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(54) **A bedroom light control device**

(57) A bedroom light control device comprises a microphone (6), a switching circuit (2) for switching the bedroom light on and off in response to a non-continuous sound detected by the microphone, and an audio sensitive control member (VRI) for controlling the sensitivity of the bedroom light control device to the sound. The circuit includes amplifier means (R2, R3, R4, R5, C3, C5, TRI: R6, R7, R8, R9, C6, TR2) for amplifying the microphone output, trigger means (R10, R11, C8, THY1) for producing an output signal consequent upon the microphone detecting the sound, a pulse transformer T2 for receiving the output signal from the trigger means and for producing current pulses, bistable multivibrator TR3, TR4 operable in consequence of signals received from the pulse transformer, and switch means for receiving signals from the bistable multivibrator means and for making or breaking a mains circuit for the bedroom light.

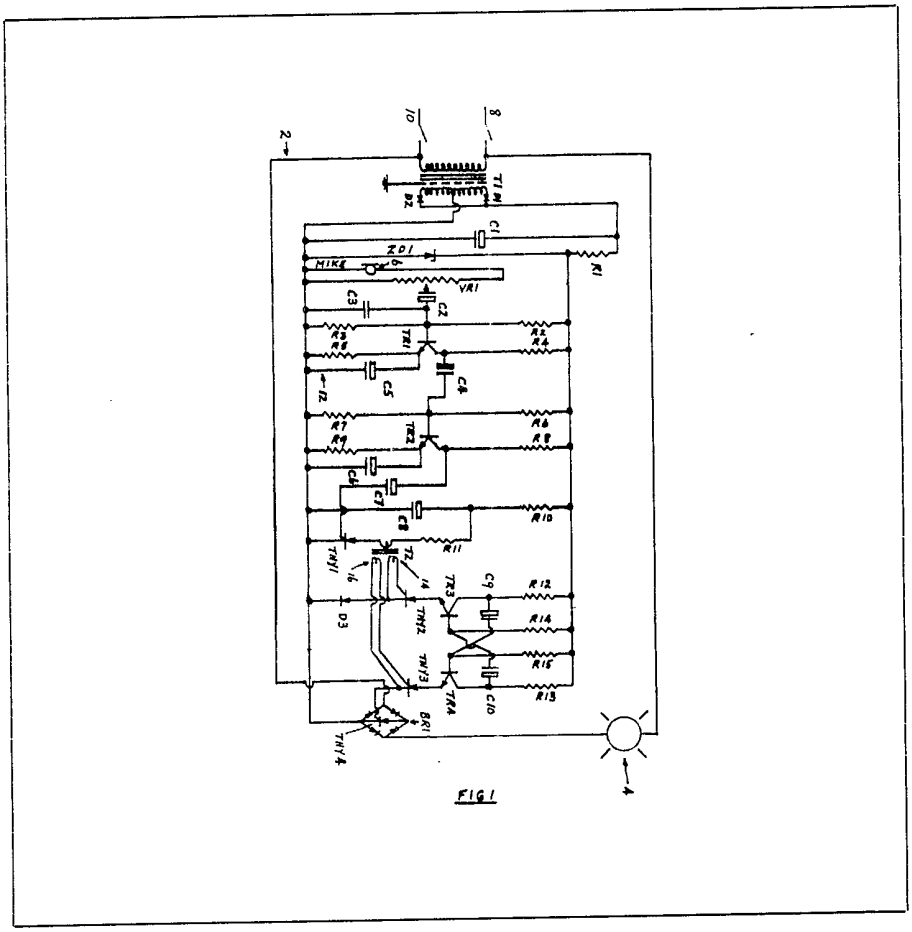

FIG 1

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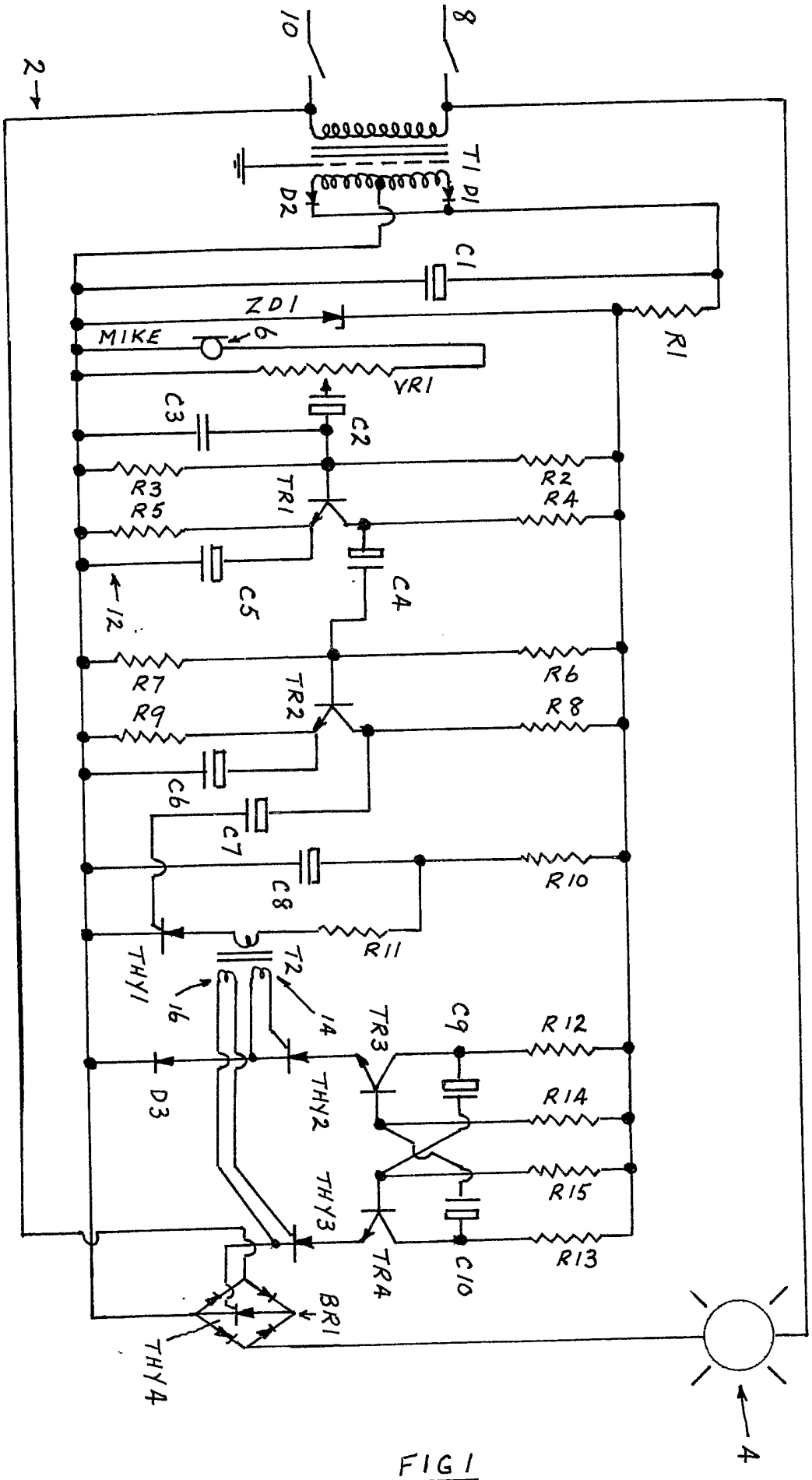
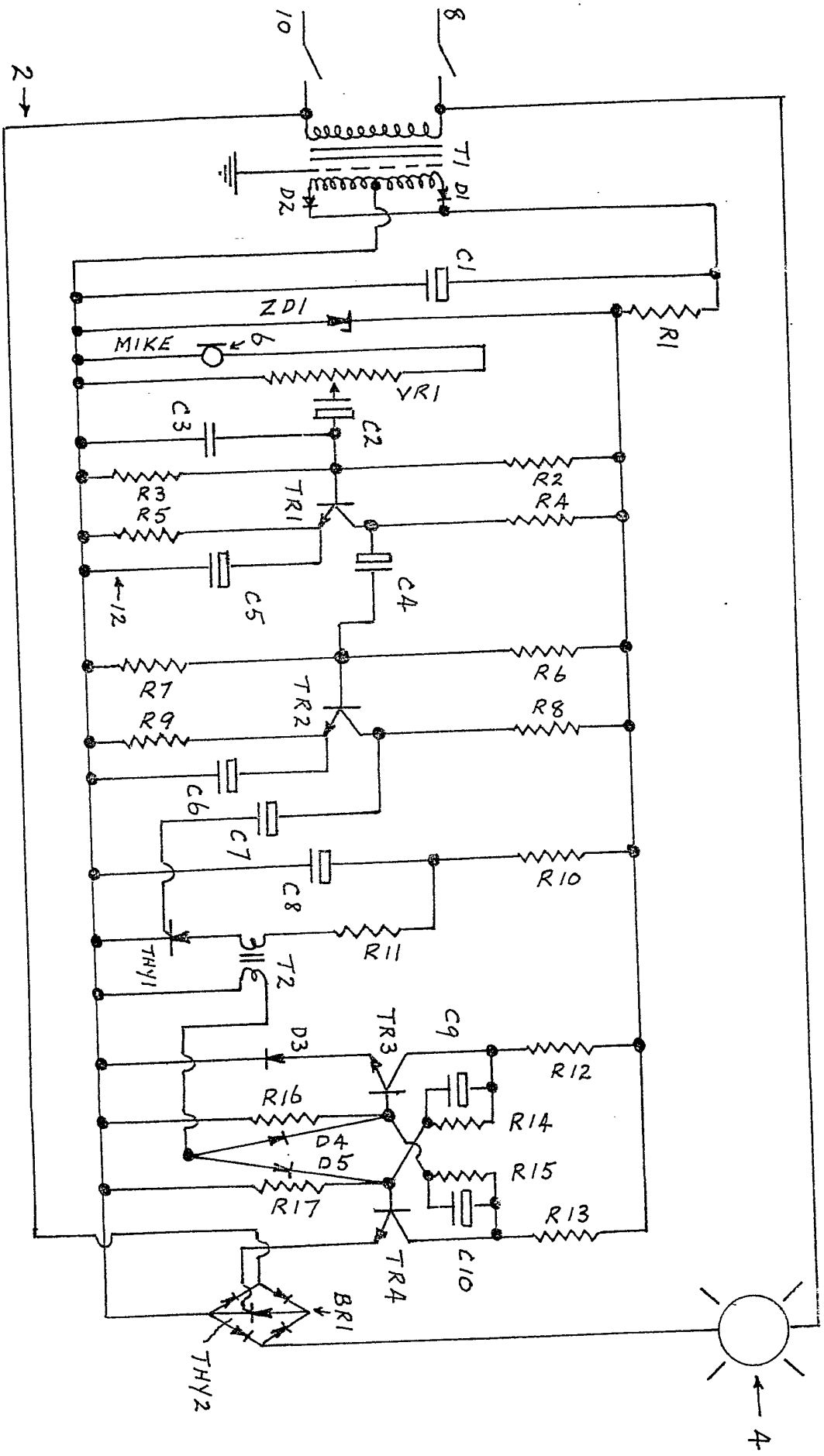

