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(71) Applicant: **NCR International, Inc.**
Dayton, Ohio 45479 (US)

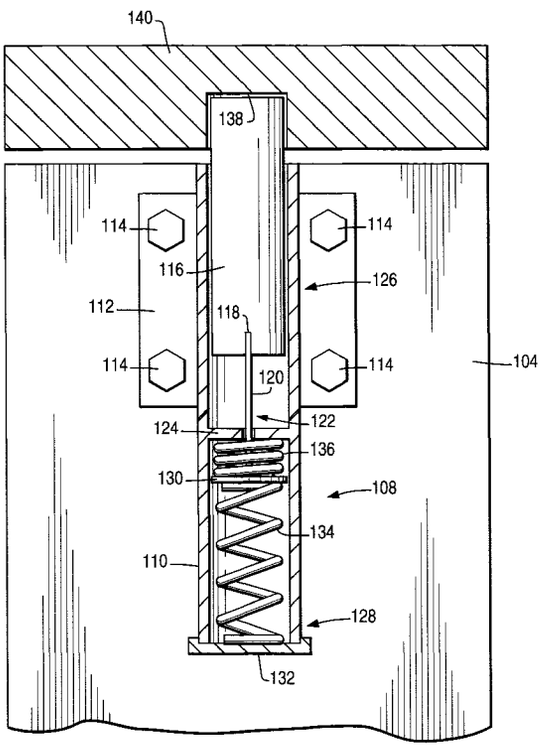
(72) Inventor: **Flood, Dennis**
Dundee, Scotland, DD2 2JD (GB)

(74) Representative: **Irish, Vivien Elizabeth et al**
International IP Department,
NCR Limited,
206 Marylebone Road
London NW1 6LY (GB)

(54) Safe re-locker

(57) In a safe (102) having thermal re-lockers (108), each thermal re-locker (108) comprises two opposing springs which both act on a plunger (122) attached to a re-locking bolt (116) mounted within a tubular container (110). One spring is a memory metal spring (134) and the other is a non-memory metal spring (136). At room temperature the strength of the non-memory metal spring (136) is sufficient to hold the re-locking bolt (116) within the container (110). If a safe (102) comes under thermal attack, the temperature rises causing the re-locker (108) to be activated. The memory metal spring (134) becomes stiffer compressing the non-memory metal spring (136) and pushing out the re-locking bolt (116) so that it protrudes out of the container (110), and thereby prevents either a safe door (104) from being opened, or a safe boltwork mechanism (106) from being unlocked. Once the re-locker (108) has cooled down to room temperature, the memory metal spring (134) returns to its normal less stiff state thus bringing about retraction of the bolt (116).

FIG. 4



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Description

The present invention relates to safes, and more specifically to safes having mechanisms which bring about an additional locking effect in the event of an unauthorized attack being made on a safe, in a bid to remove some of its contents. Such safes may be used in automated teller machines (ATMs) and typically comprise a welded steel container having a hinged door.

When such additional locking mechanism is activated, it may cause a spring loaded bolt to fire into a position which will either cause additional blocking, thus preventing the safe door from being opened, or which will prevent the safe locking boltwork mechanism from being unlocked. These mechanisms are known as "relockers". One type of re-locker is a thermal re-locker which is designed to be activated when an attempt is made to break into a safe using thermal tools.

A known thermal re-locker will now be described with reference to Fig. 1 which is a part sectional, side elevational view of such re-locker shown in its unlocked position. The re-locker 10 includes a bolt 12 primed by means of a compressed spring 14 and held in a tubular container 16 fixed, in this instance, by four bolts 18 to a safe door 20. The spring 14 is prevented from firing the bolt 12 by having a retaining string 22 attached to the bolt 12, the other end of the string being anchored at a point 24, so that the string is under tension. The string is routed over two pulley wheels 26 so as to avoid obstacles. The material of the string 22 has thermal properties, such that the string 22 will break when the surrounding air reaches a certain temperature. This string breakage will cause the bolt 12 to fire, thereby locking the safe door 20 by means of the bolt being pushed into a recess 28 in the jamb 30 of the safe door.

