

The invention relates to an alarm device, particularly for an alarm clock, the alarm signal of which can either be interrupted for a time or be finally stopped by an acoustic signal formed by the human voice. Both the interruption in the alarm signal - in wakening alarm clocks, this operation is controlled by a so-called snooze device - and the stopping thereof is effected in the alarm device relating to the invention independently of the information contained in the acoustic signal, for example a word or a phrase of a language.

Such an alarm device is known from US-PS 3 855 574. In this an alarm clock with a snooze device is described wherein the alarm signal emitted at intervals by the alarm device can be interrupted by the acoustic signal formed by the human voice for a specific period of time (snooze time).

For this purpose, the acoustic signal formed by the human voice is converted into an electrical signal by a microphone and supplied, through an amplifying and tripping circuit, to the two inputs of a first time switch, the switching time of which determines the snooze time. The output signal of a second time switch, the duration of which determines that period of time within which an acoustic signal received by the microphone can lead to the interruption of the alarm signal, is applied to the second input of the first time switch. The alarm signal itself is generated by a loudspeaker, with which an audio oscillator is connected in series, and by a chopper which in turn is connected in series at the input side of this and which makes the audio oscillator capable of oscillation or incapable of oscillation (signal duration or interval duration) for certain times. The control of these times is effected by the chopper itself.

If a sufficiently large acoustic signal reaches the microphone within the interval duration of the alarm signal, further emission of the alarm signal is prevented by the signal then appearing at the output of the amplifying and tripping circuit as a result of the fact that the first time switch holds the chopper for the snooze time in the state in which the audio oscillator is incapable of oscillation.

A disadvantage of this known alarm device consists in that it is not possible to use a continuous tone for the alarm signal because in this case the alarm device would switch itself off. Even if this disadvantage is not considered very important, further expense on circuitry results from the fact that the device for interrupting the alarm signal has to be deactivated while the signal is actually being given and re-activated during the signal intervals. If the user of the alarm device wishes to interrupt this by means of a short sound, there is the possibility that he may make this sound just during the deactivated state which leads to the fact that the alarm signal cannot be interrupted at all and therefore continues to be emitted.

The known alarm device installed in a mains-operated alarm clock has the further disadvantage that it is permanently switched on although it is only needed for a few minutes during 24 hours. As a result of the associated relatively high current consumption in comparison with that needed for stepping on the display device, for example by means of a stepping motor in an analogue-display alarm clock, the known alarm device could scarcely be used in a battery-operated device, particularly an alarm clock or watch.

A further disadvantage of the known alarm device consists in that, despite the above-mentioned drawbacks,

this is constructed in a relative expensive manner from discrete components and therefore is too expensive to be able to be installed in a device which can be produced relatively cheaply by mass production, such as an alarm clock costing only a few 10.--DM for example.

It was therefore the object of the invention to indicate an alarm device in accordance with the preamble to Patent Claim 1, which has the following characteristics:

- a) low current consumption so that the alarm device can also be used in battery-operated devices,
- b) ability to operate even if the acoustic signal given by the user is only of very short duration,
- c) ability to operate even if the alarm signal is given as a continuous tone,
- d) the ability to use integrated circuits already in existence for the cheap mass production of the alarm device.

This problem is solved in that a first output of a monostable trigger circuit is connected to a control input, controlling the alarm signal, of an integrated circuit of the alarm device, that applied to one input of the monostable trigger circuit is the output signal of a rectifier which is preceded first by a filter and amplifier unit and before that by a microphone, that the output of the integrated circuit, at which an alarm signal can be given out, is connected both to an alarm signal converter and to the input of a switching element, while the switching element only connects the microphone and the filter and amplifier unit to their supply voltage when an alarm signal coming from the output of the integrated circuit is applied to its input and that an acoustic signal picked up by the microphone sets the monostable trigger circuit in its astable state through the filter and

amplifier unit and the rectifier and as a result the signal present at the control input is inverted.