10
8
2
T1
D1
D2
C1
ZD1
MIKE
6
R1
VR1
C3
C2
R3
TR1
R2
R4
R5
C5
C4
12
R7
TR2
R6
R9
R8
C6
C7
C8
R10
R11
THY1
16
T2
14
TR3
C9
R12
D3
THY2
R14
THY3
R15
TR4
C10
R13
BR1
THY4
4

FIG 1


10
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R1
MIKE
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VR1
C3
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R2
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R5
TR1
R4
C5
C4
12
R7
R6
TR2
R9
R8
C6
C7
C8
R10
R11
THY1
T2
TR3
C9
D3
R12
R16
R14
D4
D5
R15
R17
R13
TR4
C10
BR1
THY2
4

FIG 2

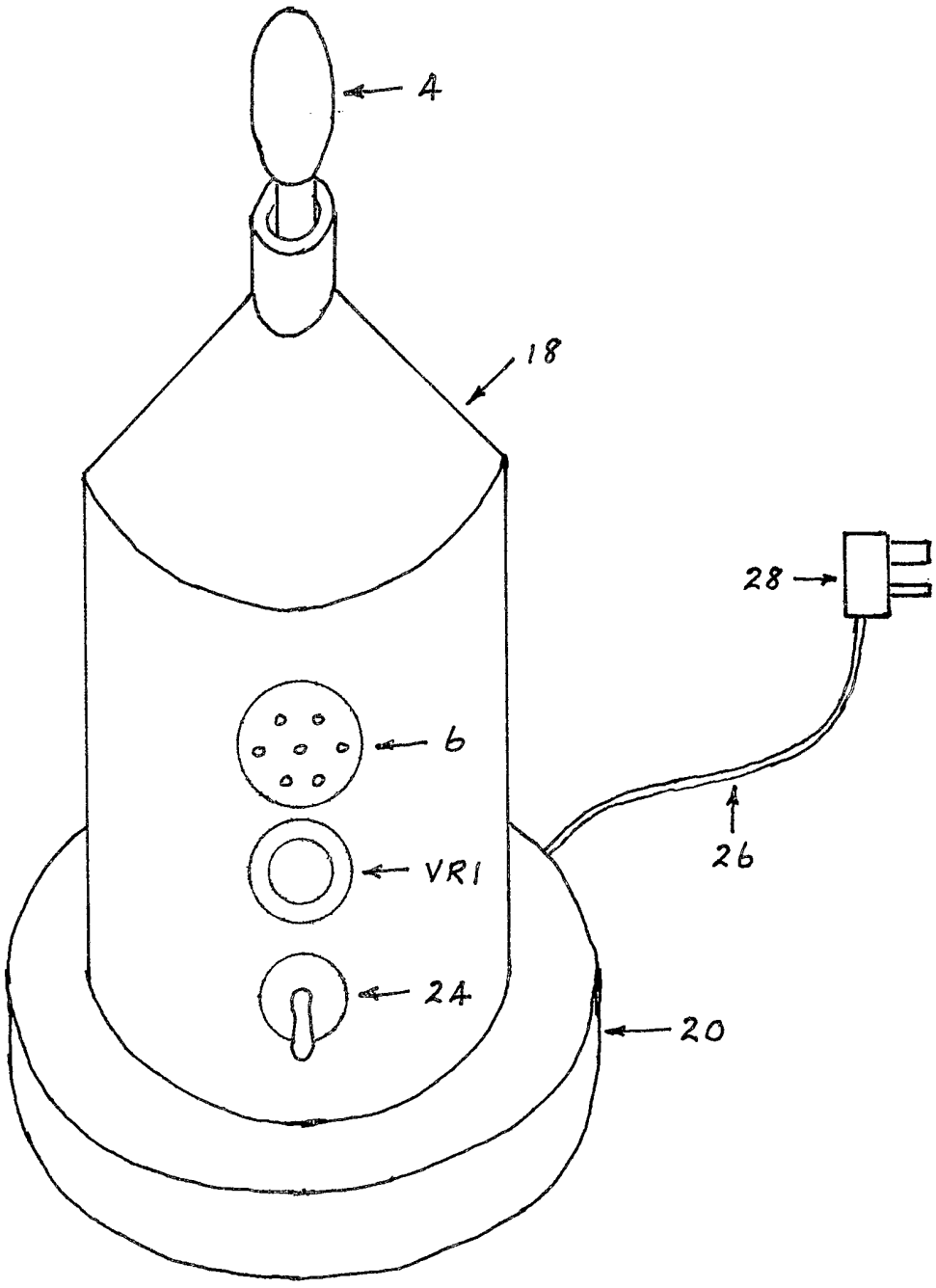

FIG 3

SPECIFICATION

A bedroom light control device

This invention relates to a bedroom light control device for a mains operated light. This invention also relates to a mains operated bedroom light when provided with the control device.

It often happens that persons in bed wake up during the night and they wish to turn on the bedroom light. This often necessitates the person getting out of bed which is inconvenient. Also, light switches can be difficult to find in the dark, even light switches for bedside table lamps.

