United States Patent

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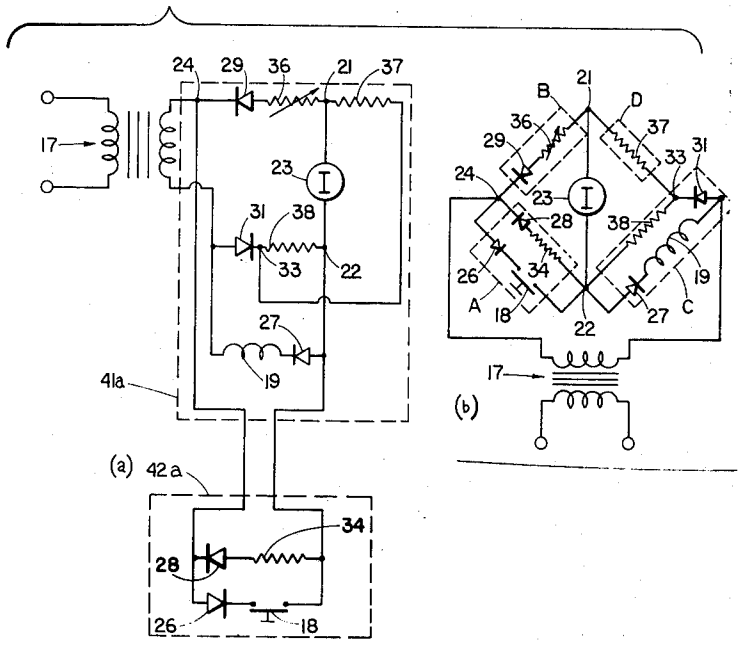
[54] **THERMOMETER AND DOORBELL CHIME IN WHEATSTONE BRIDGE CIRCUIT**
7 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **340/371,** 340/330, 340/285
[51] **Int. Cl.** **G08b 5/00**
[50] **Field of Search** 340/371, 330, 285

[56] **References Cited**
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Attorney—Nienow & Frater

ABSTRACT: A thermometer/chime combination wherein the usual chime circuitry is modified to indicate the outdoor temperature during the period of time that the chime is not in actual use. Thus, the composite circuitry normally indicates the temperature; but sounds the chime tone when the exterior pushbutton is activated.



