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United States Patent

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[54] SOUND GENERATOR FOR ALARM CLOCKS

11 Claims, 6 Drawing Figs.

[52] U.S. Cl. 58/38, 58/19, 340/392
[51] Int. Cl. G04c 9/00
[50] Field of Search .... 58/19, 23, 23 (A), 38, 39 (S); 340/392

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ABSTRACT: A sound generator for an alarm clock including a mechanical oscillator driven by a transistor circuit. The transistor circuit includes a drive coil on the output and a control coil on the input. The drive coil excites a mechanical oscillator which in turn varies the reluctance of the control coil. The drive and control coils are magnetically coupled together so that the circuit operates initially as a conventional blocking oscillator whose frequency depends upon the values of the circuit elements. Once the mechanical oscillator begins to move, however, the control coil reluctance is affected so as to convert the operation of the circuit into an amplifying circuit which amplifies the pulses on the control coil and operates the mechanical oscillator at its mechanical resonant frequency.

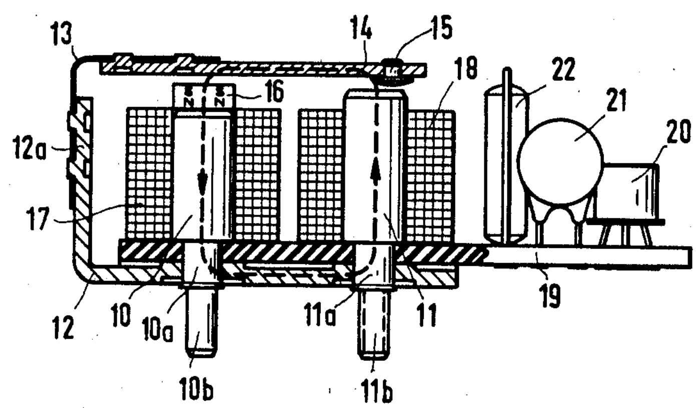


Fig.1

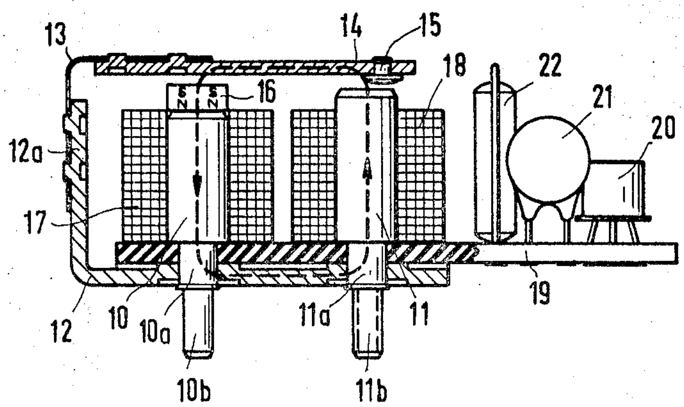
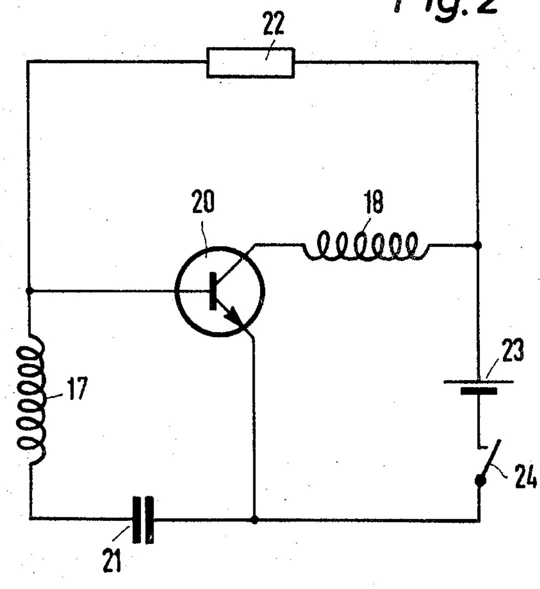


