the invention will now be described solely by way of example and with reference to the accompanying drawings:

Figure 1 is an exploded perspective view of an electromagnetic lock;

Figure 2 is a section through the lock as shown in Figure 1 and in an assembled condition;

Figure 3 is a view on line A - A and shows the lock in a closed condition;

Figure 4 is a view on line A - A and shows the locks in an open position;

Figure 5 is a view on line B - B and shows the lock in a closed position;

Figure 6 is a view on line B - B and shows the lock in an open position; and

Figure 7 is a circuit diagram for an energizer circuit for the electromagnetic lock shown in Figures 1 - 6.

Referring to Figures 1 - 6, there is shown an electromagnetic lock 2 comprising a housing 4 and a locking member 6 which is slidable with respect to the housing 4 between an extended position as shown in Figures 2 and 3 in which the electromagnetic lock 2 is closed, and a retracted position as shown in Figure 4 in which the electromagnetic lock 2 is open.

The electromagnetic lock 2 also comprises a shaft 8, a cam device 10, an electromagnetic device 12, a coil spring 14 and abutment means 16. The cam device 10, the electromagnetic device 12, the coil spring 14 and the abutment means 16 are all mounted on the shaft 8 as best seen from Figures 1 and 2.

The cam device 10 and the electromagnetic device 12 are rotatable with respect to the shaft 8. The

abutment means 16 is fixed with respect to the shaft 8.

As best seen from Figures 1 and 2, the coil spring 14 has a first end portion 18 which is engageable with the cam device 10, and a second end portion 20 which is connected to the electromagnetic device 12.

The electromagnetic lock 2 is such that activation of the electromagnetic device 12 causes the electromagnetic device 12 to become connected to the abutment means 16 due to magnetism. Rotation of the shaft 8 then causes rotation of the abutment means 16 and the electromagnetic device 12. Rotation of the electromagnetic device 12 then causes the coil spring 14 to reduce in diameter and grip the cam device 10 such that the cam device 10 is caused to rotate. Rotation of the cam device 10 then causes the locking member 6 to slide from the extended position to the retracted position in order to open the electromagnetic lock 2.

As can be seen from Figure 1, the cam device 10 has a curved slot 22 which received a pin 24 on the locking member 6. The cam device 10 also has a central boss 26 which extends into the first end portion 18 of the coil spring 14. The central boss 26

is gripped by the first end portion 18 of the coil spring 14 when the coil spring 14 reduces in diameter.

As can best be seen from Figure 1, the second end portion 20 of the coil spring 14 is a pointed portion which extends into an aperture 28 in the electromagnetic device 12.

The abutment means 16 is a disc 30 which is secured to the shaft 8 by a pin 32. The disc 30 has an abutment plate 34 which extends outwardly of the disc 32 as shown in Figure 1 and which engages the electromagnetic device 12 by magnetism when the electromagnetic device is energized with electric current. The electromagnetic device 12 has an electromagnet 36 and a mounting arm 38. The mounting arm 38 has an outwardly extending boss 40 which is received in the coil spring 14 from the second end portion 20. When the coil spring 14 reduces in diameter, the second end portion 20 of the coil spring 14 adjacent the pointed end grips the boss 40.

The electromagnetic lock 2 includes hold means 42 for holding the electromagnetic lock 2 in the open condition when the electromagnetic device is deactivated. The hold means 42 is a time lock which locks the cam 10 in a position in which the locking member 6 is in the retracted position. The hold means 42 is a lever as can be seen from Figure 1. The lever

has a shoulder portion 44 which is inclined and which engages with a shoulder portion 46 on the cam device 10 to effect the locking of the cam device 10.

The hold means 42 in the form of the illustrated lever has an inclined tip 48 which extends proud of the housing 4 in the open condition of the electromagnetic lock 2 as shown in Figure 4. When a door, drawer or other device is pushed shut to lock the drawer, door or other device, then the tip 48 catches on a keep plate or other device and gets pushed downwardly as shown in Figure 4. When this happens, the shoulder portion 44 comes out of engagement with the shoulder portion 46 and the cam device 10 is then allowed to rotate from the open position shown in Figure 4 to the closed position shown in Figure 3. This rotation of the cam device 10 causes the locking member 6 to move from the retracted position shown in Figure 4 to the extended position shown in Figure 3. It will thus be apparent that closing of the electromagnetic lock 2 by pushing the drawer, door or the like shut causes the hold means 42 automatically to move to get ready for another opening cycle. First spring biasing means in the form of a spring 50 biases the hold means 42 towards the retracted position. Second spring biasing means in

the form of a spring 52 acts to rotate the cam device 10 to the closed position shown in Figure 3.

