

Oct. 21, 1958

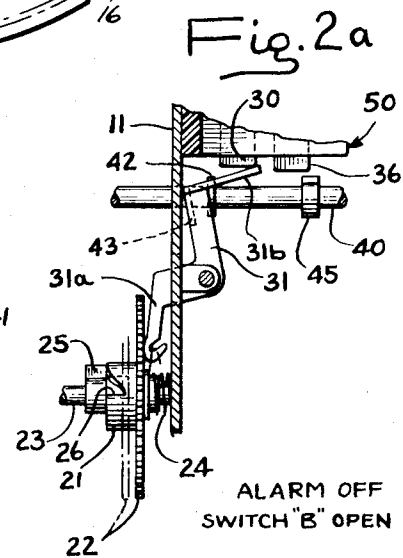
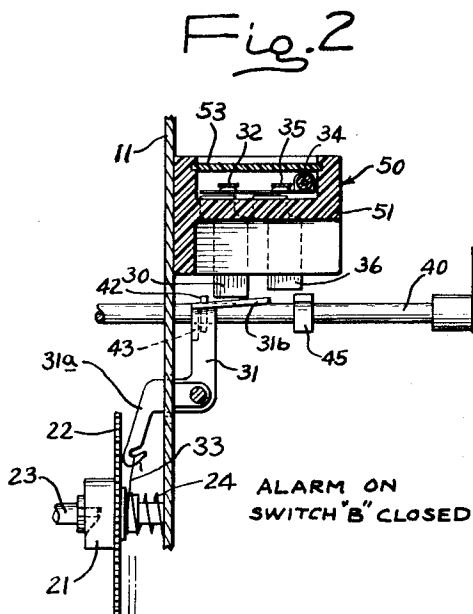
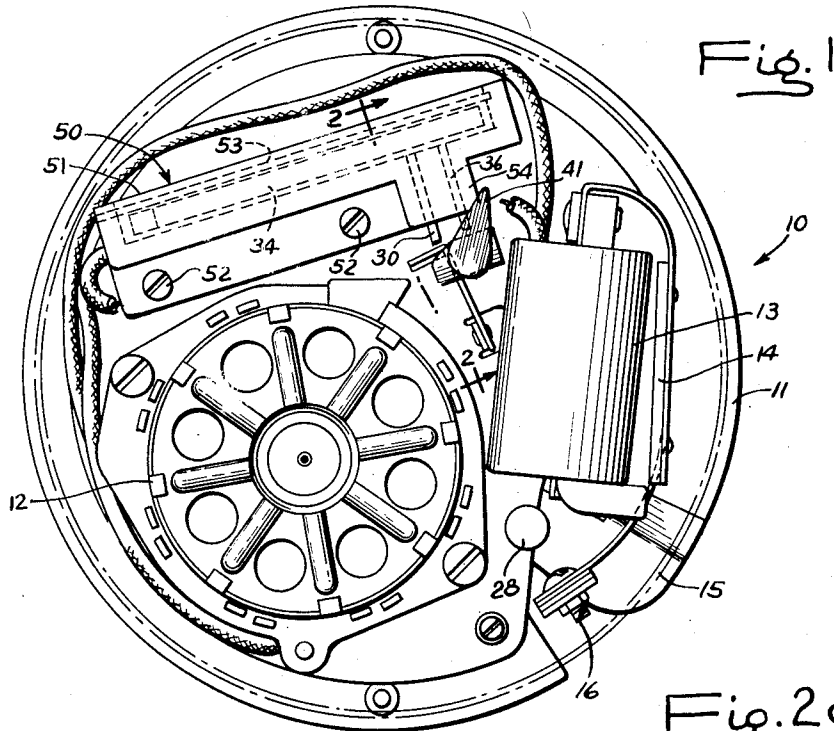
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2,856,751

