(12) UK Patent Application (19) GB (11) 2 024 917 A

(21) Application No **7920484**
(22) Date of filing **12 Jun 1979**
(23) Claims filed **12 Jun 1979**
(30) Priority data
(31) **7817702U**
(32) **13 Jun 1978**
(33) **Fed. Rep of Germany (DE)**
(43) Application published
16 Jan 1980
(51) **INT CL³**
E05B 45/06
(52) Domestic classification
E2A 419
(56) Documents cited
GB 1351046
(58) Field of search
E2A
G4N
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(54) **Door lock**

(57) A door lock, for example a mortise lock, comprises a casing (2), a bolt (7) which can be thrown outwardly from the casing, and an alarm device which can be connected to an electrical alarm unit and which triggers the alarm unit when pressure is exerted upon the bolt. The alarm device includes a piezoelectric element (9), (13) which is located in the region of a side face of the bolt head (8) of the bolt between the bolt and the casing. In one embodiment, (shown), the piezoelectric element is disc-shaped and is disposed in a cavity (11) in the bolt (7). In an alternative embodiment the piezoelectric element is mounted in the casing adjacent a side face of the bolt.

FIG.1

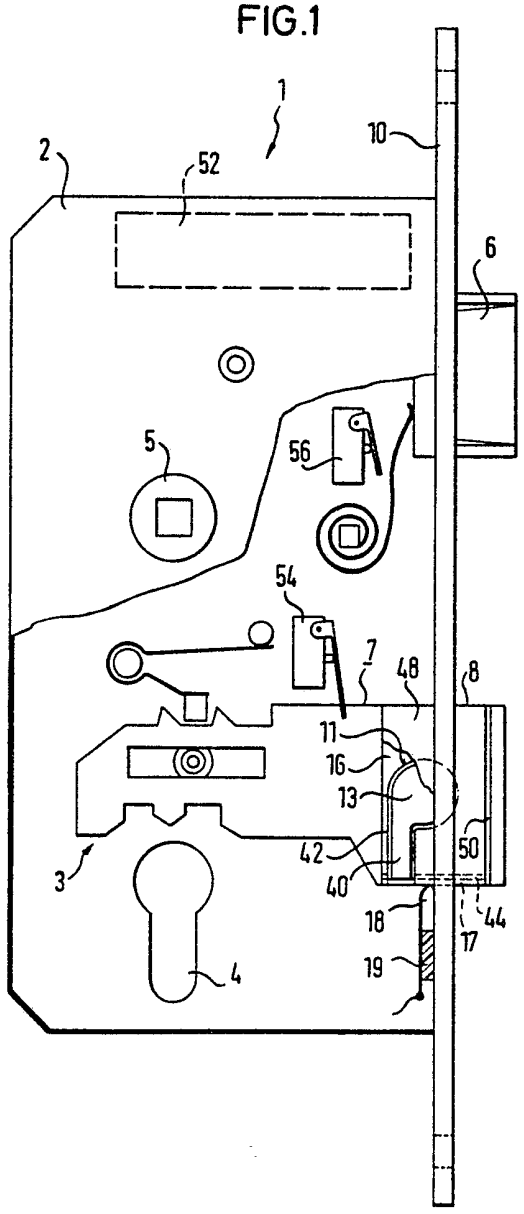

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FIG.2

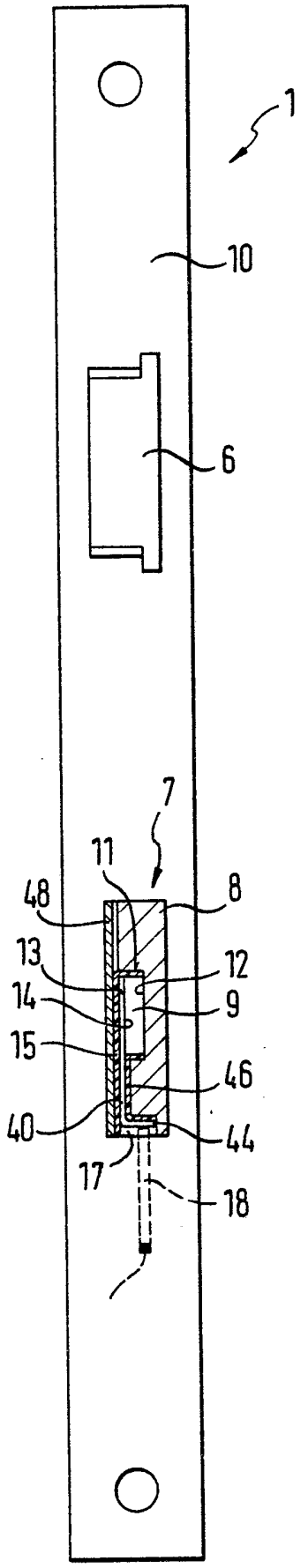
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FIG.1