It is an aim of the present invention to overcome the above mentioned problem by providing a bedroom light control device for a mains operated bedroom light that will enable the bedroom light to be turned on and off in response to a non-continuous sound such for example as the clapping of a person's hands.

Accordingly, this invention provides a bedroom light control device for a mains operated bedroom light, which bedroom light control device comprises a microphone, a switching circuit for switching the bedroom light on and off in response to a non-continuous sound detected by the microphone, and an audio sensitive control member for controlling the sensitivity of the bedroom light control device to the sound, the switching circuit comprising a transformer for reducing the mains voltage, rectifier means for rectifying an A.C. output from the transformer and for producing a D.C. output, amplifier means for amplifying an A.C. output from the microphone, trigger means for producing an output signal consequent upon the microphone detecting the sound, a pulse transformer for receiving the output signal from the trigger means and for producing current pulses, bistable multivibrator means operable in consequence of signals received from the pulse transformer, and switch means for receiving signals from the bistable multivibrator means and for making or breaking a mains circuit for the bedroom light to cause the bedroom light to switch on and off.

The present invention also provides a mains operated bedroom light when provided with the bedroom light control device.

It is envisaged that the control device may be simply and cheaply produced. It can then be sold, for example as a box, for fitting into the leads of the mains operated bedroom light. The bedroom light may be a table lamp, a standard lamp, a wall mounted lamp or a light hanging from a ceiling. By appropriately controlling the audio sensitive control member, the bedroom light control device can be arranged to operate in response to a sound of any desired volume. This sound may be the clapping of a person's hands but it could also be a person's voice. The bedroom light control device should obviously not be so sensitive that it will randomly turn on and off in response to extraneous sunds such for example as that of persons walking up and down stairs or shutting doors. With the control device of the present invention, a bedroom light can simply be turned on and off by a person making an appropriate noise such as the clapping of their hands and there will be no need for the person to get out of bed and/or fumble in the dark for light switches. The bedroom light control device may be especially useful for infirm or aged persons who find difficulty in getting out of bed.

The rectifier means may include a pair of diodes connected to the secondary winding of the transformer. Preferably, the control device includes a capacitor for receiving and smoothing the D.C. output from the pair of diodes.

The amplifier means may comprise first and second amplifier circuits. The first amplifier circuit is preferably a class A amplifier circuit, and the second amplifier circuit is preferably a class AB amplifier circuit. Other types of amplifier circuits may be employed.

The trigger means may comprise a series connected resistor and capacitor.

The operation of the pulse transformer may be controlled by a thyristor. The duration of the transformer pulse may be controlled by a resistor.

In one embodiment of the invention, the bistable multivibrator means comprises first and second transistors and first and second thyristors, connected in circuit with diodes, resistors and capacitors, the first and the second thyristors converting an otherwise astable multivibrator means into the bistable multivibrator means. In another embodiment of the invention, the bistable multivibrator means comprises first and second transistors connected in circuit with resistors and capacitors.

The switch means preferably comprises a thyristor and a bridge rectifier. Alternatively, the switch means may comprise a triac.

Embodiments of the invention will now be described solely by way of example and with reference to the accompanying drawings in which:

Figure 1 shows a first switching circuit for a bedroom light control device;

Figure 2 shows a second switching circuit for a bedroom light control device; and

Figure 3 shows a mains operated bedside lamp.

Referring to Fig. 1, there is shown a switching circuit 2 of a bedroom light control device for a mains operated bedroom light 4. The circuit 2 comprises a microphone 6 and a transformer T1 for reducing mains voltage from live and neutral terminals 8, 10 respectively. The secondary winding of the transformer T1, diodes D1 and D2 and a reservoir

capacitor C1 form a conventional centre tap D.C. power supply.

A zener diode ZD1 maintains the circuit voltage constant irrespective of variations in transformer supply voltage. A resistor R1, working in conjunction with the zener diode ZD1 serves as both a voltage dropper and a current limiter to the Zener diode ZD1.