The disc 30 of the abutment means 16 has a first stop member 54 and a second stop member 56 in the form of a pair of shoulder as shown in Figure 1. The first and the second stop members 54, 56 engage on a pin 58 which extends from the housing 4 as shown in Figures 5 and 6. The first and second stop members 54, 56 thus restrict the clockwise and anti-clockwise rotation of the abutment means 16.

Opening of the electromagnetic lock 2 is caused by rotation of the shaft 8 once the electromagnetic device 12 has been energized. Rotation of the shaft 8 is effected by rotating a handle 60 which is secured to the shaft 8 by a pin 62 passing through a boss 64 of the handle 60 which extends over the shaft 8.

The electromagnetic lock 2 shown in Figures 1 - 6 is powered by an energizer circuit as shown in Figure 7.

Power for the electromagnet 36 is provided by an oscillator arrangement 66 which is effective for causing at the end of an opening period, an electric current to pass through the electromagnet 36 in alternating directions and for increasingly shorter periods of time, thereby to reduce the holding power of the electromagnet device 12. This ensures that the

electromagnetic device 12 does not remain magnetized for relatively long periods of time and thus saves on battery power.

The oscillator arrangement 66 comprises two pairs of field effect transistors T2, T4; T3, T5. The two pairs of transistors T2, T4; T3, T5 are operated alternately. The operation is effected by a switching circuit in the form of a computer chip 68. Current from the oscillator arrangement 66 passes to the electromagnet 36 via leads 69, 70. A pair of Zener diodes ZD1 and ZD2 are employed as shown for the purpose of avoiding a back electro motive force. Protector resistors R4, R5 are also employed as shown.

The computer chip 68 is able to provide a variable time delay as may be required.

The energizer circuit shown in Figure 7 includes a level changing circuit 72 for reducing power from a battery power supply connected between terminals 74, 76. The level changing circuit 72 is also able to provide a controlled take off of the available power from the battery or batteries. The level changing circuit 72 comprises diodes D1, D2, a transistor T1, a resistor R3, and a regulator 78. The use of the level changing circuit 72 ensures that very little consumption is taken from the battery power supply.

In Figure 7, the resistor R1 represents a start button. Resistor R2 represents a cancel button for use if it is desired to open the electromagnetic lock 2 after the start button R1 has been pressed. The electromagnetic device 12 is only provided with current during relatively short operating times during which it is possible to rotate the handle 60. The battery or batteries for the battery power supply may be provided in a container (not shown). This container and a time delay switch may be provided in a normally non-accessible secure part of the electromagnetic lock 2.

The energizer circuit shown in Figure 7 includes a power reducing circuit. The power reducing circuit 80 includes a power reducing transistor T6.

When it is possible to open the electromagnetic lock 2, then a green light emitting diode L2 is illuminated. When it is not possible to open the electromagnetic lock 2, then a red light emitting diode L1 is operated. When the electromagnetic lock 2 is able to be opened, audible means in the form of a buzzer 82 operates.

The energizer circuit shown in Figure 7 includes switches SW2 and SW3 associated with resistors R1, R2 respectively. A bank of switches SW1 is also employed. The energizer circuit has a time delay

selector part 84. The switch SW2 is the switch for the start of the time delay. The switch SW3 is the switch for the end of the time delay.

The energizer circuit shown in Figure 7 further employs the illustrated capacitors C1, C2, C3 and C4, and the illustrated resistor R8. These components form part of the computer chip 68 central circuitry.

It is to be appreciated that the embodiment of the invention described above with reference to the accompanying drawings has been given by way of example only and that modifications may be effected. Thus, for example, the energizer circuit shown in Figure 7 may be varied. The handle 60 may be a lever handle instead of a knob handle. Alternatively, instead of manually rotating the shaft 8 by means of a handle 60, drive means in the form of an electric motor or other appropriate device may be employed.

CLAIMS

1. An electromagnetic lock comprising a housing, a locking member which is slidable with respect to the housing between an extended position in which the electromagnetic lock is closed and a retracted position in which the electromagnetic lock is open, a shaft, a cam device on the shaft, an electromagnetic device on the shaft, a coil spring on the shaft, and abutment means on the shaft, the cam device and the electromagnetic device being rotatable with respect to the shaft, the abutment means being fixed with respect to the shaft, the coil spring having a first end portion which is engageable with the cam device and a second end portion which is connected to the electromagnetic device, and the electromagnetic lock being such that activation of the electromagnetic device causes the electromagnetic device to become connected to the abutment means due to magnetism, whereby rotation of the shaft then causes rotation of the abutment means and the electromagnetic device, whereby rotation of the electromagnetic device then causes the coil spring to reduce in diameter and grip the cam device such that the cam device is caused to rotate, and whereby rotation of the cam device then causes the locking member to slide from the extended

position to the retracted position in order to open the electromagnetic lock.