AUTOMATIC CRESCENDO ALARM

Filed Dec. 13, 1956

2 Sheets-Sheet 1



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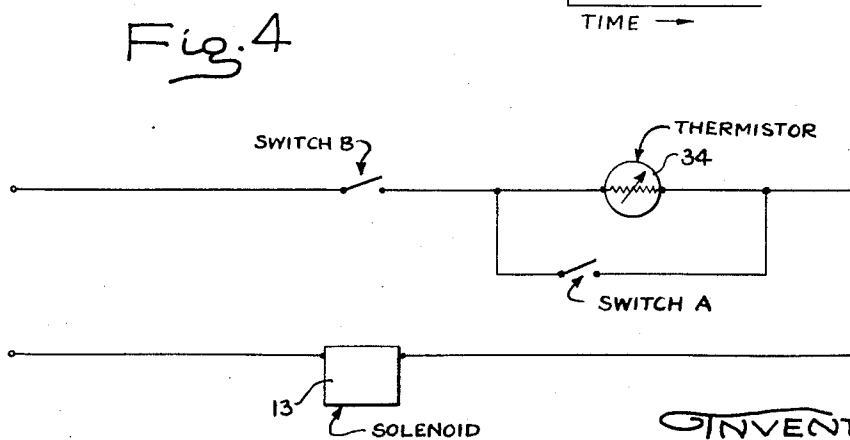
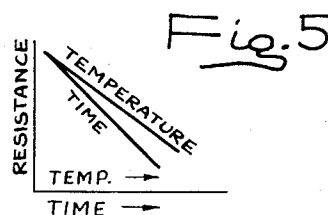
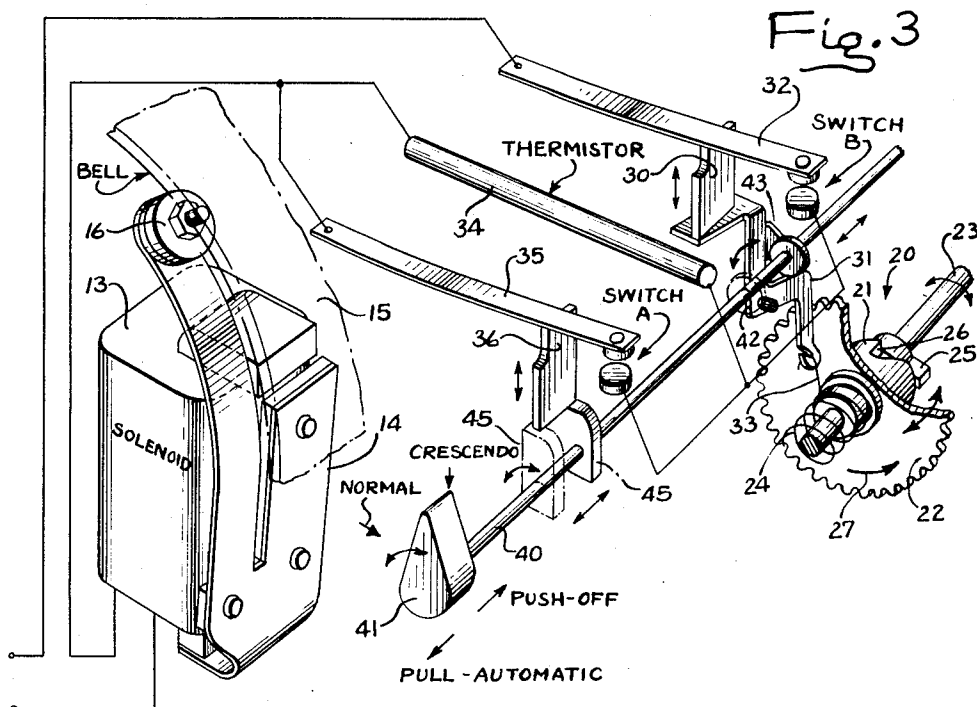
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AUTOMATIC CRESCENDO ALARM

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2 Sheets-Sheet 2



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2,856,751

AUTOMATIC CRESCENDO ALARM

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6 Claims. (Cl. 58—19)

This invention relates to automatic alarm clocks and, more particularly, to an electric clock having an audible alarm whose volume is automatically controlled.

It is an object of the invention to provide an improved electric alarm clock that may be set to begin signaling softly and quietly, but will automatically and gradually increase the volume of its signal to its maximum intensity.

It is a more detailed object to provide a signaling alarm of the above type wherein a single positionable knob affords complete control of the alarm. It is a collateral object to provide an improved alarm that can be set either for normal, full intensity operation or for a "crescendo" mode of operation wherein the audible signal of the alarm gradually increases to its maximum intensity.

It is another object to provide an improved electric alarm clock of the above type which employs a simple circuit that is foolproof and inexpensive.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:

Figure 1 is a rear view of an electric clock with its cover removed showing an automatic alarm constructed according to the present invention.