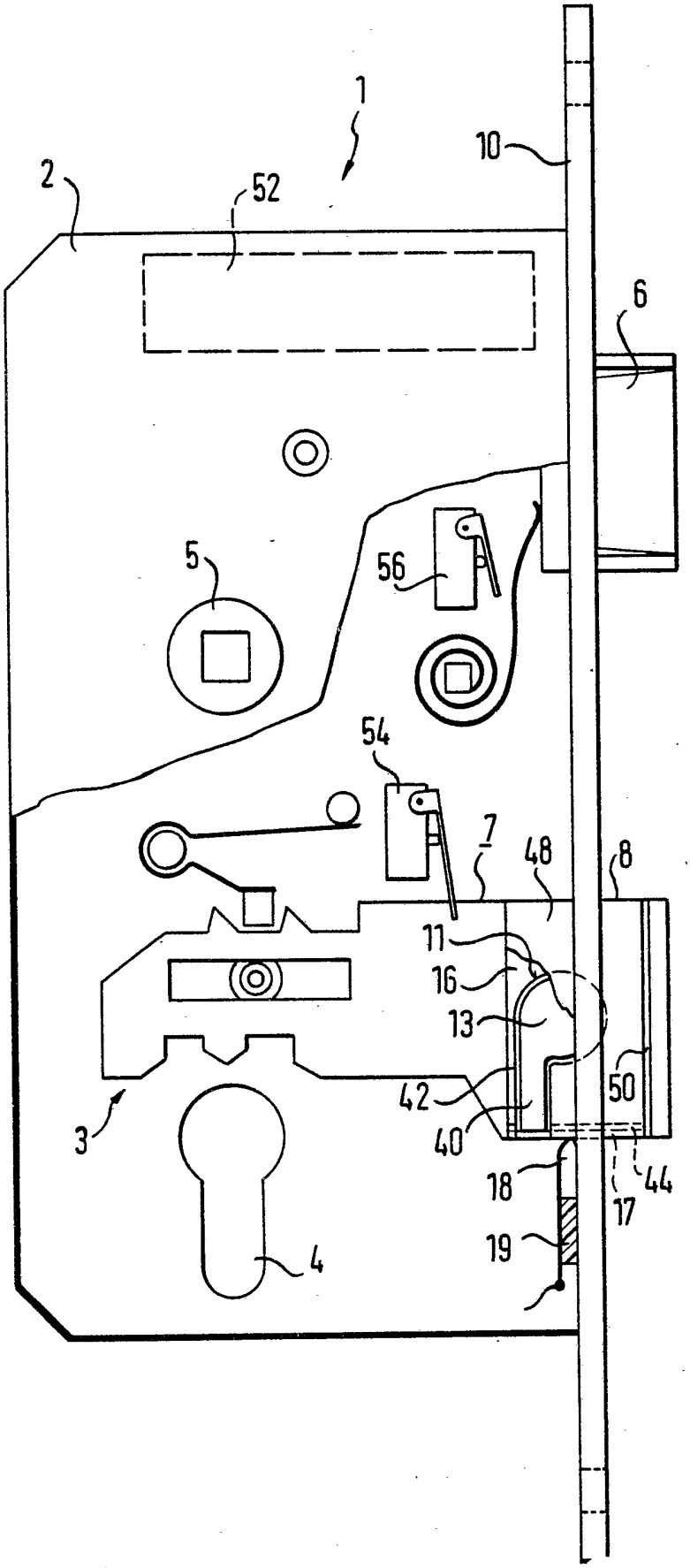
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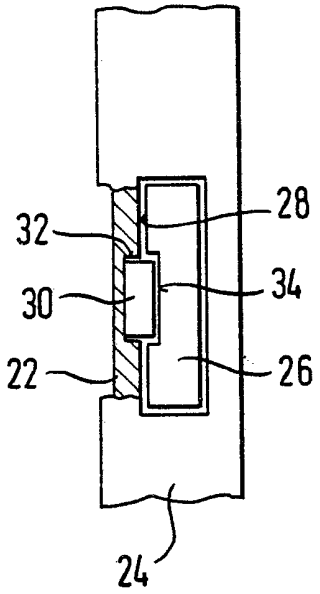
FIG. 3