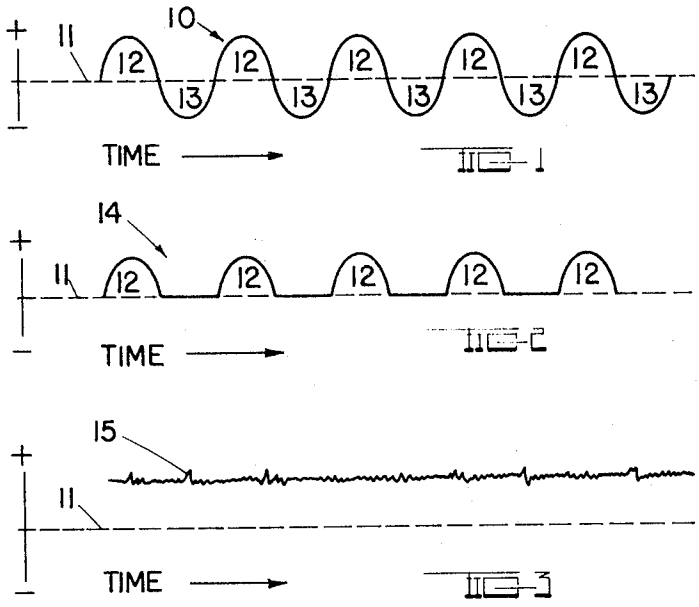


FIG. 1 FIG. 2 FIG. 3

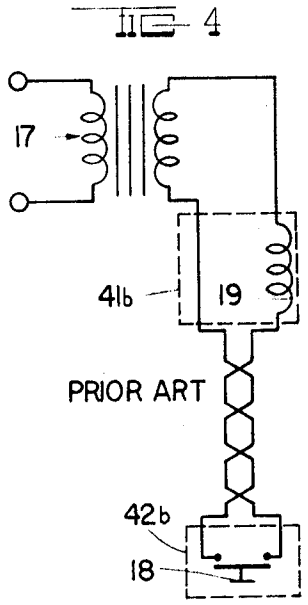
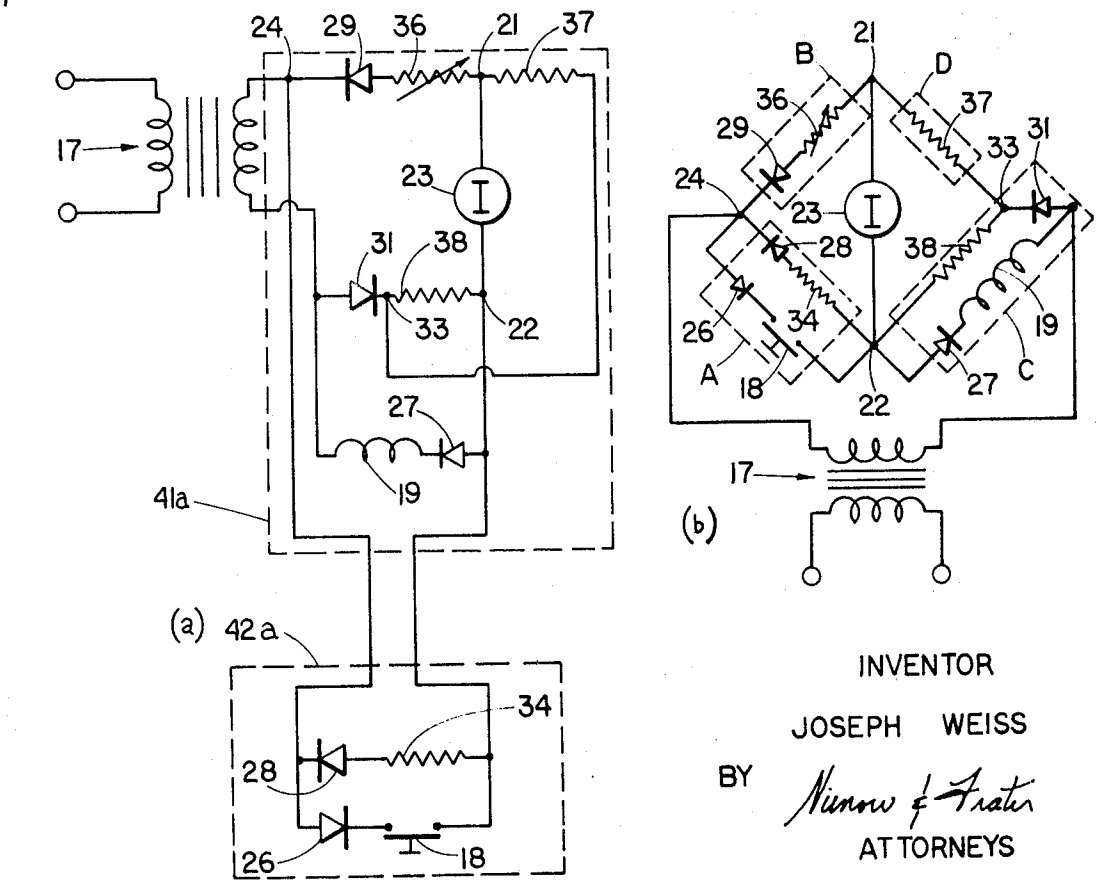