Fig. 2 is a partial sectional view taken along lines 2—2 of Fig. 1 with the alarm mechanism tripped.

Fig. 2a is a fragmentary view showing portions of Fig. 2 prior to tripping of the alarm.

Fig. 3 is a schematic perspective view of the alarm shown in Fig. 1.

Fig. 4 is a wiring diagram of the alarm structure shown in Fig. 3.

Fig. 5 is a chart showing the performance of the exemplary structure illustrated in the other figures.

While the invention will be described in connection with a preferred embodiment, it will be understood that I do not intend to limit the invention to that embodiment but, on the contrary, intend to cover such alternative embodiments and constructions as may be included within the spirit and scope of the appended claims.

Turning first to Fig. 1, there is shown an electric clock 10 having a substantially circular mounting plate 11 upon which the elements of the alarm structure to be described are supported. The normal gear train, clock face, and minute, second and hour hands, forming a conventional electric clock structure are supported on the forward side of mounting plate 11 and do not appear in the drawings. A conventional electric motor 12 is mounted on the rear face of plate 11 to power the clock. To sound an audible alarm, an electromagnetic vibrator 13 is provided having a resiliently supported, vibrating armature 14. The audible alarm in the present instance comprises an annular bell 15, shown in outline in Fig. 1, and a clapper 16 which is supported on the vibrating armature 14. It will be apparent that when the vibrator 13 is energized, the A.-C. field acting upon the armature produces a continuous audible alarm. The energization of vibrator 13 is effectuated through a circuit, shown in Fig. 4, which includes a switch B connected in series with the vibrator.

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It will thus be apparent that the vibrator remains inoperative, and the alarm silent, so long as the switch B is held open.

In order to control switch B, and thus regulate the energization of vibrator 13, a trip cam structure 20 (see Fig. 3) is provided. In the particular embodiment illustrated, the trip cam structure includes a face cam 21 fixed for rotation with a gear 22 which is suitably geared with the clock mechanism by means, not shown, so as to rotate in unison with the hour hand of the clock. The cam 21 and gear 22 are mounted for axial and peripheral movement on a positionable shaft 23, and are urged toward the right in Fig. 3 by a helical spring 24. Blocking the movement of cam 21 along the shaft 23 is a cam follower 25 which is fixed to the shaft 23 and rotates therewith. The cam 21 is provided with a drop-off portion 26, and it will be apparent that as the gear 22 rotates in the direction of arrow 27, the cam 21 will reach a point where it will drop from the cam follower 25, causing the cam and gear to shift toward the right in Fig. 3 under the urging of the helical spring 24.

The time at which the cam 21 and gear 22 shifts toward the right in Fig. 3 can be selected by properly positioning the cam follower 25. This is accomplished by manually rotating the shaft 23 to which the cam follower 25 is attached by means of a knurled nob 28 (see Fig. 1) which is fixed to the shaft 23.

For the purpose of closing switch B when alarm drop-off occurs, i. e. when the gear 22 moves to the left in Fig. 2, a bell crank 31 is provided having a lower arm 31a and a lifting plate 31b at its upper end. The lifting plate engages a vertical pushbar 30 which pushes against a resilient blade 32 of the switch B. To understand the switch operating sequence, reference may first be made to Fig. 2a which shows the mechanism prior to tripping of the alarm. The gear 22 is cammed to the right and held there by the cam follower 25. The bell crank 31 under such conditions is rotated counterclockwise, holding the pushbar 30 in upraised position against the resilient blade 32 and maintaining the contacts of switch B separated and the switch therefore open.

At the predetermined time the cam 21, rotating in unison with the hour hand of the clock, will drop from the cam follower 25 and slide to the left in Fig. 2a along the shaft 23 under the urging of helical spring 24 so as to assume the position shown in Fig. 2. The bell crank 31 is thus permitted to rotate clockwise under the urging of an extending arm 33 of the spring 24 which drops the plate 31b beneath the pushbar 30 and allows the resilient blade 32 to close the contacts of switch B, as shown in Fig. 2.