Even if something is being said already when the alarm signal is set off, an alarm signal can still be given by the alarm device, at least for some time. The technical solution for this consists in that the filter and amplifier unit can only deliver an output signal some time after connection to the supply voltage which can be achieved as a result of the fact that a capacitor first has to be charged to a certain charge before the operating point of an amplifier contained in the filter and amplifier unit can be set.

The alarm device can be constructed in such a manner that extraneous noises with frequencies which are outside the frequency range of the fundamental tone of the human voice cannot interrupt or finally stop the alarm signal. The technical solution for this may consist in that the filter and amplifier unit contains a low-pass filter and a high-pass filter which act respectively above and below the frequency range of the fundamental tone of the human voice.

For the further saving of energy, the monostable trigger circuit may be constructed in such a manner that it has a negligible energy consumption in its stable state. The technical solution for this may consist in that the monostable trigger circuit comprises two transistors which are both switched through only in the astable state of the monostable trigger circuit while neither transistor is switched through in its stable state.

The alarm device may also be equipped with a lighting device which illuminates a display device for some time if the alarm signal given by the alarm device has been interrupted or finally stopped by the human voice. The technical solution for this may

consist in that a second output of the monostable trigger circuit delivers a signal which is inverted in relation to the first output and is connected to a lighting device.

All the features basically essential for the invention can be seen from the Patent Claims.

The invention will be described in more detail below with reference to an example of embodiment. All the details essential for the invention are included in this description of an example.

Figure 1 shows a block circuit diagram of the alarm device according to the invention.

Figure 2 shows a circuit diagram of the alarm device according to the example of embodiment of the invention and

Figure 3 shows the frequency response of the filter and amplifier device of the example of embodiment.

The basic mode of operation of the alarm device according to the invention is explained below with reference to the block circuit diagram illustrated in Figure 1 using the example of an alarm clock:

Of an integrated circuit (IC) 5, which controls not only the stepping on of the display device but also various additional functions of an alarm clock and which has a total of eight connections, only the connections 4 and 6 are illustrated in Figure 1. The IC 5 is so constructed that a continuous train of pulses with a frequency in the audible range is delivered at its connection 6 when a signal with a positive voltage level (H signal) is applied to its connection 4. The construction of the IC 5 can also be extended in such a manner that the above-mentioned pulses are delivered at the connection 6 in the form of an intermittent signal with a specific signal-interval ratio.

Before the connection 4 of the IC 5 there is, on the one hand, an alarm setting-off switch 12, the two positions of which are controlled by an alarm control device not illustrated here, that is to say by an alarm clock in the example of embodiment. On the other hand, the connection 4 is also preceded by an alarm-setting switch 20 which can be opened and closed manually by the user of the clock, the alarm device only being ready for operation in the closed position of the switch. If, with the alarm-setting switch 20 closed, the alarm setting-off switch 12 has been closed by the alarm control device, the signal appearing at one output 15 of a monostable trigger circuit (monostable multivibrator) 7 is present at the connection 4 of the IC 5. In the stable state, zero potential (L signal) appears at a further output 16 of the monostable multivibrator 7 while an H signal appears at the output 15. Consequently, in the stable state of the monostable multivibrator 7, the above-mentioned pulse train is delivered at the connection 6 of the IC 5 and, via the base-emitter voltage of a switching transistor 11, serves as a driver signal for an electroacoustic transducer 10 which is connected, on the one hand to the positive pole 19 of a d.c. voltage source and on the other hand, through the transistor 11, to earth. The electroacoustic transducer then delivers a continuous acoustic alarm or waking signal, or one appearing at intervals, with a specific alarm signal frequency according to whether the driver signal appearing at the output 6 of the IC 5 consists of an uninterrupted or of an intermittent pulse train.