2. An electromagnetic lock according to claim 1 in which the cam device has a curved slot which receives a pin on the locking member.

3. An electromagnetic lock according to claim 1 or claim 2 in which the cam device has a central boss which extends into the first end portion of the coil spring and which is gripped by the coil spring when it reduces in diameter.

4. An electromagnetic lock according to any one of the preceding claims in which the second end portion of the coil spring is a pointed portion which extends into an aperture in the electromagnetic device.

5. An electromagnetic lock according to any one of the preceding claims in which the abutment means is a disc which is secured to the shaft and which has an abutment plate extending outwardly of the disc for engagement with the electromagnetic device.

6. An electromagnetic lock according to any one of the preceding claims and including hold means for

holding the electromagnetic lock in the open condition when the electromagnetic lock is de-activated.

7. An electromagnetic lock according to claim 6 in which the hold means is a cam lock which locks the cam in a position in which the locking member is in the retracted position.

8. An electromagnetic lock according to claim 7 in which the cam lock is a lever which has a shoulder portion for engaging with a shoulder portion on the cam to effect the locking of the cam device.

9. An electromagnetic lock according to claim 8 in which the lever extends proud of the housing in the locking position of the lever, in which closing of the electromagnetic lock causes the lever automatically to move and the two shoulder portions to come out of engagement, and in which the electromagnetic lock includes first spring biasing means for biasing the lever to a position ready for a next rotation of the cam device.

10. An electromagnetic lock according to any one of the preceding claims and including second spring

biasing means for biasing the cam device to a position in which the electromagnetic lock is closed.

11. An electromagnetic lock according to any one of the preceding claims in which the abutment means has first and second stop members for restricting clockwise and anti-clockwise rotation of the abutment means by the shaft.

12. An electromagnetic lock according to any one of the preceding claims and including handle means for enabling the shaft manually to be rotated.

13. An electromagnetic lock according to claim 12 in which the handle means is a knob or a lever.

14. An electromagnetic lock according to any one of claims 1 - 11 and including drive means for enabling the shaft automatically to be rotated.

15. An electromagnetic lock according to claim 14 in which the drive means is an electric motor.

16. An electromagnetic lock according to any one of the preceding claims in which the locking member is a rectilinear locking member having an inclined face.

17. An electromagnetic lock according to any one of the preceding claims and including an energiser circuit for energising the electromagnetic lock.

18. An electromagnetic lock according to claim 17 in which the energiser circuit comprises an oscillator arrangement for causing an electric current to pass through an electromagnet of the electromagnetic lock in alternating directions and for increasingly shorter periods of time thereby to de-energise the electromagnet.

19. An electromagnetic lock according to claim 18 in which the oscillator arrangement comprises two pairs of field effect transistors and a switching circuit for causing alternate operation of the field effect transistors.

20. An electromagnetic lock according to any one of claims 17 - 19 in which the energiser circuit is d.c. powered and it includes a level changing circuit for reducing and effecting a controlled take-off of available power from a battery power source.

21. An electromagnetic lock according to claim 20 in which the energiser circuit is such that when the electromagnetic lock is in a locked condition, then the energiser circuit is in a sleep mode using minimal power.

22. An electromagnetic lock according to any one of claims 17 - 21 in which the energiser circuit is operated by a switch.

23. An electromagnetic lock according to claim 22 in which the switch is a push button switch or a lever switch.

24. An electromagnetic lock according to claim 22 or claim 23 in which the energiser circuit is operated by the switch, and in which the electromagnetic lock includes time delay means for providing a time delay before the electromagnetic lock can be opened.

25. An electromagnetic lock according to any one of claims 17 - 23 in which the energiser circuit is operated by an unlocking combination from a key pad.

26. An electromagnetic lock substantially as herein described with reference to the accompanying drawings.



Application No: GB 9616468.6
Claims searched: All

Examiner: Mr A Angele
Date of search: 24 October 1997

**Patents Act 1977
Search Report under Section 17**

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.O): E2A(AMXD, AMXT, AMXX)
Int Cl (Ed.6): E05B-047/06, -047/00
Other:

Documents considered to be relevant:

| Category | Identity of document and relevant passage | Relevant to claims |
|----------|---|--------------------|
| A | GB 2178474 A SAEFARER NAVIGATION INTERNATIONAL Ltd | |

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