A variable resistor VR1 constitutes an audio sensitive control member which is connected as a volume control across the sound operated microphone 6. The variable resistor VR1 regulates the electrical output of the microphone 6, the electrical output of the microphone 6 being supplied to a frist stage transistor amplifier containing a transistor TR1, resistors R2, R3, R4 and R5, and capacitors C3 and C5.

A capacitor C2 serves both as a D.C. blocking capacitor to the microphone circuit and as a coupling device between the microphone circuit and the first transistor amplifier. The capacitance of the capacitor C2 is chosen such that it has a low reactance at speech frequencies.

The resistors R2, R3, R4 and R5, the transistor TR1 and capacitors C3 and C5 in fact form a conventional first stage class A amplifier circuit. The resistors R2 and R3 are chosen to bias the transistor TR1 such that the collector of the transistor TR1 is at the mid point of the D.C. supply voltage. The resistor R5 is a stabilising resistor which permits the use of transistors of the same type but with slightly different characteristics to be operated at approximately the same point. The resistor R5 also prevents thermal runaway of the transistor TR1. The capacitor C5 is chosen to have a low reactance at speech frequencies and serves as a low impedance path at these frequencies, thereby reducing negative feedback along line 12 to a minimum at these frequencies. The capacitor C3 is chosen to have a high reactance at speech frequencies but a low reactance at high frequencies. The capacitor C3 shunts away from the input to the first stage amplifier any high frequency pick up in the microphone circuit. The transistor TR1 is a general purpose transistor such as a BC107 and has a current gain in the region of 250. The resistor R4 constitutes the collector load of the transistor TR1 and is chosen to give the requisite voltage drop at the D.C. current operating point of the transistor TR1.

A capacitor C4 serves as a D.C. blocking capacitor between the collector of the transistor TR1 and the base of a transistor TR2. The capacitor C4 also serves as a coupling device between the first stage amplifier (constituted by the resistors R2, R3, R4 and R5, the transistor TR1 and the capacitors C3 and C5) and a second stage amplifier (constituted by resistors R6, R7, R8 and R9, the transistor TR2 and a capacitor C6). This second stage amplifier is a conventional second stage class AB amplifier and the components serve the same purpose as the components R2, R3, R4 and R5, the transistor TR1 and the capacitor C5 in the first stage amplifier, except that the resistors R6 and R7 are chosen to bias the transistor TR2 such that the collector of the transistor TR2 is at one quarter of the D.C. supply voltage. The transistor TR2 is again a general purpose transistor such as a BC107 having a current gain in the region of 250 so that the overall gain of both the first and second amplifier stages is in the region of 40,000. The first and second stage amplifiers are not linear amplifiers and they give a high percentage of harmonics in the output but this is immaterial as the output is only required to trigger a thyristor.

A capacitor C8 is held in a fully charged state via a resistor R10. The value of the resistor R10 is chosen such that the time constant of the resistor R10 and the capacitor C8 is in the region of 1 second. The value of the resistor R10 is typically approximately 2.2 megohms.

When sound waves, for example caused by a person clapping their hands, impinge upon the microphone 6, the microphone 6 produces an electrical output which in turn is amplified by the first and second stage amplifiers. Let the sound be at say 1000 Hz and last for an unknown length of time. The second of the amplifier is class AB as indicated above and when the voltage on the collector of the transistor TR2 rises on the first cycle of the amplified sound signal, a positive going current pulse is applied to the gate of a thyristor THY1 via a coupling capacitor C7. This current pulse triggers the thyristor THY1 into its firing state and the capacitor C8 discharges through the resistor R11, the primary of a high frequency TR2 and the thyristor THY1. After the capacitor C8 has fully discharged and the discharge current through the thyristor THY1 falls below the firing hold on minimum value, the thyristor THY1 turns off and the capacitor C8 starts to recharge via the resistor R10. Since the sound signal is at 1000 Hz, the thyristor THY1 is triggered on every 0.001 seconds during the time that the sound signal lasts. The time constant of the resistor R10 and the capacitor C8 is however in the region of 1 second so that virtually no charge has been able to build up in the capacitor C8 before the capacitor C8 discharges for a second and subsequent times. While the sound signal lasts these secondary consequential discharges are so small as to have no effect on the operation of the circuit.