Fig. 2



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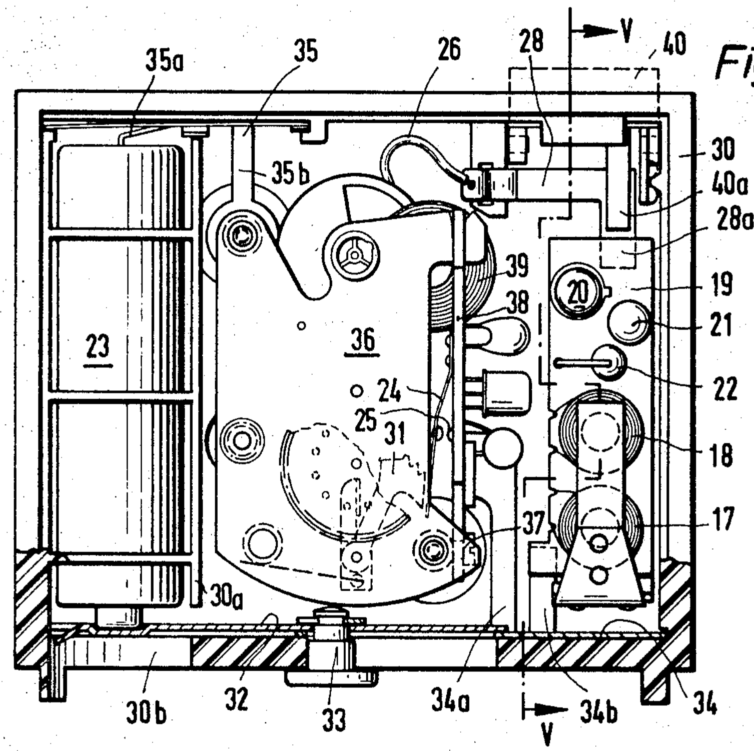

Fig. 3

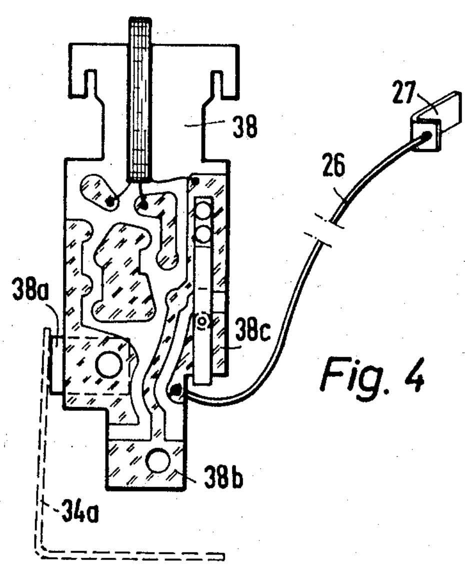

Fig. 4

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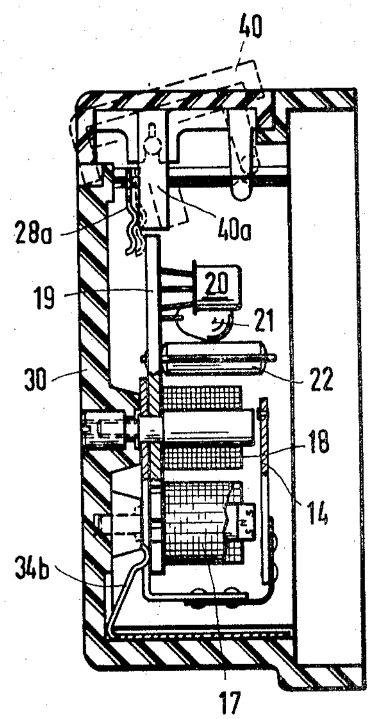

