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

(11) Publication number: 0 215 685 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 86307237.7

(22) Date of filing: 19.09.86

(51) Int. Cl.^{4}: G 08 B 13/04

(30) Priority: 20.09.85 GB 8523280

(43) Date of publication of application: 25.03.87 Bulletin 87/13

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

(71) Applicant: MAXIMAL ELECTRICAL ENGINEERS LIMITED
67 Westow Street Crystal Palace
London SE19 (GB)

(72) Inventor: Steinbrucker, Harald
Herbststrasse 3
D-8031 Wesling (DE)

(74) Representative: Hartley, David et al
c/o Withers & Rogers 4 Dyer's Buildings Holborn
London, EC1N 2JT (GB)

(54) Glass break detector.

(57) A method of monitoring an object, such as a pane of glass, for breakage, in which vibrations are generated in the object, detected and converted to an electrical signal, and the signal is processed to detect changes in amplitude or frequency. The signal may be compared with its time average, or examined for the presence of high frequency components, or for amplitudes outside a pre-set range. A warning may be generated only when the detected condition has been maintained for a pre-set time.

EP 0 215 685 A2

GLASS BREAK DETECTOR

This invention relates to detection apparatus, more specifically a glass-break detector alarm device such as is used to warn of intruders tampering with or breaking windows to gain access to a property.

Conventional detectors are generally so-called passive detectors in which a transducer which may be a peizoelectric transducer, a microphone or any other suitable device is arranged to detect either vibrations in the glass or noise and vibrations generated when the glass breaks. One problem with such passive detectors is that in an attempt to reduce the occurrence of false alarms the detector has to be "tuned" to respond to the vibration characteristics of the particular glass objects to be monitored and/or of the frequencies likely to occurwhen the object is tampered with or broken. It will be appreciated that in general terms, the vibration characteristics may vary widely from one object to another depending inter alia upon the type of material concerned, its shape and configuration and, in the case of window panes, its mounting.

One object of the present inventin is to provide a detector which obviates the disadvantages outlined above, more specifically which does not require to be "tuned" to respond to the conditions prevailing in a particular application.

In accordance with the present invention, we propose monitoring an object particularly a glass object such as a window pane, by causing the object to vibrate such that vibration is transmitted through the object to a transducer operatively connected to a device for detecting a change in the vibrations received by the transducer.

The change is preferably represented by a difference signal produced following comparison of a first signal corresponding to the received vibrations and a second signal derived by delaying the first signal for a predetermined period of time. As a result, the apparatus attunes after the said predetermined time to any change in the object or its mounting that affects the vibration transmission characteristics of the object. The difference signal disappears. It follows that the apparatus is thus largely independent of the nature or condition of a particular object to be monitored. Irrespective of these considerations or following a predetermined time after a change in the vibration transmission characteristics, a steady state condition is reached, in which no difference signal is generated.

When a change occurs for whatever reason, the resulting difference signal is recognised and processed to distinguish between events of which a warning is required and transient effects. In the case of a window such effects may be caused, for example, by a bird or insect striking a window, by wind or rain, or by a passing vehicle.

The removal of putty from a window pane, the drilling of a hole through the pane or the occurence of a crack will, on the other hand, have a permanent effect upon the vibration transmission characteristics of the window.

Both transient and permanent effects produce a different signal for the said predetermined period and to distinguish between the two, the difference signal is preferably applied to a discriminator for ascertaining whether any change in amplitude and/or the frequency spectrum of the vibrations received by the transducer occur and/or are sustained for a period of time, which may if required be adjustable and is shorter than the said predetermined time. Only then is the device operable to trigger an alarm.

One important advantage of the present invention is that the device can be reset following an alarm caused for example, by an intruder cracking a window pane but failing to gain access and possibly being deterred by the alarm, and will continue to provide effective protection.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which Figure 1 is a circuit diagram of a glass break detector having a transmitter and a receiver intended to be attached to or otherwise mounted in contact with a window pane, usually at opposite corners thereof, and Figure 2 Is a view of the components of the selective preamplifier.