FIG. 4

FIG. 5



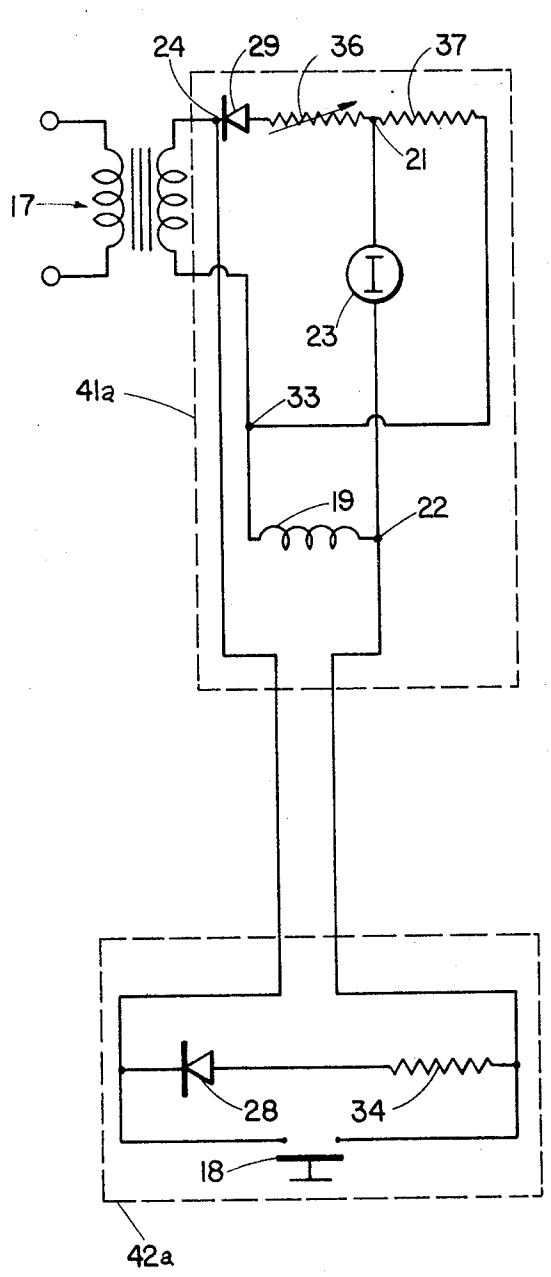
INVENTOR

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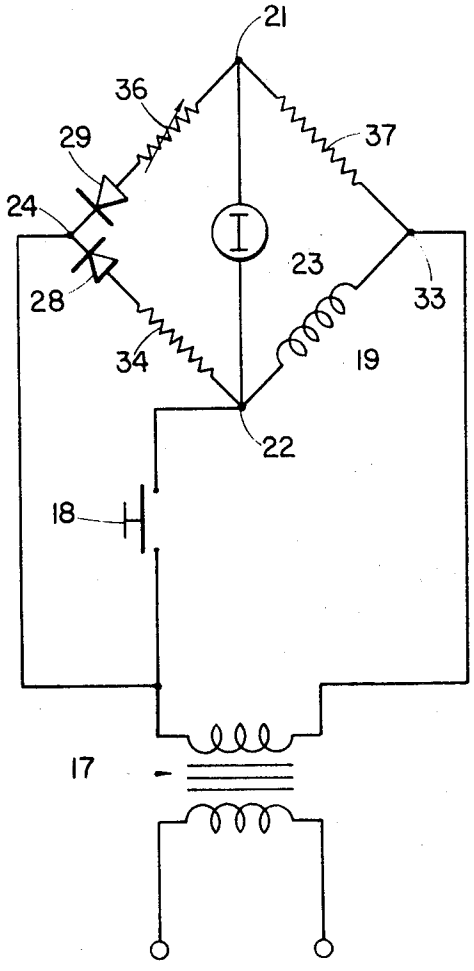
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FIG-6



(a)



(b)

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THERMOMETER AND DOORBELL CHIME IN WHEATSTONE BRIDGE CIRCUIT

BACKGROUND

In the past, doorbells were placed at the doors of a house in order to permit a visitor to announce his presence; and these doorbells were eventually replaced with pushbuttons that activated electrical bells or buzzers. At present there is available a large assortment of chime arrangements that replace the previously used bells and buzzers, the chimes having a more pleasant sound, and in some cases, providing different sound effects for the front, side, and rear pushbuttons. Chimes have become a very popular item in the recent past, and are now a normal installation in practically every new house. However, the chimes and their electrical wiring is used so infrequently, and even then for such a short time interval, that they are in their nonuse "standby" state about 99 percent of the time.