Fig. 5

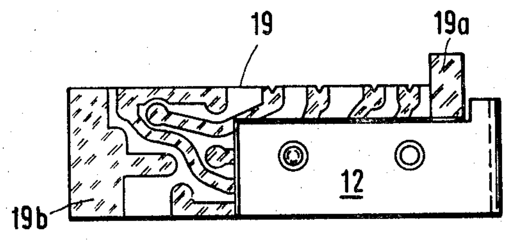

Fig. 6

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SOUND GENERATOR FOR ALARM CLOCKS

BACKGROUND OF THE INVENTION

The invention relates to a sound generator for alarm clocks, comprising a mechanical oscillator and a transistor circuit which produces drive pulses for the oscillator and is capable of operating as a blocking oscillator circuit. The input section of the transistor circuit is provided with a control coil series-connected to a capacitor whereas the output section is provided with a drive coil. The circuit is furthermore provided with a resistor which connects a battery terminal to the control electrode; the coils being acted upon by a premagnetized magnetic circuit, the reluctance of which is affected by the movement of the mechanical oscillator.

A bell is known which is operated without contact, by electromagnetic means, and the hammer of which is actuated by a coil provided in the output section of a transistor. In this structure, a control coil magnetically coupled with the coil that actuates the hammer is provided in the input section of the transistor. The transistor circuit acts as feedback circuit, so that in the output section drive pulses occur, the frequency of which is affected by the of ferromagnetic material which moves within the coils, so that the hammer oscillates at its natural frequency. The employment of such a circuit however involves the risk that the feedback oscillations start only slowly or not at all, for instance if the voltage of the battery has dropped. Moreover, power consumption is relatively high since the frequency of the feedback oscillator is not necessarily the same as the natural oscillation frequency of the hammer.

Furthermore, a sound generator of the initially mentioned kind with a blocking oscillator transistor circuit is known wherein the circuit elements on which the pulse train frequency of the blocking oscillator depends are of such value that the pulse train frequency of the blocking oscillator device equals approximately the natural frequency of the diaphragm. To be sure, by the employment of a blocking oscillator circuit a very rapid start of the oscillations is achieved, but coincidence between the pulse train frequency of the blocking oscillator circuit and the natural oscillation frequency of the mechanical oscillator is not always assured.

The invention aims at the construction of a sound generator of the initially mentioned kink which is of simple structure, responds quickly and operates efficiently. According to the invention this is accomplished by giving the elements of the transistor circuit and the magnetic circuit such values that the transistor circuit operates, when the oscillator is at rest, as a blocking oscillator circuit. When the mechanical oscillator oscillates at normal amplitude the transistor circuit operates as an amplifier circuit controlled by the oscillator.

The magnetic circuit may consist of two parallel cores of ferromagnetic material unilaterally connected to each other by a yoke, in which structure a leaf spring with a magnetic armature is arranged in front of the free ends of the cores to act as the mechanical oscillator. A permanent-magnet strip magnetized in the direction of the core axis may be mounted onto the front surface of the core which supports the control coil.

The cores that support the coils may be connected to a plate of insulating material on which the electric circuit elements are mounted. The insulating material is preferably provided with a printed circuit.

The ends of the cores, connected to each other by a yoke, may be provided with fastening bolts projecting through the yoke.

Contact springs are suitably provided in the clock case so as to supply current and to rest with their free ends upon conductive areas of the printed circuit. In this structure it is preferable to provide in the area of the contact springs an arm of a switch-off key which in one terminal position of the key lifts the contact spring from the printed circuit so as to switch off the sound generator independently of the contact actuated by the clockwork.

Preferably, one line for feeding current to the sound generator passes via the drive circuit for the movement-regulating oscillator. The contact, actuated by the clockwork, for releasing the sound generator is arranged on a plate on which the clockwork driving circuit is mounted. The plate that supports the clockwork-driving circuit may be connected via a cable provided with a plug to a circuit-feeding contact spring for the sound generator.