SPECIFICATION

Door lock

This invention relates to door locks.

A mortise door lock with a lock casing, a bolt which can be thrown from the lock casing and an alarm device which can be connected to an electrical alarm unit and which triggers off the alarm unit when pressure is exerted upon the bolt is disclosed in German Specification No. 20 30 867. In this arrangement the alarm device takes the form of a switch contact which is subject to an electrical voltage and which is connected to the input of an alarm unit physically remote from the door. The switch contact is actuated by a guide sleeve of the bolt, the guide sleeve pivoting transversely to the plane of the door with the bolt when a tensile or compressive force is exerted upon the door. However, in this known door lock it is necessary for the bolt to be guided with relatively great play in the lock casing due to the relatively long contact stroke of the switch contact which triggers the alarm unit. This means that the door cannot be closed into snug abutment, furthermore the pivotable mounting of the bolt in the lock casing necessitates additional measures, so that it is not possible for door locks of any desired type to be equipped with the alarm device.

The present invention seeks to provide a door lock which can, without structural modification of the guide sleeve of the bolt means, be equipped with an alarm device which reacts to the opening of the door when the bolt is thrown.

According to the present invention there is provided a door lock comprising: a casing; a bolt which can be thrown outwardly from the casing; and an alarm device which can be connected to an electrical alarm unit and which triggers the alarm unit when pressure is exerted upon the bolt, the alarm device including a piezoelectric element located in the region of a side face of a bolt head of the bolt between the bolt and the casing.

The piezoelectric element detects pressure forces which act between the bolt and the casing. The movement of the bolt transversely to the door which then has to be executed is negligibly small, so that no additional play need be provided between the bolt and the casing. More particularly, there is no need to modify guide means of the bolt in order to permit relatively great movements of the bolt transversely to the door, such as are necessary in the case of the known door lock described hereinbefore. Because the piezoelectric element only generates an electric voltage when pressure is exerted between its terminals, but otherwise remains unenergised, the alarm security of the door lock cannot be detected by measuring electrical fields.

The piezoelectric element may be retained on the casing in the region of a face plate of the lock. Fixing the piezoelectric element to the casing has the advantage that no additional supply leads need be provided to the piezoelectric element. If the piezoelectric element is retained on the bolt, then it is preferably mounted on the side face of the bolt in the region of a face plate of the lock when the plate is thrown. The guidance play of the bolt is least in the region of the face plate, consequently the maximum certainty of triggering of the alarm unit is achieved.

According to a preferred embodiment of the invention the piezoelectric element is disc-shaped and is disposed in a cavity in either the bolt or the casing. This facilitates assembly.

Preferably, one end face of the piezoelectric element is in electrical contact with the bolt or the casing and the other end face is in electrical contact with a contact plate, the piezoelectric element being masked by an electrically insulating layer.

In this case the contact plate may be connected by means of a cable to one input of the alarm unit. The bolt preferably has a groove and a contact track arranged in the groove for a wiper contact, the contact track being electrically insulated from the bolt, and connected to the contact plate. The wiper contact is preferably fixed to an electrically non-conductive block. The voltage generated is picked up between the casing in electrical communication with the bolt and the wiper contact and fed through an electrical connection to the alarm unit.

The piezoelectric element is preferably located on the side face of the bolt head or on a part of the casing opposite the said side face the insulating layer protruding out from the side face of the bolt head or said part of the casing. Thus a mechanical compressive force can be transmitted to the piezoelectric element.