During the pulsed operation of the electroacoustic transducer 10 containing inductive elements, a.c. voltage peaks, which are caused by self-induction

effects appear at the input 13 of a switching element 9 at the alarm signal frequency. As a result of these voltage peaks, an input 18 connected to the positive pole 19 of the d.c. voltage source and an output 17 of the switching element 9, likewise connected to the switching element 9, are electrically connected to one another. Only as a result of this are a microphone 1 and a filter and amplifier unit 2 connected to the d.c. voltage source.

Apart from the fact that the microphone 1 and the filter and amplifier unit 2 are only connected to the voltage supply during the giving of an alarm signal, the fact that the monostable multivibrator 7, because of its wiring (Figure 2), only has a non-negligible current consumption when it is in its astable state contributes to the further saving of energy.

For the further description of the example of embodiment, without the invention being in any way restricted as a result, the starting point will be an IC which, apart from the control of the display device, for example the stepping mechanism of an analogue-display clock, which control is effected by it but is not of further interest here, has the following characteristics:

1. If the section consisting of the alarm setting-off switch 12 and the alarm-setting switch 20 is closed and an H signal remains at the input 4, an intermittent pulse train with a signal duration of one second, an interval duration of three seconds and an alarm signal frequency of 2048 Hz is delivered at the output 6 for about two minutes. A renewed delivery of the aforesaid pulse train at the output 6 is only effected again when the aforesaid section is once opened and then closed again.

2. On the other hand, if the signal at the input 4 changes from H to L before the expiration of two minutes, the pulse train described under 1. at the output 6 is interrupted. After a snooze time of about four minutes, the pulse train described under 1. is delivered afresh. This so-called snooze operation caused by the change of the signal from H to L at the input 4 can be repeated as often as desired provided the section mentioned under 1. remains closed.

Apart from the possibility of opening the alarm-setting switch 20 manually, the temporary interruption of the alarm signal can be effected by the user in that acoustic oscillations produced by the human voice and picked up by the microphone 1 are amplified in the filter and amplifier unit 2 and an output signal is delivered by this to a rectifier 3 which in turn is connected to an input 22 of the monostable multivibrator 7. If a sufficiently large signal is applied to the input 22, the monostable multivibrator changes over into the astable state, that is to say an L signal appears at the output 15 and an H signal at the output 16. The consequence of this is that a driver signal for the electroacoustic transducer no longer appears at the connection 6 of the IC, thus the alarm signal is interrupted. At the same time, the L signal at the output 15 is applied to a further input 14 of the switching element 9. The switching element 9 is so designed that the connection through of the voltage supply is immediately interrupted as a result. As a result of the H signal now appearing at the connection 16, a lamp 8 connected between the connection 16 and earth lights up and serves to illuminate a display device not illustrated.

The switching element 9 is so designed that the connection through of the supply voltage to the micro-

286

phone 1 and the filter and amplifier unit 2 remains in existence longer, for example here about 10 seconds, than the alarm signal interval of three seconds lasts in the intermittent alarm signal. As a result, assurance is provided that even during the signal intervals in the intermittent alarm signal the microphone 1 and the filter and amplifier unit 2 are capable of operation and the alarm signal can be interrupted.

It must also be mentioned that the filter and amplifier unit 2 is so designed that, when a supply voltage is applied to it, it nevertheless needs a starting time of a few seconds before a signal coming from the microphone 1 can be amplified at all. This ensures that the alarm device in any case gives an alarm signal for a few seconds even if someone has already spoken which may be the case, for example, if an alarm clock serving as a reminder and containing the alarm device according to the invention, is used during a discussion.

Furthermore, the filter and amplifier unit 2 is of such a nature (Figures 2 and 3) that not only is the frequency of the alarm signal of 2048 Hz filtered out completely but also noises with a frequency below about 100 Hz are largely filtered out.

The time during which the monostable multivibrator 5 remains in its astable state on its first change of state and during which the lamp 8 burns, may be about 5 seconds. Later changes of state of the monostable multivibrator 7 would be possible at considerably shorter intervals of time as a result of this circuit (see Figure 2). In this connection, it should be mentioned that the immediate interruption of the current supply by the L signal at the input 14 of the switching element 9 ensures that the lamp 20 is not switched on and off again several times if the monostable

multivibrator 7 returns to its stable state and further acoustic signals are picked up by the microphone 1. Such switching on and off would actually involve an undesirably high current consumption.