The high frequency pulse transformer TR2 has two secondary windings 14, 16 and the ratio of primary to secondary turns 1:1:1. When the capacitor C8 is caused to make its initial discharge through the primary of the pulse transformer T2, the resistor R11 and thyristor THY1, current pulses by transformer

action are fed onto the gates of two thyristors THY2 and THY3. The magnitude and width of these current pulses are governed by the current limiting resistor R11.

Resistors R12, R13, R14 and R15, capacitors C9 and C10 and transistors TR3 and TR4 constitute a conventional astable multivibrator if the emitters of both transistors TR3 and TR4 are connected to the negative rail. Under these conditions, the astable multivibrator gives a continuous sequence of square wave outputs at the collector of either transistor TR3 or TR4. Since the output from this astable multivibrator is a square wave, it can be said that the output consists of a train of momentary steady state flip-flops from one transistor to the other transistor, the duration of each flip and flop being dependent upon the capacitor-resistor time constants which is given by 0.7 × C10 × R14 and 0.7 × C9 × R15 as a conventional close approximation.

With the addition of the thyristors THY2 and THY3, the conventional astable multivibrator becomes a bistable multivibrator or a flip-flop having two stable circuit conditions.

Let thyristor THY2 be conducting and the thyristor THY3 be non-conducting. The transistor TR3 must now be conducting and the transistor TR4 non-conducting.

When the thyristor THY1 is triggered into the firing state, the capacitor C8 discharges as mentioned above, through the resistor R11, the primary of the high frequency pulse transformer T2 and thyristor THY1 itself. By transformer action, simultaneous current pulses are applied to the gates of both thyristor THY2 and thyristor THY3. Since the thyristor THY2 is already conducting, the current pulse to its gate has no effect while the current pulse to the gate of the thyristor THY3 momentarily turns it on. This allows base current to the transistor TR4 to flow through the resistor R15 plus an initial surge of base current through the capacitor C9. Multivibrator action occurs and the transistor TR4 flips on and the transistor TR3 flops off. A sudden change of voltage occurs at the collector of the transistor TR4, the voltage rapidly changing from near positive rail voltage to near negative rail voltage. This sudden change of voltage reference level is transferred through the capacitor C10 taking the base of the transistor TR3 to minus near positive rail voltage, i.e. the base of the transistor TR3 goes below negative rail voltage, and cuts the transistor TR3 off. The transistor TR3 is held cut off for the time constant 0.7 × C10 × R14 and this is arranged to be longer than the pulse width of the pulse applied to the gate of the thyristor THY2. As soon as the pulse to the gate of the thyristors THY2 and THY3 dies away, the thyristor THY2 turns off since the transistor TR3 is cut off. The thyristor THY2 stays off while the thyristor THY3 stays on after the applied pulse dies away since the transistor TR4 is now conducting. Current from the cathode of the thyristor THY3 flows through the gate-cathode junction of the thyristor THY4 and mains current flows through the lamp 4, through the bridge rectifier BR1 and the thyristor THY4, and the lamp 4 turns on and stays on. The bridge rectifier BRI and the thyristor THY4 form switch means.

The transistor TR3 and the thyristor THY2 have now changed states with the transistor TR4 and the thyristor THY3 due to the application of a simultaneous trigger pulse to the gates of both the thyristors THY2 and THY3. The application of a second trigger pulse simultaneously to the gates of the thyristors THY2 and THY3 causes another reversal of state of TR3, THY2 and TR4, THY3 and the lamp 4 turns off and stays off.

The diode D3 is not essential and merely balances the forward voltage drop of the gate-cathode junction of the thyristor THY4.

The resistors R12, R13 form part of a balanced circuit and the resistor R13 is chosen to allow both sufficient current to flow to hold the thyristor THY3 on after it is triggered on and to keep the thyristor THY4 in the firing state when the thyristor THY2 turns on. The resistors R14, R15 also form part of a balanced circuit and they are chosen to allow sufficient current to flow to keep the transistors TR3, TR4 hard on when they are conducting.

The capacitors C9, C10 form part of a balanced circuit and they are chosen in conjunction with the resistors R15, R14 to give a time constant for the circuit greater than the pulse width of the gate pulses to the thyristors THY2 and THY3.