DESCRIPTION OF THE DRAWINGS

The invention is explained in greater detail in the following with the aid of the drawings by way of an embodiment. The drawings show in:

FIG. 1, a side view of the sound generator of the invention, partly in cross section;

FIG. 2, a circuit diagram of the drive circuit for the sound generator;

FIG. 3, a rear view of an alarm clock with the sound generator of the invention;

FIG. 4, an illustration of the electric drive circuit for the movement-regulating oscillator of the alarm clock;

FIG. 5, a section along line V–V in FIG. 3; and

FIG. 6, a view of the sound generator according to FIG. 1, from the bottom.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The sound generator contains two cores **10** and **11** of ferromagnetic material unilaterally connected to each other by a yoke **12** which likewise consists of ferromagnetic material. Cores **10** and **11** are provided with projections **10*a*** and **11*a*** by means of which they are riveted to yoke **12**. Cores **10** and **11** support a plate **19** of insulating material provided with a printed circuit (cf. FIG. **6**) which in turn supports the elements of the drive circuit of the sound generator.

Coils **17** and **18**, of which coil **17** is arranged in the input section and coil **18** in the output section of transistor **20**, are mounted on cores **10** and **11** (FIG. **2**). A permanent-magnet strip **16** is mounted on the free end surface of core **10**, which strip is magnetized in the direction of the longitudinal axis of core **10**.

Yoke **12** is provided with a bent arm **12*a*** to which a leaf spring **13** is fastened. This leaf spring **13** is bent off at a right angle and supports an armature **14** which is located in front of the free ends of cores **10** and **11**. Armature **14** consists likewise of ferromagnetic material. In the area of the free end of core **11**, armature **14** is provided with a rivet of nonmagnetic material which prevents the armature from adhering to core **11**.

Ends **10*b*** and **11*b*** of cores **10** and **11** are provided with a threading. They serve for fastening the sound generator in the clock case **30** (FIG. **5**).

In the input section of the circuit a capacitor **21** is series-connected to coil **17**, and the base electrode of transistor **20** is connected via a resistor **22** to the positive terminal of a DC voltage source **23**. Numeral **24** (FIG. **2**) indicates the contact actuated by the clockwork.

The circuit operates as follows:

When armature **14** is at rest, i.e. when no pulses are induced in control coil **17** by moving armature **14**, the circuit operates as blocking oscillator circuit, whereby pulse groups are generated, the frequency of which is preferably greater than the natural oscillation frequency of leaf spring **13** with armature **14**. By these pulses which pass through coil **18**, the mechanical oscillator including the leaf spring **13** and armature **14** is made to oscillate, whereby the air gap between cores **10** and **11** and armature **14**, and therefore the reluctance of the magnetic circuit are modified. Thereby control pulses are induced in coil **17**. These pulses act upon transistor **20**. Capacitor **21** is charged by these pulses so that, when a specified oscillation amplitude is reached by the mechanical oscillator, transistor **20** is given a bias voltage, whereby its point of operation is shifted and the circuit operates no longer as blocking oscillator. On the contrary, transistor **20** operates then solely as an amplifier, controlled by pulses induced in coil **17** and furnishing at the output side correspondingly amplified pulses. Thus the frequency of the pulses passing through drive coil **18** correspond exactly to the natural frequency of the mechanical oscillator.

FIG. **3** shows the arrangement of the sound generator within an alarm clock case **30**. Numeral **23** indicates a feeding battery which is lodged in a chamber separated by an intermediate wall **30*a***. An aperture **30*b*** for battery **23** is provided at the bottom of clock case **30**. This aperture **30*b*** can be shut by a contact plate **32** which is in friction contact with a stationary slide plate **34**. Numeral **33** indicates a rivet that holds contact plate **32** in place and serves also as handle for shifting contact plate **32**.