If the piezoelectric element is accommodated in the bolt head, then it must be moved through beneath the face plate when the bolt is thrown. This may lead to damage to the insulating layer or to the piezoelectric element. The side surface of the bolt head, out of which the insulating layer protrudes, is therefore preferably covered by a cover plate movable transversely to the side face in the region of the piezoelectric element. The cover plate may e.g., be attached along one of its edges to the bolt head, whereas it simply rests upon the side surface elsewhere. In a particularly simple embodiment a groove in which an angled edge of the cover plate engages, extends in the said side face transversely to the throwing direction of the bolt, at least those regions of the said side face located at the end face of the bolt head outside the cover plate terminating substantially flush with the latter. This prevents the bolt head from catching in the opposite closing plate of the casing. Because the cover plate is opaque, it is impossible to detect that the lock has an alarm unit even when the bolt is thrown.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:—

Figure 1 illustrates a first embodiment of a door lock according to the present invention in schematic side elevation;

Figure 2 shows the door lock of Figure 1 in end elevation; and

Figure 3 shows a partly sectioned elevation of an end face of a second embodiment of a door lock according to the present invention.

Referring first to Figures 1 and 2, there is shown a first embodiment of a door lock 1 according to the present invention. The door lock has a frame or casing 2 with a closure mechanism 3 located therein. A mortise aperture 4 is provided for a closing or locking cylinder (not shown) and a mortise aperture 5 is provided for a door handle (not shown) to operate a door latch 6.

A bolt 7 is arranged beneath the door latch 6. The bolt 7 carries on a wide side or side face 16 of a bolt head 8 a piezoelectric element 9 acting as an alarm device. The piezoelectric element 9 is located so that it is in the region of a face plate 10 when the bolt 7 is thrown.

The piezoelectric element 9 is disc-shaped and is disposed in a circular recess 11 of the side face 16 of the bolt head 8 so that one end face 12 thereof is in electrical contact with the bolt 7. The opposite end face of the piezoelectric element 9 is in contact with a contact plate 13 formed by, for example, etching or stamping. The contact plate 13 merges integrally into a tag 40 which extends in a groove 42 in the side face 16 of the bolt head 8 towards the underside of the latter. On the underside of the bolt head 8 there is disposed a groove 17 in which there is a contact track 44. The contact track 44 is shaped integrally on the tag 40 or angled out of the plane of the tag 40 lying in the side face 16. An electrically insulating layer 15 covers the contact plate 13 and the tag 40. The tag 40 and the contact track 44 is furthermore electrically insulated from the bolt head 8 by an insulating layer 46. The insulating layer 15 further extends round the piezoelectric element 9 into the recess 11 in order to insulate its envelope surface with respect to the bolt head 8. The insulating layer 15 protrudes slightly — e.g., 0.2 mm — beyond the width of the bolt head 8, in order to be able to transmit pressure to the piezoelectric element 9. If the insulating layer 15 terminates flush with the side face 16 of the bolt head 8, an elevated portion (not shown) is provided in the face or in a cover plate 48, to transmit pressure to the piezoelectric element 9 when the bolt head 8 is closed.

A wiper contact 18, which is attached to an electrically insulated block 19 on the inside of the face plate 10, extends into the groove 17. The block 19 may, alternatively, be attached to one of the side cheeks of the casing 2. The side face 16 of the bolt head 8 is covered by the cover plate 48 terminating flush with upper and lower narrow sides of the bolt head. The leading edge of the cover plate 48 is angled in manner not shown in detail and engages into a groove 50 of the bolt head 8 extending parallel to the face plate 10. The cover plate 48 otherwise rests with free mobility upon the side face 16 so that it can transmit pressure acting on the face plate 10 to the piezoelectric element 9. The region of the end face of the bolt head 8 outside the cover plate 48 closes flush with the outer face of the cover plate 48.

An electronic processing circuit, which may take the form, for example, of a flexible printed circuit, is indicated at 52. The processing circuit 52 is connected to the piezoelectric element 9 through the casing 2 and the wiper contact 18 and comprises a threshold value stage and an impulse transmitter which delivers a definite impulse to an alarm unit, not shown in detail, when the voltage produced by the piezoelectric element 9 exceeds an adjustable threshold value.

In order to permit correct opening of the door lock to be detected, two microswitches 54, 56 connected in series to the alarm unit are fitted on the casing 2. The microswitches 54, 56 react when both the bolt 7 and the latch 6 are retracted.