The working voltage (10.4 to 15 V DC, AC portion 110 mVss) is stabilised by the positive voltage regulator IC 1 to 8 V DC. The components D1, D2, L1, C1, C2 constitute the polarity safeguard, act as a screen and protect the circuit against high frequency interference fields as well as interference and over voltage peaks.

Transistors T1 and T2 together form an oscillator generating a frequency of approximately 230kHz which can within limits (approx. 10%) be varied by the potentiometer P1 (adaptation to reflection quality). T3 serves to monitor functioning and is operated by a test button.

The frequency determining elements are the inductance L2 and capacitors C7, C8. The capacitors are of Styroflex construction to achieve a high frequency stability. This frequency is used to operate a piezo-ceramic unit which converts the electrical oscillations into mechanical vibrations.

The mechanical vibrations are tapped, again by means of a piezo unit, forming part of the receiver and is converted to an oscillating electrical signal which is fed to a selective preamplifier 10 consisting of T1, T2 and feedback resistors R2, R3 the frequency determining components constituting the high pass filter which in turn consists of capacitors C3, C4 inductance L1 and resistor R7.

From the selective preamplifier, the now amplified sinusoidal oscillation is applied to a variable-gain amplifier stage consisting of field effect transistor TF1, the selective amplifier consisting of transistors T 4 T 5 and the variable gain amplifier consisting of operational amplifier OP 1.

From the amplifier stage consisting of transistors T4 and T 5, the sinusoidal oscillation is rectified by diodes D 5, D 6, capacitor C 24 and resistor R 34 and fed to the variable gain amplifier OP 1. The potential divider consisting of R 31 and R 32 indicated the desired value of the control arangement. The capacitor C 21 operates thereby as a stabiliser. The capacitor C 22 serves as a storage means and regulates the time lag as a function of the variation in reflection.

The gate of the field effect transistor TF 1 is controlled via R 28 by the variable gain amplifier OP 1. The control arrangement operates on $U_{Stab}/2$. If a variation in reflection typical of a glass breakage occurs and endures for approximately 200 ms, then via C 22, the secondary adjustment is delayed for approximately 1.5 s - for approximately 10 mVss variation in amplitude. There is a differential voltage between desired and actual values and this differential voltage is fed to the level amplifier consisting of operational amplifiers OP 2 and OP 3 and is boosted by a total of approximately 40 dB. The desired value is present at resistors R 35 and R 36. The actual value is tapped by the selective amplifier T 4, T 5, via C 18 and, rectified by D 3, D 4, R 33 and C 23, is fed to the non-inverting input of the operational amplifier OP 2. The operational amplifier OP 3 automatically compensates for temperature and direct current voltage fluctuations. The amplifier output, when at rest, settles down to a level of $U_{Stab}/2$.

From the output OP 3, the signal level passes to a window discriminator OP 4 and OP 5. The size of the window is determined by resistors R 41, R 42, R 44. The output of the window discriminator is when at rest at a high level but when there is any misalignment of the window discriminator, the output displays a low level potential via the diodes D 7 and D 8. This low level potential is fed to an RS flip-flop comprising G 1 and G 2. The L or low level must be formed via τ from C 35 and R 54 and be present at G 1, otherwise a reset takes place via the diode D 11. The output of the flip-flop G 1, G 2 is applied to the emitter of the transistor T 7.

For frequency measurement a signal is tapped-off downstream of the selective preamplifier and fed via the diode D 17 and the high pass filter comprising C 14, L 3, C 15 to the thyristor Thy 1 which, when activated, causes operation of the RS flip-flop IC 4 consisting of G 3 and G 4. The output of the flip-flop then shows a low potential. This low potential remains until such time as C 36 is discharged through R 56 and until thyristor Thy 1 is reset. The output of the flip-flop G 3, G 4, inverted, passes through IC 5, G 5 via R 59 to the base of transistor T 7. When both signals - reflection and frequency variation - are present for 500 ms, the emitter of T 7 is set by reflection measurement to a low level potential and the base of T 7 is operated with a high level potential by the frequency measurement. Thus a low level potential is present at the collector of T 7. This low level potential operates the RS flip-flop consisting of G 7 and G 8. The low level potential from the output G 7, G 8 blocks T 6 and the alarm relay falls. The inverter IC 5, G 6, via the thyristor Thy 2, controls the storage unit LED and furthermore ensures that the flip-flop G 7, G 8 remains tipped via Thy 2 until a manual reset (the relay remains dropped for this period).