With the block circuit diagram otherwise unaltered, the IC 5 may also be so constructed that no snooze operation can be effected and so the alarm signal is only finally stopped by the human voice. In this case, a signal in the form of continuous or interrupted pulse trains is delivered at the output 6 only for a certain time, for example again for two minutes, if the alarm setting-off switch 12 has been closed by the alarm clock and an H signal is therefore applied to the input 4. If the signal at the input 4 changes from H to L within this time as a result of an acoustic signal received by the microphone 1 or as a result of manual opening of the alarm-setting switch 20, the signal at the output 6 is stopped prematurely. With the alarm-setting switch 20 closed, pulse trains only appear at the output 6 again if the alarm setting-off switch 12 has been re-opened and closed again by the alarm clock. In the usual alarm clocks, this occurs after 12 or 24 hours.

In digital clocks, no alarm setting-off switch is closed mechanically but an appropriate signal is delivered when the stored waking time coincides with the contents of a counter containing the time of day.

The lamp 8 for illuminating the display device can also be switched on by manual actuation of the push-button switch 21, during the time when the monostable multivibrator 7 is in its stable position. An L signal is simultaneously applied to the input 4 of the IC 5 as a result of closing the push-button switch 21. The alarm signal can therefore also be manually interrupted or finally stopped by the push-button switch 21.

The construction of the circuit of the example of embodiment, illustrated only in the form of blocks in Figure 1, will, with the exception of the IC 5, be described in detail below with reference to Figure 2:

With the alarm-setting switch 20 closed and after the closing of the alarm setting-off switch 12, the input 4 of the IC 5 is connected to the positive pole 19 of the d.c. voltage source through the resistor 58.

If the above-mentioned a.c. voltage peaks appear at the input 13 of the switching element 9, a capacitor 64 is charged through a diode 63 and a Zener diode 62. An n-p-n transistor 69 is connected through via two resistors 67 and 68 connected in parallel to the capacitor 64, as a result of which, a transistor 72 is also connected through via a further resistor 70. A diode 65, which is connected to the connection 18 and to the positive electrode of the capacitor 64, limits the voltage to which the capacitor 64 can be charged. A capacitor 73 is charged through a resistor 71 which is connected in series with the collector of the transistor 72, as a result of which the microphone 1 and the filter and amplifier unit 2 are supplied with voltage, that is to say the output 17 and the input 18 of the switching element 9 are connected to one another.

The amplifier section of the filter and amplifier unit 2 consists of a three-stage transistor amplifier in a common-emitter connection with three transistors 39, 41 and 43 and the collector resistors 40, 42 and 44, the collector of the preceding transistor being connected to the base of the following transistor in each case. In order to adjust the operating point of the three-stage transistor amplifier, the collector voltage from the collector of the transistor 43 is applied to the base of the transistor 39 through two resistors 47

and 38 connected in series, which leads to a negative feedback. In order to achieve the effect that only the d.c. voltage component of the collector voltage of the transistor 43 is strongly degenerative, a capacitor 45 and a resistor 46 are connected in series between the junction point of the resistors 47 and 38 and the earth of the d.c. voltage source.

The starting time of the filter and amplifier unit 2 already mentioned in the description of Figure 1 and amounting to a few seconds results from the fact that after the voltage is applied to the output 17 of the switching element 9, the capacitor 45 must first be charged, through the resistors 44, 47 and 46, to such an extent that the operating point is adjusted and so the three-stage transistor amplifier is capable of operation.

The microphone 1, for example an electret capacitor microphone with built-in impedance transformer, is connected, by one connection to earth and by its other connection to the output 17 of the switching element 9 through a load resistor 32. The a.c. voltage signal generated by the microphone 1 is fed to the base of the first transistor 39 of the amplifier through a filter, of which the components 33-37 and the operation will be described in more detail below in connection with Figure 3.