At present, the usual way of learning the outdoor temperature is by means of an outdoor thermometer positioned outside a window. This arrangement is not completely satisfactory, especially in climates where windows become frosted over or snow covered. It is therefore desirable to provide an improved temperature indicating arrangement, and in the present age of sophistication, an indoor indication of the outdoor temperature is an interesting conversation piece.

OBJECTS AND DRAWINGS

It is therefore the principal object of the present invention to provide an improved outdoor temperature indicating arrangement.

It is another object of the present invention to provide an improved temperature indicating arrangement that is used in conjunction with a chime arrangement.

It is still another object of the present invention to provide an improved temperature indicating arrangement capable of using the electrical wiring of a presently installed chime circuit.

It is a further object of the invention to provide a thermochime arrangement.

It is a still further object of the present invention to provide a thermochime circuit wherein the temperature indication is normally present, but is overridden when a chime tone is to be produced.

The attainment of these objects, and others, will be realized from a study of the following detailed description, taken in conjunction with the drawings, of which

FIG. 1 shows an AC waveform;

FIG. 2 shows a rectified waveform;

FIG. 3 shows a smoothed rectified waveform;

FIG. 4 shows a prior art chime circuit;

FIGS. 5*a* and 5*b* show one embodiment of the circuit of the present invention; and

FIGS. 6*a* and 6*b* show another embodiment.

INTRODUCTION

In order to better understand the present invention, it is desirable at this point to clarify the distinction between AC and DC electricity, as this distinction is important to the following explanation.

Basically, AC (Alternating Current) electricity reverses its direction of flow periodically, so that "positively flowing" portions alternate with "negatively flowing" portions; in the case of commercially supplied electricity, the rate of reversal (frequency) is 60 times per second. In FIG. 1, the sinuous waveform 10 represents an AC current or an AC voltage that periodically reverses itself. For example, FIG. 1 shows the amplitude/time variation, and shows that the amplitude becomes progressively more positive for awhile, then reverses itself to assume a value of zero when it crosses the dotted baseline 11, then extends downwardly to show that it becomes progressively more negative, and then reverses itself again to become zero when it again crosses the baseline 11. While the above explanation is directed to only one "cycle" of AC, these continuously repeat themselves. The portions of waveform 10 that are above baseline 11 are arbitrarily called the "positive loops" 12, and the portions of waveform 10 that are below the baseline 11 are called the "negative loops" 13.

In the field of electricity, there are many types of devices that act as one-way electrical valves, that is, they permit the electricity to flow in only one direction; these devices being known by a number of names such as "unidirectional devices", "rectifiers", "diodes", etc. For simplicity, the term "diode" will be used in the following explanation.

When a diode is used as discussed above; i.e., for the production of unidirectional flow of electricity, the effect is as shown in FIG. 2. AS indicated by waveform 14, the negative loops have been blocked by the diode; and only the positive loops 12 remain, these having passed through the diode. Due to electrical characteristics, inherent and/or intentionally introduced, the resultant waveform tends to take a form similar to that shown at 15 of FIG. 3—wherein the loop formations have been smoothed out into a more-or-less rippled waveform. Now the electricity always flows in the same direction, this being indicated by the fact that the entire waveform 15 is always above the baseline 11. Waveform 15 is characteristic of DC (Direct Current) electricity.

It should be pointed out that the waveforms 14 and 15 of FIGS. 2 and 3 would be produced by a diode that has a given "polarity"i.e., is "poled" in a given direction to pass the positive loops and to block the negative loops. By reversing the polarity of the diode, the negative loops would have been passed, and the positive loops would have been blocked, and a resultant waveform corresponding to waveform 15 of FIG. 3 would have appeared below the baseline 11.

Thus, it becomes clear that AC electricity may be converted to DC electricity; and, by the use of a suitably placed and suitably poled diode, certain portions of the electricity may be passed into or blocked from selected circuits.