One disadvantage of this known thermal re-locker is that it is difficult and time consuming to assemble. Apart from attaching the components of the re-locker 10 to the safe, the string 22 has to be attached to the bolt 12 and the bolt 12 has to be held compressed against the spring 14 while the string 22 is routed, often over several pulley wheels 26, and anchored at a point 24, so that the string is under the correct tension. Thus this re-locker 10 has many component parts and its assembly is labour-intensive.

Another disadvantage of this known thermal re-locker is that the string can deteriorate, such as by abrasion effects during alarm fitting or maintenance, or through environmental conditions, such as high humidity. This can lead to premature firing of the locking bolt, causing unwanted lock-outs on the safe.

Yet another disadvantage is that if the re-locker is activated as a result of a thermal attack or through some other cause, so as to block the door or boltwork, then the resulting lock-out is not easily overcome, necessitating expensive destructive operations on the safe to allow it to open.

A thermal re-locker in accordance with the invention makes use of an actuating member made of a special alloy which exhibit temperature controlled, reversible mechanical memory behaviour known as shape memory effect. By varying the components and actual proportions of an alloy, a shape memory effect alloy can be produced which will abruptly change its crystalline state, and thereby its physical properties such as its shape or stiffness if its temperature is raised above a specified level. Also, an item made of such an alloy may change its shape if its temperature is raised above said specified level. Correspondingly, if the temperature later falls to an appropriate level, the shape memory effect alloy will abruptly regain its original properties.

Shape memory effect alloys are known as memory metals. A technical paper "Shape Memory Alloys" by D E Hodgson, M H Wu and R J Biermann, available from Shape Memory Applications Inc., 2380 Owen Street, Santa Clara CA 95054 gives details of the types of alloys used, their composition and the current uses of memory metals.

It is an object of this invention to provide thermal re-lockers for safes that overcome the disadvantages referred to above.

According to the present invention there is provided a safe having at least one thermal re-locker which includes a re-locking bolt, characterized in that said bolt is movable between a locking and a non-locking position under the control of an actuating member of memory metal, said bolt being held in its non-locking position when the temperature of said actuating member is below a predetermined value.

One embodiment of the invention will now be described by way of example with reference to Figs. 2 to 4 of the accompanying drawings in which: -

Fig. 2 is a perspective view of the rear of an ATM having a safe provided with thermal re-lockers in accordance with the invention;

Fig. 3 is a part sectional, side elevational view of one of the thermal re-lockers of Fig. 2 shown in its unlocked position; and

Fig. 4 is a view similar to Fig. 3 but showing the thermal re-locker in its locked position.

Referring now to Fig. 2, an ATM 100 having a safe 102 is shown. Access to the safe 102 is by a hinged door 104. The door 104 is locked by a boltwork mechanism 106. On the inside of the door 104 are fixed several thermal re-lockers 108.

Referring next to Fig. 3, a thermal re-locker 108 is shown in its retracted, non-locking position. The re-locker 108 includes a tubular container 110 which is fixed by means of an integral flange 112 to the inside of the safe door 104 by four bolts 114. Suitably mounted within the container 110 is a re-locking bolt 116 which has a recess 118 into which one end of the shaft 120 of a plunger 122 is fixed. The shaft 120 passes through a hole in a partition plate 124 which divides the container 110 into first

and second tubular portions 126 and 128, the tubular portion 126 serving to accommodate the bolt 116 when in its retracted position. The other end of the shaft 120 is attached to the head 130 of the plunger 122, the head being slidably mounted within the second tubular portion 128. A cap 132 is fixed to and covers the end of the container 110 remote from the re-locking bolt 116. A compressed spring 134 of memory metal is disposed between one side of the head 130 and the cap 132, while a compressed metal spring 136 of non-memory metal is disposed between the other side of the head 130 and the partition plate 124. It will be appreciated that the springs 134, 136 are mounted so as to exert opposing forces on the head 130 and thereby on the bolt 116. As will be explained later, the spring serves as an actuating member for bringing about activation of the re-locking bolt 116. A suitable memory metal for the spring 134 is a nickel-titanium alloy with a composition of 49 atoms of nickel to 51 atoms of titanium.