In accordance with the present invention, the alarm vibrator 13 is energized by the switch B through a novel control circuit including a resistor having a high negative temperature coefficient of resistance, whose resistance therefore decreases as the current flowing through it gradually increases its temperature, which is connected in the circuit so that the current flow energizing the vibrator is steadily increased to increase the intensity of the audible alarm. In the preferred embodiment this function is performed by a thermistor 34, having a negative temperature coefficient of resistance, connected in series with the vibrator 13 and the control switch B. The thermistor 34 provides a high initial resistance but as the electrical current causes the thermistor to heat, the resistance gradually drops to a low value. It will thus be apparent that since the thermistor 34 and the vibrator 13 are connected in series, when the switch B is closed to provide power to the circuit only a small amount of current is initially available to energize the solenoid 13 and the alarm therefore sounds very softly. Gradually, however, as the resistance of the thermistor

causes it to heat, more and more current becomes available for actuating the vibrator, and this causes the clapper 16 to vibrate with greater and greater force and thus progressively increases the intensity of the audible alarm signal.

Thermistors having the electrical property described above are commercially available and commonly make use of well-known materials having a negative temperature coefficient of resistance such as carbon or graphite. In a particular case, a practical thermistor will provide a resistance that varies from 25,000 ohms to 1,500 ohms within a few minutes.

Fig. 5 illustrates, in simplified, graphic form, the operation of a typical thermistor. When electric current is passed through a thermistor, its temperature gradually increases and, as shown by the "TEMPERATURE" line, an increase in temperature is accompanied by a decrease in resistance. Since the temperature build-up is gradual over a period of time, time becomes related to resistance and, as shown by the "TIME" line, passage of time is accompanied by a decrease in resistance.

In order to cause the alarm of clock 10 to operate normally and not follow the "crescendo" mode of operation discussed above, a second switch A is provided in the solenoid energizing circuit which bypasses the thermistor 34 (see Fig. 4). When switch A is closed, the closing of switch B by the trip cam assembly 20 causes the vibrator 13 to be immediately fully energized and the alarm to sound steadily at its normal full intensity. The construction of switch A is identical to that of switch B (see Fig. 3) and includes a resilient blade 35 and a slidable pushbar 36.

According to one of the features of the invention, a single control shaft is provided having two distinct positionable controlling movements which are effective to independently control each of the switches A and B. In the preferred embodiment, a control shaft 40 is mounted for both rotative and axial movement and carries a pointed nob 41 which may be manually grasped at the rear of the clock to position the control shaft. Control of switch B is achieved by fastening a collar 42 (see Fig. 3) onto the shaft 40 and by providing a lug 43 on the bell crank 31. When the control knob 41 is pushed so as to move the control shaft axially toward the right in Fig. 3, the collar 42 engages the lug 43 and rocks the bell crank 31 clockwise to thus slide pushbar 30 upwardly and open switch B. When the shaft 40 is pulled outwardly or toward the left in Fig. 3, the collar 42 moves away from lug 43 and the switch B is then under the automatic control of the trip cam assembly 20.

To control the switch A, the control shaft 40 is provided with a cam arm 45 which is fixed to the shaft and positioned beneath the pushbar 36. When the pointed knob 41 is turned clockwise to the "crescendo" position shown in Fig. 3, the cam arm 45 slides the pushbar 36 upwardly to open switch A against the resistance of resilient blade 35. By turning the knob 41 counterclockwise to the "normal" position, the cam arm 45 will also be turned counterclockwise to allow the pushbar 36 to slide downwardly under the urging of resilient blade 35 and thus close switch A.

It will be appreciated that both the axial and rotative controlling movements of the shaft 40 are completely independent of each other. That is, the circular collar 42 is in position to engage the lug 43 no matter what the angular position of the control shaft 40 may be. Also, due to the width of the pushbar 36 and the position of cam arm 45, the arm is able to engage the pushbar in any axial position of the control shaft 40; note the alternative dotted line position of arm 45 in Fig. 3.

Turning more particularly to the construction of switches A and B, it can be seen that they, together with the thermistor 34, are mounted in a single switch assembly 50 (see Figs. 1 and 2) comprising a housing 51

which is preferably integrally molded of an insulating material such as Bakelite. The housing 51 is secured to the mounting plate 11 by means of suitable screws 52 and has a hollowed upper portion to receive the resilient blades 32 and 35, as well as the thermistor 34. The hollowed upper housing is closed by a sliding panel 53 which fits into suitably formed grooves in the housing 51.