Contact plate **34** is provided with two bent-off resilient strips **34*a*** and **34*b***. Contact spring **34*a*** rests against a contact element **38*a*** of the drive circuit for the movement-regulating oscillator of the alarm clock mechanism (FIG. **4**). The circuit is supported by a plate **38** of insulating material, fastened to clockwork **36**. The clockwork is connected via a screw **37** to a conductive section **38*b*** of the drive circuit. Furthermore, an electrically conductive plate **35** provided with an arm **35*b*** is inserted in clock case **30**. The arm **35*b*** is conductively connected to clockwork **36**. Plate **35** contains also a resilient arm **35*a*** which in turn is connected to battery **23**.

A spring **24** is mounted on plate **35**, which spring is movable by means of a cam **31** actuated by the clockwork. A countercontact **25** connected to a conductive section **38*c*** of the printed circuit (FIG. **4**) is coordinated with spring **24**. A cable **26**, provided on its free end with a terminal plug **27**, is connected to conductive element **38*c***. This terminal plug **27** can be connected to a conductive spring arm **28**, the bent-off end **28*a*** of which rests against a conductive section **19*b*** (FIG. **6**) of the printed circuit of the sound generator.

The second current supply to the sound generator takes place via a contact spring **34*b*** which abuts against a conductive element **19*a*** of the printed circuit of the sound generator.

An arm **40*a*** of a switch-off key **40** is provided in the area of arm **28*a***. The said arm **40*a*** lifts, in one terminal position of key **40**, arm **28*a*** from the conductive area **19*b*** of the printed circuit, so that the current supply remains interrupted, independently of contact **24, 25** which is actuated by the clockwork.

As clearly shown in the drawing, the structure of the sound generator and its arrangement within the clockwork are simple. The current supply is also assured at lowest expenditure.

We claim:

1. A sound generator for alarm clocks comprising: a mechanical oscillator and a transistor circuit which produces drive pulses for the oscillator and is capable of operating as blocking oscillator circuit, said transistor circuit being provided in the input section with a control coil series-connected to a capacitor, and in the output section with a drive coil; a resistor which connects a battery terminal to the control electrode, the coils being acted upon by a premagnetized magnetic circuit the reluctance of which is affected by the movement of said mechanical oscillator; whereby the circuit elements of said transistor and said magnetic circuit are of such values that said transistor circuit operates, when said mechanical oscillator is at rest, as a blocking oscillator circuit and when the mechanical oscillator oscillates at its rated amplitude, as an amplifier circuit controlled by the said mechanical oscillator.

2. The sound generator as recited in claim **1**, wherein said magnetic circuit comprises two parallel cores of ferromagnetic material unilaterally connected to each other by a yoke and said mechanical oscillator comprises a leaf spring with a magnetic armature arranged in front of the free ends of said cores.

3. The sound generator recited in claim **2** further comprising a permanent-magnet strip magnetized in the direction of the core axis and mounted on the front surface of the core which supports said control coil.

4. The sound generator recited in claim **2** wherein said cores which support said coils are connected to an insulating plate on which the electric circuit elements are mounted.

5. The sound generator recited in claim **3** wherein said cores which support said coils are connected to an insulating plate on which the electric circuit elements are mounted.

6. The sound generator recited in claim **4** wherein said plate of insulating material is provided with a printed circuit.

7. The sound generator recited in claim **2**, wherein said cores are connected to each other by a yoke and are provided on their ends with fastening bolts which protrude through said yoke.

8. The sound generator recited in claim **6** further comprising contact springs arranged in a clock case, the free ends of said contact springs resting on conductive areas of said printed circuit.

9. The sound generator recited in claim **8** further comprising a switch-off key having an arm which, in one terminal position of the key, lifts one of said contact springs from the printed circuit.

10. The sound generator recited in claim **2** further comprising a current supply line passing to the sound generator via the drive circuit for the movement-regulating oscillator and a contact actuated by the clockwork for the release of the sound generator, said contact being mounted on a plate on which the clockwork drive circuit is mounted.

11. The sound generator recited in claim **10** wherein the plate on which the clockwork driving circuit is provided is connected, via a cable provided with a plug, to a current supply contact spring for the sound generator.