For the case of a too slow pressure rise or too great leakage currents the bolt may also be constructed so that a linearly rising pressure upon the door is transformed into nonlinear pressure surges and transmitted to the piezoelectric element, so that the first impulse triggers off the alarm unit.

Figure 3 shows another embodiment of a mortise door lock according to the present invention with a frame or casing 22 and a face plate 24 from which a bolt 26 can be thrown. A piezoelectric element 30, which responds to pressure loads upon the lock 26, is again located between the casing 22 and an adjacent wide side or side face 28 of the bolt 26. In contrast to the lock of Figures 1 and 2 the piezoelectric element 30 is contained in a cavity 32 of the casing 22. The form and contacting of the piezoelectric element 30 corresponds to those of the piezoelectric element 9, although no wiper contact such as the wiper contact 18 is necessary. The piezoelectric element 30 protrudes beyond the surface of the casing 22 towards the side face 28 of the bolt 26. If the wall thickness of the casing 22 is insufficient to fully accommodate the piezoelectric element 30, then a groove 34 extending in the closing or throwing direction of the bolt 26 is formed in the side face 28 of the bolt 26.

CLAIMS

1. A door lock comprising: a casing, a bolt which can be thrown outwardly from the casing, and an alarm device which can be connected to an electrical alarm unit and which triggers the alarm unit when pressure is exerted upon the bolt, the alarm device including a piezoelectric element located in the region of a side face of a bolt head of the bolt between the bolt and the casing.

2. A door lock as claimed in claim 1 in which the piezoelectric element is retained on the casing in the region of a face plate of the lock.

3. A door lock as claimed in claim 1 in which the piezoelectric element is mounted on the side face of the bolt in the region of a face plate of the lock when the bolt is thrown.

4. A door lock as claimed in claim 1 in which the piezoelectric element is disc-shaped and is disposed in a cavity in either the bolt or the casing.

5. A door lock as claimed in claim 4 in which one end face of the piezoelectric element is in electrical contact with the bolt or the casing and the other end face is in electrical contact with a contact plate, the piezoelectric element being masked by an electrically insulating layer.

6. A door lock as claimed in claim 5 in which the bolt has a groove and a contact track arranged in the groove for a wiper contact, the contact track being electrically insulated from the bolt, and connected to the contact plate.

7. A door lock as claimed in claim 6 in which the contact plate is connected integrally to the contact track.

8. A door lock as claimed in claim 6 or 7 in which the groove is located on the underside of the bolt head.

9. A door lock as claimed in any of claims 6 to 8 in which the wiper contact is fixed to an electrically nonconductive block.

10. A door lock as claimed in claim 9 in which the block is located on the inside of the face plate.

11. A door lock as claimed in any of claims 5 to 10 in which the said insulating layer terminates flush with a surface of the casing confronting the bolt or with the side face of the bolt head, a portion elevated towards the piezoelectric element being provided in the opposite surface of the bolt head or of the casing or of the face plate.

12. A door lock as claimed in any of claims 5 to 10 in which the piezoelectric element is located on the side face of the bolt head or on a part of the casing opposite the said side face the insulating layer protruding out from the side face of the bolt head or said part of the casing.

13. A door lock as claimed in claim 12, in which the side face of the bolt head is covered by a cover plate movable transversely to the side face in the region of the piezoelectric element.

14. A door lock as claimed in claim 13 in which a groove in which an angled edge of the cover plate engages, extends in the said side face transversely to the throwing direction of the bolt, at least those regions of the said side face located at the end face of the bolt head outside the cover plate terminating substantially flush with the latter.

15. A door lock as claimed in claim 14 in which an electronic block with a threshold value stage connected to the piezoelectric element is attached to the casing.

16. A door lock substantially as herein described with reference to the accompanying drawings.

17. Door lock, particularly a mortise door lock with a lock frame, a bolt which can be closed from the frame and an alarm section which can be connected to an electrical alarm unit and which triggers off the alarm unit when pressure is exerted upon the bolt, characterised in that the alarm section takes the form of a piezoelectric element located in the region of the closing end of the bolt between the bolt and the lock frame on the side of the bolt in the closing direction of the door.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.