To slidably support the pushbars 30 and 36, the housing 51 is provided with a depending portion 54, which is suitably slotted to receive the pushbars and allow them to project into the housing 51 and engage the resilient blades 32 and 35. It can, therefore, be seen that a particularly effective and economical switch construction has been provided.

In the practice of the invention it has been found most desirable to permit the audible alarm to reach its maximum intensity over a time interval of from two to three minutes. It will be appreciated that this "crescendo" mode of operation has been achieved by structure that is inexpensive to manufacture and foolproof in operation. The alarm control circuit is not subject to mechanical wear and, therefore, presents no problem of maintenance or repair.

I claim as my invention:

1. In an electric alarm clock, the combination comprising a clock mechanism having means for closing an electric alarm circuit at a preselected time, a voltage source, an audible alarm including an electromagnetic vibrator coupled in said circuit to said voltage source and so arranged that the loudness of the alarm varies in accordance with the current flowing through said vibrator, a resistor in said circuit having a high temperature coefficient of resistance and so arranged that the current through said vibrator is at a minimum when the alarm circuit is closed and increases gradually over a period of several minutes as current flows through said resistor heating the same, the increasing current thus progressively increasing the loudness of said alarm.

2. In an electric alarm clock, the combination comprising a clock mechanism having means for closing an electric alarm circuit at a preselected time, a voltage source, an audible alarm including an electromagnetic vibrator coupled in said circuit to said voltage source and so arranged that the loudness of the alarm varies in accordance with the current flowing through said vibrator, a thermistor connected in said circuit in series with said vibrator so that the current through said vibrator is at a minimum when the alarm circuit is initially closed and increases gradually over a period of several minutes as current flows through said thermistor heating the same, the increasing current thus progressively increasing the loudness of said alarm.

3. In an electric alarm clock having an audible signal-producing device operable by an electromagnetic vibrator and controlled by a positionable trip mechanism that can be set for operation at any chosen clock setting, an automatic alarm control comprising, in combination, a circuit for energizing said vibrator, a switch in said circuit being operable by said trip mechanism to complete the circuit and energize the vibrator, and a thermistor whose electrical resistance varies as its temperature is gradually raised by current flowing therethrough connected in said circuit so that the current flow energizing the vibrator is steadily increased to increase the audible intensity of said device.

4. In an electric alarm clock having a signal-producing device operable by an electromagnetic vibrator and controlled by a positionable trip mechanism that can be set for operation at any chosen clock setting, an automatic alarm control comprising, in combination, a circuit for conducting power to said vibrator, a resistor in said circuit connected in series with said vibrator and having the electrical property of a negative temperature coefficient of resistance, and a switch in said circuit, connected in series

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with said resistor and vibrator, being operable by said trip mechanism to complete said circuit so that a gradually increasing amount of current will be supplied to said vibrator as said resistor becomes heated and its effective electrical resistance decreased.

5. In an electric alarm clock having an audible signal-producing device which can either (1) produce a steady, normal intensity signal, or, (2) can begin sounding softly and gradually increase in intensity to its normal level, a single-knob control system comprising, in combination, a control shaft mounted for both axial and rotational movement, said shaft carrying a control knob enabling the shaft to be manually positioned in each direction of its movement, means selectably operable to deactivate said device and prevent it from signaling, means carried by said shaft to control said deactivating means by positioning the shaft in one of its directions of movement, and other means controlled by said shaft when moved in its other direction of movement to select between said modes of operation (1) and (2) of said signal device.

6. In an alarm clock having a signal-producing device operable by an electromagnetic vibrator and controlled by a positionable trip mechanism that can be set for operation at any chosen clock setting, an automatic alarm control comprising, in combination, a circuit for conducting

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power to said vibrator, a resistor in said circuit connected in series with said vibrator and having the electrical property of a negative temperature coefficient of resistance, a switch connected in parallel to said resistor permitting selective completion of said circuit around said resistor, a second switch in said circuit connected in series with said resistor and said vibrator being operable by said trip mechanism to complete said circuit so that a gradually increasing amount of current will be supplied to said vibrator as said resistor becomes heated and its effective electrical resistance decreased, a positionable control shaft movable axially and rotatably, and means connecting said control shaft to said switches so that its rotative movement will selectively operate said first switch and its said axial movement will be effective to selectively hold said second switch open independently of said trip mechanism.

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