PRIOR ART

Attention is now directed to FIG. 4, which shows a schematic circuit for a prior art chime installation. Here a transformer 17 is electrically connected to a suitable source of AC power, and transforms the voltage of the power source to a lower valued voltage that is suitable for the chime operation. The output voltage of the transformer is applied to a series circuit that (A) comprises a pushbutton 18 that is physically positioned outside the door, and (B) further comprises a "solenoid" coil 19 that momentarily becomes an electromagnet when electricity flows through the wires that form the coil. The crisscrossed lines interconnecting the pushbutton 18 and the solenoid coil 19 indicate that the electrical wires are twisted, but this twisting of the wires is not essential.

The operation of this prior art chime circuit is as follows. When the pushbutton 18 is activated, it completes the electrical circuit between the transformer 17 and the solenoid coil 19, and electricity flows through the now-closed circuit, and causes the solenoid coil to assume its magnetic state, whereupon it magnetically attracts a chime plunger (not shown) that strikes a chime bar to produce a chime tone. When the pushbutton is released, the chime circuit reverts to its normal standby condition in which it is totally inactive.

SYNOPSIS

Broadly speaking, most embodiments of the disclosed invention use one or more diodes to control the energization of chime apparatus and/or temperature indicating apparatus. The illustrations and discussions teach how various embodiments may be made responsive to AC or to DC electricity.

DESCRIPTION

One embodiment of the present invention is shown in FIG. 5; FIG. 5*a* showing a schematic representation, while FIG. 5*b* shows an "equivalent" circuit. This equivalent circuit concept is widely used in the electric field to analyze and explain elec-

trical circuit operation; and since the schematic circuit of FIG. 5*a* is electrically the same as the equivalent circuit of FIG. 5*b*, the following explanations will be presented in terms of the simplified equivalent circuit.

A slight digression is desirable at this time in order to explain a couple of electrical terms that will be used in the following discussion. Many electrical circuits use a so-called "-bridge" circuit because of its wide usefulness; and, broadly speaking, this bridge circuit may be envisioned as four electrical arms interconnected into a diamond-shaped configuration (although in actuality the components of the bridge are usually remote from each other). The diamond-shaped bridge, therefore, has four "connection points" where the adjacent arms are connected together; and the oppositely positioned connection points are used in pairs. The operating power is applied to one pair of connection points, and an indicator is connected to the other pair of connection points. The operation of such a bridge will be understood by referring to FIG. 5*b*.

In FIG. 5*b*, the diamond-shaped bridge is formed of four arms, A, B, C, and D; each, in turn, comprising one or more electrical components. Assume for the moment that each of the arms A, B, C, and D has identical electrical characteristics; under this assumed condition and with a voltage applied between connection points **24** and **33** the voltage at the bridge's upper and lower connection points **21** and **22** will be the same; i.e., the bridge is "balanced." Under this balanced condition, indicator **23**—which is sensitive to slight differences—does not produce any indication.

Assume now that one or more of the bridge's arms has changed, so that the bridge is no longer balanced. Under this unbalanced condition, the indicator **23** will now produce an indication of the unbalance.

Indicators are available in many types, such as voltage-sensitive devices, voltmeters, milliammeters, microammeters, lamps, digital readout devices, etc. Most of the indicators are designed to detect changes, so the balanced, or "null" bridge circuit is the most widely used.

As indicated above, the following explanation will use the term "diode" (which actually means two electrode) for identifying a device that controls the direction of electricity flow; and one of the most widely used diodes is the "crystal" diode that is an outgrowth of transistor technology. This crystal diode is very small, is available in a wide range of capacities, and relatively cheap. Its accepted symbol is an arrowhead pointing to a short transverse line; and this symbol implies that conventional electric current flows in the direction indicated by the arrowhead, and is blocked from flowing in the opposite direction. Thus, the symbol indicates how the diode is poled.