The window discriminator IC 3 consisting of OP 6 and OP 7 constitutes the minimum-maximum monitor. If the limit value is exceeded in a positive or negative direction, then the output of the window discriminator displays a low level potential. This low level potential acts on the flip-flop G 7, G 8 and, during a breakdown, causes the relay to drop and causes the LED 1 to give a display.

Claims

1. Method of monitoring an object, the method comprising generating vibrations of predetermined frequency and constant amplitude within the object, detecting the vibrations in the object and converting them to an electrical signal, processing the electrical signal to detect changes in its amplitude or frequency, and generating a warning on detection of such changes.

2. Method according to claim 1 in which the instantaneous amplitude of the signal is compared with an average value over a delayed time and the warning is generated if the difference exceeds a pre-set value.

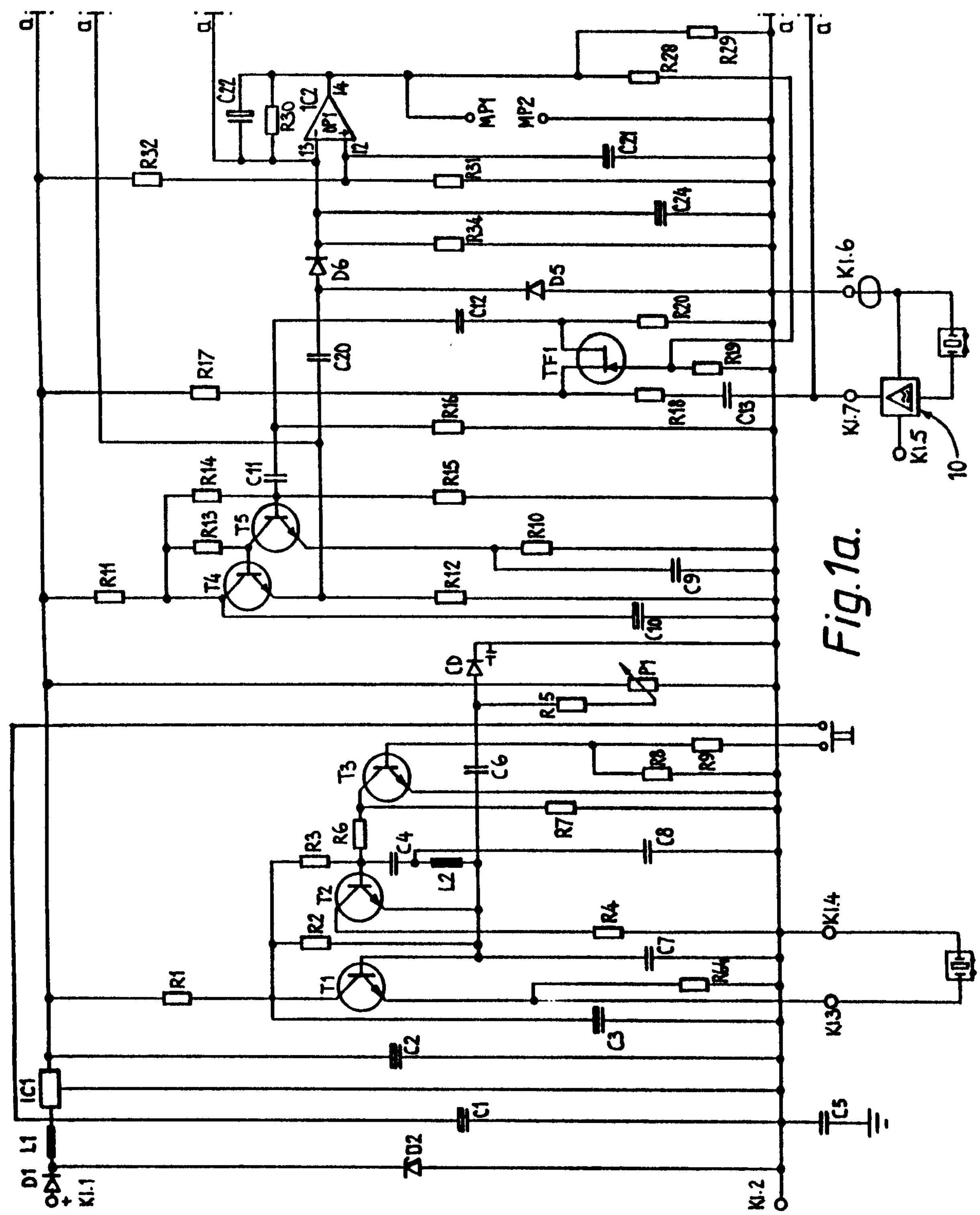
3. Method according to claim 1 or claim 2 in which the electrical signal is filtered to remove components at and below the predetermined frequency, and the warning is generated on detection of signal components at higher frequency.