Opposite the re-locking bolt 116 there is a recess 138 in a jamb 140 associated with the safe door 104. Part of the bolt 116 is pushed into the recess 138 if the re-locker 108 is activated.

At normal room temperatures, the memory metal spring 134 gives a soft springing action so that the strength of the compressed spring 136 is greater than the memory metal spring 134. Thus the strength of the spring 136 is sufficient to hold the re-locking bolt 116 in its retracted position in the tubular portion 126, with the free end of the bolt 116 being flush with the edge of the safe door 104 adjacent the jamb 140.

Referring to Fig. 4, if an attempt is made to break into the safe using thermal tools then the temperature of the spring 134 of one or more of the re-lockers 108 is likely to rise to a sufficiently high temperature (typically around 80°C) to trigger the shape memory effect of the relevant spring 134. The spring 134 would then abruptly become much stiffer, compressing the non-memory metal spring 136 and pushing part of the re-locking bolt 116 into the recess 138 in the jamb 140 thus locking the safe door 104.

Returning to Fig. 3, once the re-locker 108 has cooled down to room temperature after a thermal attack, the memory metal spring 134 returns to its normal less stiff state so that the spring 136 compresses the memory metal spring 134 and brings about the retraction of the bolt 116.

After a thermal attack it is likely to take some time (typically one or two hours) for a safe to cool to a temperature at which retraction of the bolt will take place, since in the course of such attack temperatures of hundred of degrees centigrade are reached, and the cooling of a high thermal inertia device like a safe is very slow. Thus, the thermal re-lockers 108 described serve as a highly effective defence to a thermal attack.

In this connection it should be borne in mind that the concept of safe design is not to stop access being achieved, but rather to slow down an attack. It is unlikely that thieves would wait for the length of time that it would take for the safe to cool down for the re-locking bolts 116 to retract.

An alternative arrangement could be such that the re-locking bolt 116 would block the locking boltwork mechanism so that the safe could not be opened. Its compactness could allow it to be randomly positioned at several possible points within the locking boltwork thus presenting even knowledgeable safe attackers extra problems and uncertainty as to which areas to attack.

It can be seen that the thermal re-locker 108 described above is less labour intensive and time consuming to set up than known thermal string re-lockers.

Another advantage is that the memory metal re-locker 108 is less likely to cause a premature lock out than a conventional thermal string re-locker, since the former would not be as vulnerable to abrasion or environmental conditions.

Claims

1. A safe having at least one thermal re-locker (108) which includes a re-locking bolt (116), characterized in that said bolt is movable between a locking and a non-locking position under the control of an actuating member (134) of memory metal, said bolt being held in its non-locking position when the temperature of said actuating member is below a predetermined value.

2. A safe according to claim 1, characterized in that the shape of said actuating member (134) changes from a first shape to a second shape in response to its temperature rising above said predetermined value so as to move the bolt (116) to said locking position, and the shape of said actuating member changes back to said first shape when the temperature of said actuating member falls to an appropriate value so as to return the bolt to said unlocking position.

3. A safe according to claim 2, characterized in that said actuating member is in the form of first spring means (134) there being also provided a second spring means (136) of non-memory metal, the first and second spring means (134, 136) being arranged in opposition such that said bolt (116) is held in its non-locking position when the temperature of the first spring means is below the predetermined value.

4. A safe according to claim 3, characterized in that first and second spring means (134, 136) exert opposing forces on a head portion (130) of a connecting member (122) connected to said bolt (116).

5. A safe according to claim 4, characterized in that

said re-locker (108) includes a tubular container (110) in which the bolt (116) and the head portion (130) are slidably mounted, a shaft portion (120) of the connecting member (122) passing through an aperture in a partition plate (124) which divides the container into first and second tubular portions (126, 128), the bolt being disposed in the first tubular portion (126) and the head portion (130) and the first and second spring means (134, 136) being disposed in the second tubular portion (128), with the first and second spring means being disposed on opposite sides of the head portion (130).

6. A safe according to claims 3, 4 and 5, characterized in that said first and second spring means (134, 136) are helical springs.

7. A safe according to any preceding claim, characterized in that said safe (102) comprises part of an automated teller machine (100).