THE CHIME CIRCUIT

With the above described operation of a bridge circuit and a diode in mind, the operation of the chime circuit of the present invention will now be explained. Directing attention again to FIG. 5*b*, it will first be assumed that positive loop electricity (loops **12** of FIG. **1**) is available at the left side of transformer **17**, so that positive loop electricity flows from the left side of transformer **17** to the left connection point **24** of the bridge. During this positive loop interval, when the pushbutton **18** is activated, diode action permits the positive loop electricity to flow through diode **26**, through the now-closed pushbutton **18**, through lower connection point **22**, diode **27**, through the solenoid coil **19**, and back to the right side of the transformer. Thus, the chime circuit is completed, and the solenoid coil **19** is energized to produce a chime tone.

It will be noted that in the above discussion of the chime circuit operation, the diodes **26** and **27** are suitably poled to permit the described flow of electricity.

It should also be noted that during the above described positive loop interval, the polarities of diodes **28**, **29**, and **31** are such as to block the positive loop electricity from flowing into or out of the bridge. Therefore, during the positive loop interval, the pushbutton is able to energize the chime circuit, but all other portions of the circuit are cut off.

When the AC reverses (see FIG. **1**), negative loop electricity **13** is now applied from the left side of transformer **17** to the left connection point **24** of the bridge. Rather than discussing negative loop flow of electricity, it will be more convenient to regard this as positive loop electricity available at the right side of transformer **17**, but it should be kept in mind, however, that the instant discussion is for the negative loop interval, event though it is being discussed in terms of positive loop electricity.

Using this equivalent concept, it will be noted that positive loop electricity is applied from the right side of transformer **17** to solenoid coil **19** but that diodes **27** and **26** have polarities that now block the positive loop electricity from flowing through the solenoid coil **19**. Therefore, the solenoid coil is not energized during the negative loop interval.

THE THERMOCIRCUIT

The thermocircuit has the following characteristics. Bridge arm A of FIG. 5*b* comprises a temperature-sensing resistor **34**, many such resistors being commercially available, one example being the type known as solid-state temperature-sensing silicon resistors, resistor **34** being physically positioned out-of-doors where the outside ambient temperature is to be measured. It should be noted that temperature-sensing resistors, as a class, are distinguished from ordinary resistors in that their resistance/temperature characteristics are such that a slight change in ambient temperature produces a relatively large change in resistance value.

It will be recalled that the electrical bridge is preferably normally balanced, and since the individual temperature-sensing resistors and other components of the bridge arms may vary in value from one batch to another, an adjustable "balancing" resistor **36** is positioned in bridge arm B; this balancing adjustment is desirable when setting up the circuit, and when changing the temperature-sensing resistor **34**, should this ever be necessary.

The operation of the thermocircuit may be understood from FIG. 5*b*, and is as follows. During the previously discussed positive **96** interval, it will be recalled that positive loop electricity is applied from the left side of the transformer **17** to the bridge's left connection point **24**, from where it flows through the chime circuit as previously described. However, in the operation of the thermocircuit, the positive loop electricity at the left connection point **24** is blocked by diodes **28**, **29**, and **31**, so that no electricity flows through the bridge circuit, and the indicator **23** does not produce any indication.

Again, for simplicity of explanation, the negative loop interval will be treated from the point of view of positive loop electricity applied to the right connection point **33**. Therefore, during the negative loop interval, the positive loop electricity at the right connection point **33** from diode **31** flows through stabilizing resistor **37**, through upper connection point **21**, through balancing resistor **36**, through diode **29**, to the left connection point **24**, and back to the transformer. Simultaneously, positive loop electricity also flows from the right connection point **33** through resistor **38**, lower connection point **22**, through resistor **34** and diode **28** to the left connection point **24**, back to the transformer. In this way, electricity flows through the upper and lower branches of the bridge. If the bridge arms are balanced as described above, the indicator **23** does not produce any output signal; but if the temperature had changed, the temperature-sensing resistor **34** would have changed its value, and the now unbalanced bridge would cause the indicator to produce an output signal. Indicator **23**, depending upon its type, has its output signal calibrated in terms of temperature, so that the outdoor temperature may be read directly off the indicator.