In so far as the amplified a.c. voltage signal has a sufficient amplitude, the charge in a capacitor 49 is reversed on the one hand during the positive half-wave through a diode 50 in the rectifier 3 and on the other hand during the negative half-wave through the base-emitter diode of a transistor 51.

In the second case, the transistor 51 becomes conducting and therefore a capacitor 52 is charged step-by-step. At the same time, this capacitor 52

is discharged again through a resistor 53 in parallel with it. If more charge flows per unit of time through the transistor 51 to the capacitor 52 than this delivers through the resistor, a sufficient voltage finally appears at the base of a transistor 55, which is connected to the positive electrode of the capacitor 52 through a resistor 54, for the transistor 55 to be connected through. As a result of feedback of the collector of the transistor 55, which is connected to the positive pole 19 of the voltage source through the resistor 58, the monostable behaviour of the monostable multivibrator 7 is achieved through a series connection of a resistor 56 and a capacitor 57 to the base of the transistor 51.

Therefore, in the stable state of the monostable multivibrator 7, the two transistors 51 and 55 are not connected through whereas in the astable state, both transistors are connected through. Consequently, the monostable multivibrator has an appreciable energy consumption only during the comparatively short times of its astable state.

If the transistor 55 is connected through, then with the alarm-setting switch 20 closed and the alarm setting-off switch 12 closed, on the one hand an L signal is applied to the input 4 of the IC 5 and so the alarm signal is interrupted or finally stopped. On the other hand, the capacitor 64 is discharged through a diode 66. As a result, the filter and amplifier unit 2 and the microphone 1 are separated from the supply voltage. At the same time, yet another transistor 60 is connected through via a resistor 59 as a result of which the lamp 8 lights up. A resistor 61, which is connected between the collector of the transistor 60 and the base of the transistor 55, improves the switching behaviour of the monostable multivibrator 7 by feedback.

In Figure 3, a spectrum 24 of the human voice with a spectrum 25 of the electroacoustic transducer 10 and a filter curve 23 with four regions I-IV are illustrated diagrammatically. This filter curve is achieved by the filter section of the filter and amplifier unit 2.

A resistor 33, which on the one hand is connected to the junction point between the microphone 1 and the resistor 32, is connected, on the other hand, to the one connection of a resistor 35. A capacitor 34 is connected to earth between the junction point of the resistors 33 and 35. The other connection of the resistor 35 is connected both through a capacitor 36 to the input 17 of the transistor 39 and through a capacitor 37 to its base. The resistors 33 and 35 and the capacitors 34 and 36 form a bipolar low-pass filter with a critical frequency of about 500 Hz, that is to say this low-pass filter works in the region III. The capacitor 37 and the resistor 38 form a high-pass filter with a critical frequency of about 100 Hz, that is to say this high-pass filter works in the region I. In the region II, which lies between the regions I and III and which corresponds to the frequency range of the human voice, no attenuation of signals takes place. On the other hand, disturbing noises outside this region II are attenuated.

A further filter action is achieved by a capacitor 48 which is connected to earth from the collector of the transistor 43, namely in such a manner that the capacitor 48 is rapidly discharged during the negative half-wave via the transistor 43 in the event of an amplified a.c. voltage but is charged relatively slowly through the resistor 44 during the positive half-wave. As a result, a sawtooth voltage, the amplitude of

which decreases with rising frequency above a critical frequency, is formed at the capacitor 48. Above a frequency of about 1 KHz, this sawtooth voltage is no longer sufficient to actuate the rectifier 3. Thus higher frequencies in the region IV, such as the frequency of the electroacoustic transducer for example, cannot interrupt or finally stop the alarm signal.

The filter action described with reference to Figure 3 could also be achieved by a digital filter if the block circuit diagram shown in Figure 1 is largely realized in the form of an integrated circuit.