4. Method according to any preceding claim in which the warning is generated when the amplitude of the electrical signal lies outside pre-set upper or lower limits.

5. Method according to any preceding claim in which the warning is generated only when the warning-generating condition has been maintained for a pre-set minimum time.

6. Method according to any preceding claim in which the object being monitored is a pane of glass.

7. Detection apparatus for monitoring an object such as a glass window pane comprising means for transmitting vibrations of predetermined frequency through the object, a transducer for receiving said vibrations, and means operatively connected to the transducer for detecting a change in the vibrations received.



D1
L1
Kl.1
IC1
D2
C1
C2
C5
Kl.2
R1
T1
C3
Kl.3
R64
R2
R3
T2
C4
L2
R6
C7
R4
Kl.4
C8
R7
T3
C6
R8
R9
R5
P1
CD
R11
T4
T5
R13
R14
C11
R12
C10
R10
C9
R15
R16
R17
C20
C12
TF1
R18
R19
R20
C13
Kl.7
Kl.5
10
D6
D5
Kl.6
R34
C24
R31
R32
C21
IC2
OP1
C22
R30
MP1
MP2
R28
R29
a

Fig.1a.

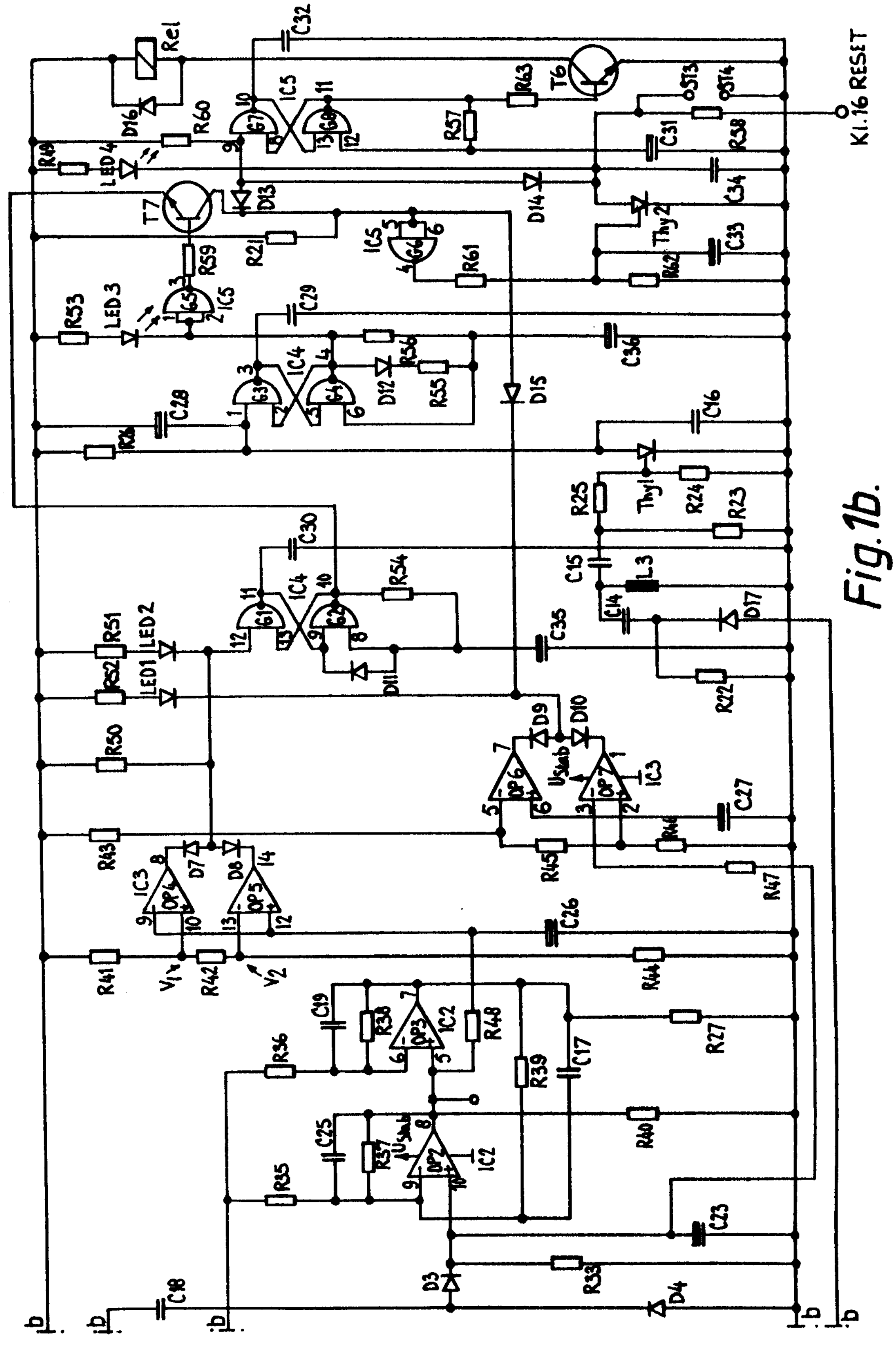


Fig.1b.

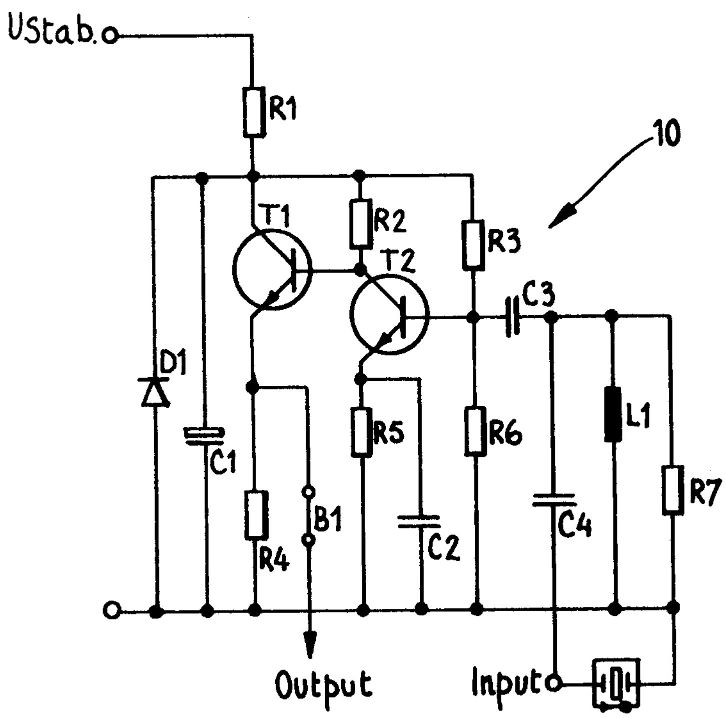

UStab.
R1
10
T1
R2
R3
T2
C3
D1
C1
R5
R6
L1
R7
B1
C2
C4
R4
Output
Input

Fig.2.