In summary, the chime circuit permits the solenoid coil to be energized by the positive loop polarity of the AC power source whenever the pushbutton is activated, so that the

chime circuit is always in its standby state, ready for operation. Similarly, the thermocircuit permits the indicator to be energized by the negative loop polarity of the AC power source, so that the thermocircuit is normally operative.

However, it will be recalled that when the pushbutton **18** is activated to energize the chime circuit, the positive loop electricity flows from the left connection point **24**, through diode **26**, through the now-closed pushbutton **18**, through lower connection point **22**, through diode **27** and through solenoid coil **19**. This current flow causes lower connection point **22** to assume a voltage determined by its position in the voltage divider circuit consisting of the following: the forward resistance of diode **26**, the resistance of the pushbutton, the forward resistance of diode **27** and the resistance of solenoid coil **19**. Since this voltage at lower connection point **22** may be of larger magnitude and of different polarity than that existing before the pushbutton is activated, indicator **23** may now sense a different voltage between lower connection point **22** and upper connection point **21** than existed before pushbutton **18** is activated and may, therefore, give an erroneous temperature reading until pushbutton **18** is released.

Since most indicators have a built-in damping device, such a dash pot or its equivalent, they are inherently self-protecting against sudden changes such as may be produced by the above temporary situation. Moreover, the pushbutton is activated only momentarily, so the above situation is merely transient. Furthermore, the chime tone indicates that the circuit is not at that moment indicating temperature.

RECAPITULATION

To recapitulate, the disclosed circuitry modifies the basic chime circuit to additionally indicate the outdoor temperature during the nonuse standby state of the chime circuit. This is achieved by causing the thermocircuit to operate on one polarity of the AC power supply, the thermocircuit being normally operative, so that the indicator reaches a stabilized damped state indicative of the outdoor temperature. The chime circuit operates on the other polarity of the AC power supply; being normally in a standby state, but becoming instantly operative when the pushbutton is activated. Essentially, the chime circuit and the thermocircuit both operate on DC produced by diodes that rectify the opposite polarities of the AC power supply. It is, of course, apparent that all of the diodes may be reversed to interchange the polarities of the chime circuit and the thermocircuit operations.

ANOTHER EMBODIMENT

FIG. **6** shows another embodiment of the invention. It will be recalled that the previously discussed embodiment had a chime circuit that operated on DC produced from a given polarity of the AC source of power; and that the thermocircuit operated on DC produced from the other polarity of the AC source of power. The new embodiment has the advantage that at least one of the circuits, illustrated as the chime circuit, operates directly from the AC power source; and this simplifies the overall circuitry.

Referring now to FIG. **6**, it will be seen that FIG. **6***a* shows the schematic circuit; whereas FIG **6***b* shows the equivalent circuit. As was done previously, the explanation will be presented in terms of the equivalent circuit of FIG. **6***b*, the previously used components being identified by the same reference characters.

The circuit of FIG. **6***b* comprises one of the previously discussed bridge circuits, and this is similar to the one described previously. Its operation is as follows:

When pushbutton **18** is activated, it completes the electrical circuit to the solenoid coil **19**, which thereupon becomes an electromagnet, and magnetically attracts the chime plunger to produce a chime tone. Because of the complete absence of diodes in the chime circuit, this circuit is capable of operating during both the positive loop interval and the negative loop interval; i.e., it operates directly on the AC provided by the transformer.

The thermocircuit in FIG. **6***b* operates as follows: During the positive loop interval, when the positive loop electricity is being applied to the left connection point **24**, the diodes **28** and **29** prevent the positive loop electricity from flowing through the bridge circuit, so that the indicator **23** does not produce any output signal during the positive loop interval.