CLAIMS

1. An alarm device, particularly for an alarm clock, the alarm signal of which can be interrupted for a time which can be determined or be finally stopped, by an acoustic signal formed by the human voice, having a
5 microphone and a connected amplifier circuit, characterised in that a first output (15) of a monostable trigger circuit (7) is connected to a control input (4), controlling the alarm signal, of an integrated circuit (5) of the alarm device and is also
10 additionally connected to a first input (14) of a switching element (9), that applied to the input (22) of the monostable trigger circuit (7) is the output signal of a rectifier (3) which is preceded first by the amplifier circuit (2) and before that by the microphone
15 (1), that the output (6) of the integrated circuit (5), at which an alarm signal can be given out, is connected, through an electronic switch (11), both to an alarm signal converter (10) as well as to a second input (13) of the switching element (9), while the switching
20 element (9) only connects the microphone (1) and the amplifier circuit (2) to their supply voltage, through its output (17), if an alarm signal coming from the output (6) of the integrated circuit (5) is applied to its second input (13) and that an acoustic signal picked
25 up by the microphone sets the monostable trigger stage (7) into its astable state through the amplifier circuit (2) and the rectifier (3) and as a result the signal present at the control input (4) and at the input (14) of the switching element (9) is inverted as a result of
30 which the microphone (1) and the amplifier circuit (2) are again disconnected from their supply voltage and the alarm signal is interrupted or finally stopped.



40

2. An alarm device according to claim 1, characterised in that the amplifier circuit is extended to form a filter and amplifier unit (2) by the addition of a high-pass filter (37, 38) and of a low-pass filter (33-36),
5 the high-pass filter and the low-pass filter being respectively so dimensioned that they act respectively below (range I) and above (range III) the frequency range of the fundamental sound of the human voice (range II).

3. An alarm device according to claim 2, characterised in that the alarm signal is given as an acoustic alarm signal by means of an electro-acoustic transducer (10) and that the frequency of the acoustic alarm signal lies
5 outside the frequency range of the fundamental sound of the human voice, preferably 1 KHz above it.

4. An alarm device according to claim 1 or 2, characterised in that the amplifier circuit (2) comprises a capacitor (45) which must first be charged to a specific voltage in order that the amplifier
5 circuit may be capable of operation.

5. An alarm device according to claim 1 or 2, characterised in that the amplifier circuit consists of a three-stage transistor amplifier (38-47).

6. An alarm device according to claim 1, characterised in that the monostable trigger circuit (7) comprises two transistors (51, 55) which are both switched through only in the astable state of the monostable trigger
5 circuit (7) while in its stable state both transistors (51, 55) are not switched through.



7. An alarm device according to claim 1, characterised in that the switching element (9) comprises a delay element which has the effect that, when an intermittent alarm signal is delivered by the alarm device, the microphone (1) and the amplifier circuit (2) are not immediately disconnected from their supply voltage in the interval between the pulse trains but remain connected to their supply voltage so long that the intervals between two successive pulse trains are bridged.

8. An alarm device according to claim 7, characterised in that the delay element comprises a capacitor (64) which can be charged through a diode (63) and a Zener diode (62) and which, although it is discharged again via an ohmic resistance (67, 68) in the absence of an alarm signal at the input (13), nevertheless, in the intervals between the pulse trains of an intermittent alarm signal, the discharge does not progress so far that the supply voltage is already no longer applied to the output (17) of the switching element (9).

9. An alarm device according to claim 1, characterised in that when the alarm signal delivered by the alarm device is interrupted or finally stopped by the human voice, an illuminating device (8) is switched on for some time via a second output (16) of the monostable trigger circuit (7) and illuminates a display device.



46

-19 -

10. An alarm device according to claim 9, characterised in that the second output (16) of the monostable trigger circuit (7) delivers an inverted signal to the first output (15) and is connected to earth through a lamp (8) and that, in the astable state of the monostable trigger circuit (5), a voltage different from zero appears at the second output (16).



* C L M S *