PRIOR ART

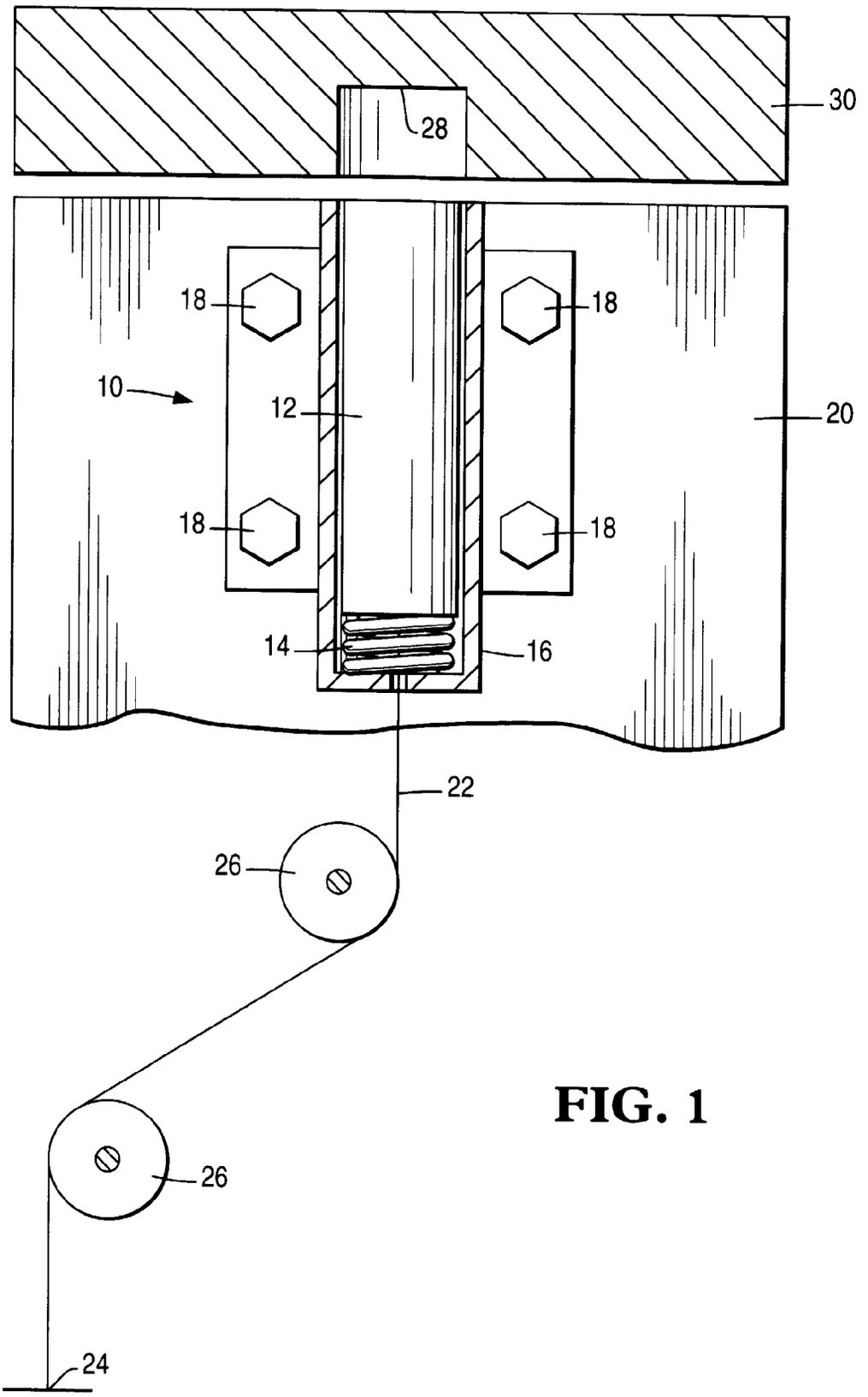

FIG. 1

FIG. 2

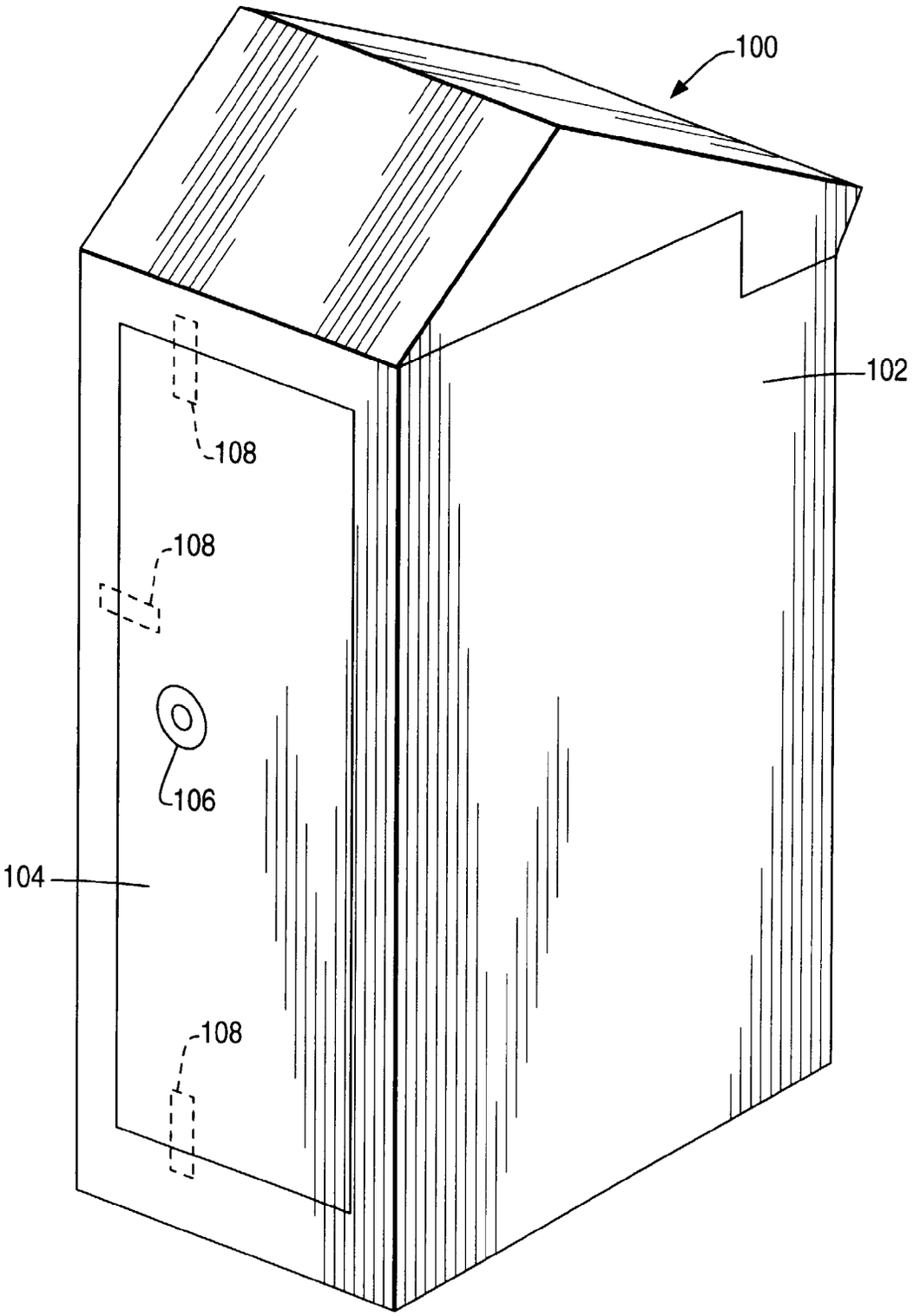

FIG. 3

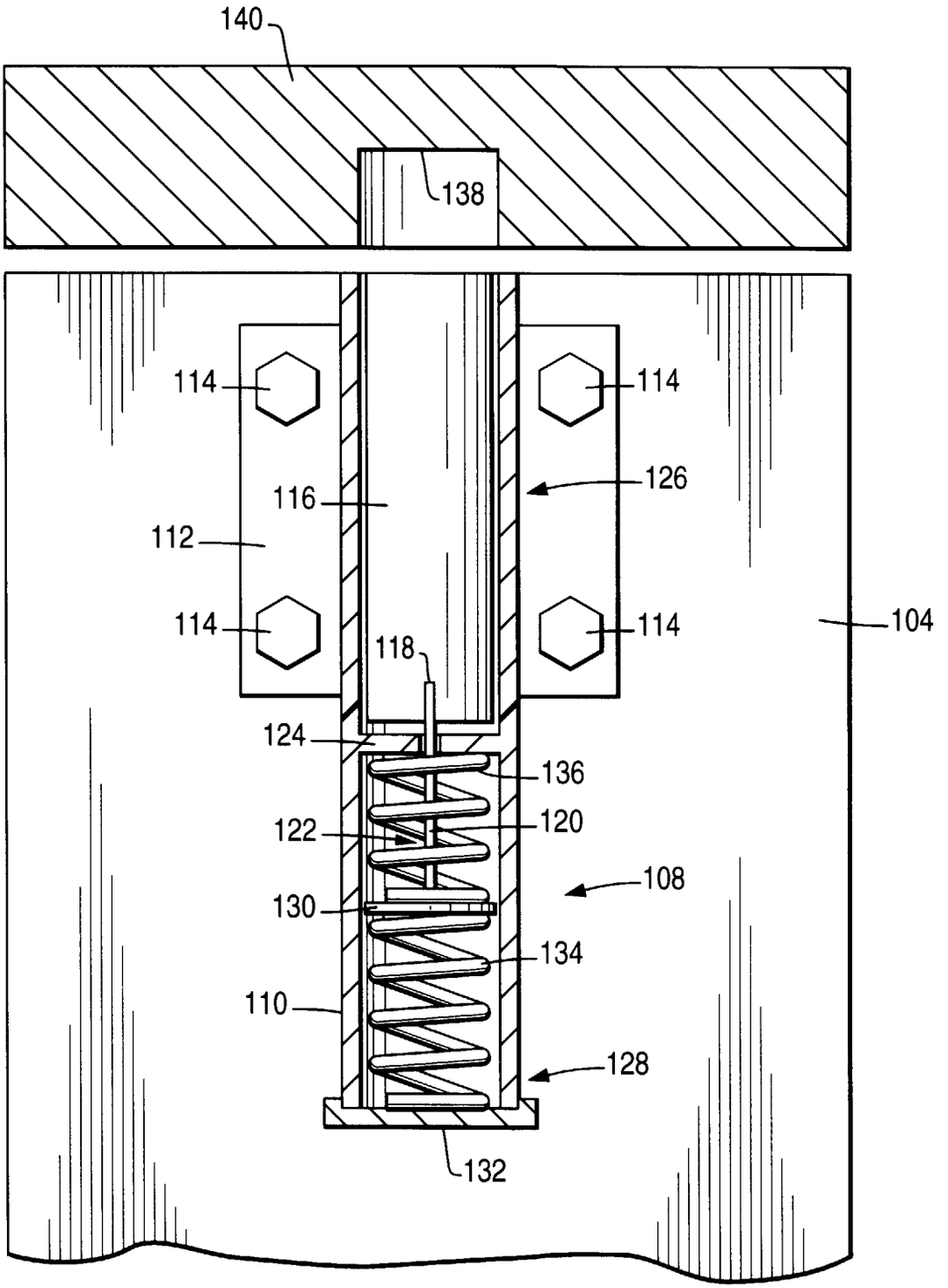
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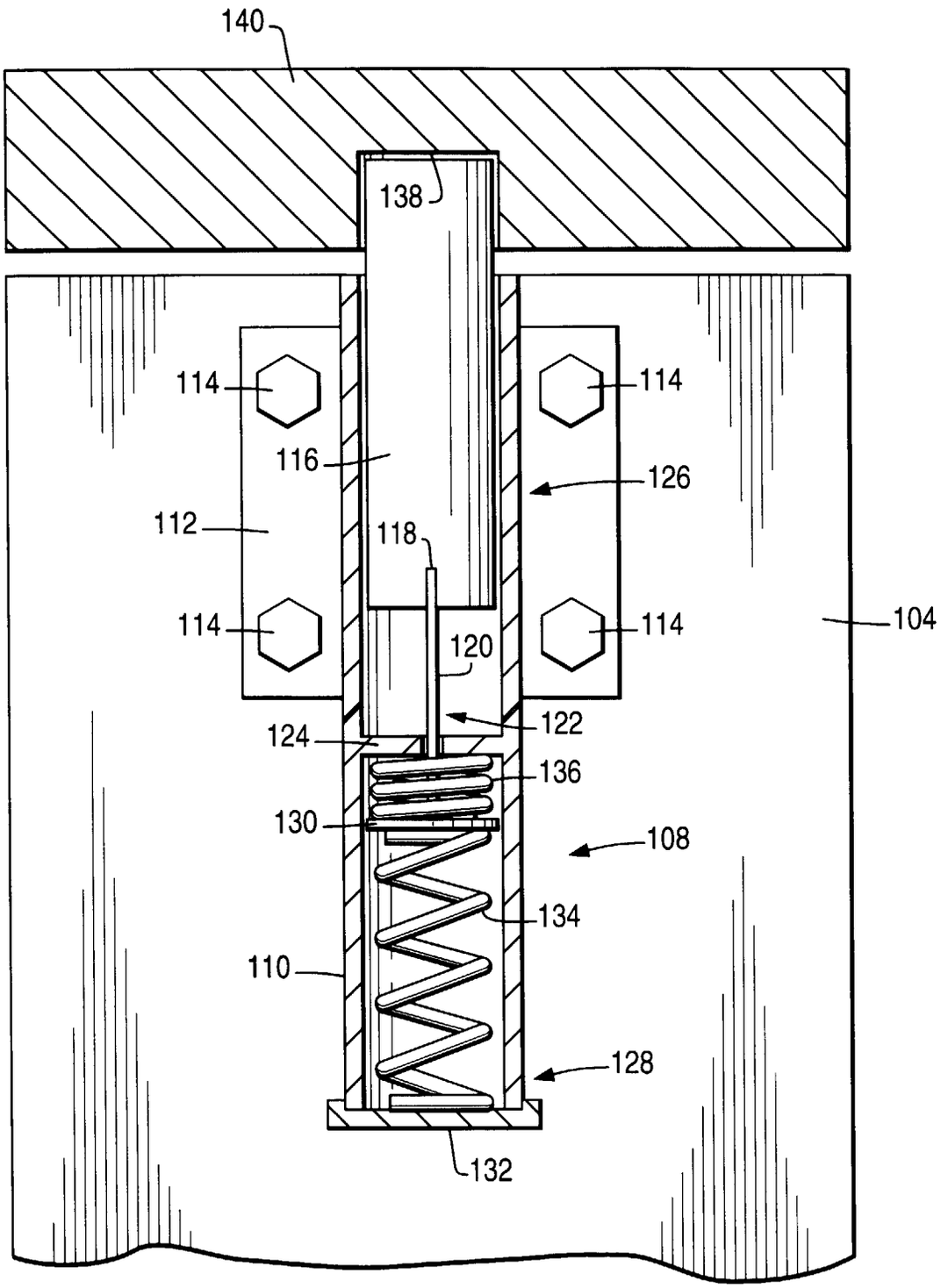
FIG. 4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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 9114

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.6)
X Y A	GB 2 172 931 A (CHUBB & SON'S LOCK & SAFE CO) 1 October 1986 * the whole document *	1,2,7 3,4 6	E05G1/04 E05B17/20 E05B15/16
Y	DE 43 27 381 A (SCHULZE LOTHAR ;GOHRBANDT DIETMAR) 16 February 1995 * the whole document *	3,4	
A	DE 37 20 550 A (ZEISS IKON AG) 5 January 1989 * the whole document *	1-4,6	
A	EP 0 412 571 A (WAGNER GMBH FABRIK FÜR MEDIZINISCHE GERÄTE) 13 February 1991		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 March 1998	PEREZ MENDEZ, J

CATEGORY OF CITED DOCUMENTS

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