During the negative loop interval, when positive loop electricity is being applied to the right connection point **33**, the positive loop electricity flows through resistor **37**, upper connection point **21**, through the balancing resistor **36**, through diode **29**, left connection point **24** and back to the transformer. Simultaneously, the positive loop electricity flows from the right connection point **33** through solenoid coil **19**, through lower connection point **22**, through temperature-sensing resistor **34**, through diode **28**, through left connection point **24** and back to the transformer. Thus electricity flows through both the upper and the lower branches of the bridge, and, as indicated previously, indicator **23** now produces an indication of the outdoor temperature.

Thus, this embodiment permits the chime circuit to operate on AC, while the thermocircuit operates on DC produced from a given polarity of the AC source.

It may be noted that during the negative loop interval, some electricity is flowing through the solenoid coil **19**, but the magnitude of this electricity flow is so small, being limited by resistor **34**, that the chime plunger is not attracted sufficiently to cause it to strike the chime bar and the chime remains silent.

As suggested previously, reversing the diodes will reverse the operating polarity for the thermocircuit It will further be apparent that by eliminating diodes **28** and **29** from circuit **6**, this modification will permit both the thermocircuit and the chime circuit to operate on AC voltage. This embodiment requires, however, that indicator **23** be of a type suitable for operation on AC voltage.

It will further be apparent that by reinserting diode **26** of FIG. **5** into the pushbutton circuit of FIG. **6**, this modification will permit the chime circuit to operate on DC voltage of a polarity controlled by the orientation of the diode.

Thus for this embodiment four modes of operation are possible as listed below:

Mode No.	Chime Circuit	Thermocircuit	Temperature Indicator
1	AC	AC	AC
2	AC	DC	DC
3	DC	AC	AC
4	DC		DC

GENERAL

In those cases wherein previously installed chime circuitry is to be updated by use of the disclosed circuitry, the chime enclosure **41***a* and the pushbutton enclosure **42***a* of FIGS. **5***a* and/or **6***a* are merely substituted for their corresponding counterparts **41***b* and **42***b* of FIG. **4**. The indicator **23** may, of course, be positioned where desired.

I claim:

1. A thermochime combination comprising:

means, comprising a chime circuit and a pushbutton for producing a chime tone;

means, comprising a thermocircuit and a temperature-sensing element and an indicator for producing a temperature indication;

means, electrically interconnecting said chime circuit and said thermocircuit, for causing said thermocircuit to normally indicate the temperature, but to sound said chime tone when said pushbutton is activated.

2. The combination of claim **1**, including means comprising at least one diode for causing a given polarity of an AC power source to energize said thermocircuit.

3. The combination of claim **1**, including means comprising at least one diode for causing a given polarity of an AC power

source to energize said chime circuit when said pushbutton is activated.

4. The combination of claim 1, including

means comprising at least one diode for causing a given polarity of an AC power source to energize said thermocircuit;

means comprising at least one diode for causing the other polarity of said AC power source to energize said chime circuit when said pushbutton is activated.

5. The combination of claim 1, including

means comprising at least one diode for causing a given polarity of an AC power source to energize said thermocircuit;

means for causing both polarities of said AC power source to energize said chime circuit when said pushbutton is activated.

6. The combination of claim 1, including

means comprising at least one diode for causing a given polarity of an AC power source to energize said chime circuit when said pushbutton is activated;

means for causing both polarities of said AC power source to energize said thermocircuit.

7. A thermochime combination comprising:

four electrical arms interconnected in an electrical bridge circuit configuration having two pairs of opposite connection points;

a first arm comprising a temperature-sensing element;

a second arm comprising a balancing resistor;

a third arm comprising a solenoid coil;

a fourth arm comprising a stabilizing resistor;

an indicator connected between one pair of said connection points;

whereby a source of AC power may be connected between the other pair of connection points;

means, comprising a pushbutton for completing the electrical circuit through said solenoid coil.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,624,646 Dated November 30, 1971

Inventor(s) Joseph Weiss

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 11, "event" should read -- even -- ; line 43, "96" should read -- loop -- . Column 6, line 50, under the Thermocircuit column, insert -- DC -- .

Signed and sealed this 14th day of November 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

ORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.