Referring now to Fig. 2, there is shown a circuit which is similar to the circuit of Fig. 1 except for the right hand part. The right hand part of Fig. 2 is an Eccles-Jordan variation circuit in which resistors R12, R13, R14, R15, R16, R17, capacitors C9, C10 and transducers TR3, TR4 in themselves constitute a bistable multivibrator or flip-flop. Simultaneous current pulses are applied via D.C. current blocking diodes D4 and D5 to the bases of both the transistors TR3 and TR4.

Let the transistor TR3 be conducting hard on and the transistor TR4 be cut off. When the thyristor THY1 is triggered on from the amplifier circuit, the capacitor C8 discharges through the resistor R11, the primary of the high frequency pulse transformer T2 and the thyristor THY1. By transformer action, a pulse of current is simultaneously applied via the steering diodes D4, D5 to the bases of the transistors TR3 and TR4. The transistor TR3 is conducting hard on and the trigger pulse has no effect upon it. The trigger pulse to the base of the transistor TR4 immediately turns the transistor TR4 hard on causing the voltage at its collector to immediately drop to near

negative rail voltage. Since before the arrival of the trigger pulse, the voltage at the collector of the transistor TR4 was near positive rail voltage, the immediate drop in voltage causes the voltage on the other side of the capacitor C10 (which is connected to the base of the transistor TR3) to immediately drop to minus near positive rail voltage i.e. below negative rail voltage and this turns transistor TR3 off. Thus on the arrival of a trigger pulse the bistable multivibrator flips over. After the flip over, the voltage on the side of the capacitor C10 connected to the base of the transistor TR3 starts to rise as the capacitor C10 charges until it reaches a level determined by the potential divider action of the resistors R15 and R16. Now that the transistor TR4 is in the same state that the transistor TR3 was in before the arrival of the trigger pulse, the bistable multivibrator flips back to its original state upon the arrival of a second trigger pulse.

The high frequency pulse transformer T2 in Fig. 2 has only one secondary winding with a ratio 1:1 between primary and secondary windings.

The resistors R12 and R13 form part of a balanced circuit and the value of the resistor R13 is chosen to allow sufficient current to flow to cause the thyristor THY2 to go into the firing state when the transistor TR4 is hard on.

The resistors R14 and R15 form part of a balanced circuit and their value is chosen to allow sufficient base current to flow to cause either the transistor TR3 or the transistor TR4 to turn hard on when the opposite transistor is cut off.

The capacitors C9 and C10 form part of a balanced circuit and their value is chosen such that the equal time constants of C9, R14 or C10, R15 are long enough to hold either transistor TR3, TR4 in the cut off state after flip over during the duration of the trigger pulse. These capacitors C9, C10 are essential for positive flip-flop action since they hold either transistor in a cut off state during the duration of the trigger pulse and without them instability would arise since the flip over is extremely rapid and the transistor that had been flipped off would tend to flip on again.

The resistors R16 and R17 are chosen such that when either of the transistors TR3, TR4 are hard on and the voltage at its collector is near negative rail voltage, then by potential divider action between resistors R14, R17 and resistors R15, R16 respectively, the base of the opposite transistor is below conduction level and the transistor remains in a steady cut off state.

As in Fig. 1, the diode D3 is not essential but balances the gate-cathode junction forward volt drop in the other leg of the bistable multivibrator.

Referring now especially to Fig. 3, the lamp 4 shown in Figs. 1 and 2 is shown as a bulb 4 in a bedside lamp 18. The lamp 18 has a base 20 and an upstanding body portion 22. The body portion 22 houses and supports a mains supply switch 24, a sound level control knob which is in effect the variable resistor VR1, and the microphone 6. A lead 26 extends from the base 20 and the lead 26 is fitted with a plug 28.

It is to be appreciated that the embodiments of the invention desribed above with reference to the accompanying drawings has been given by way of example only and that modifications may be effected. Thus, for example, different types of amplifying circuits may be employed. Also, the specific design of the bedside lamp 18 may be varied. Further the circuit 2 shown in Fig. 1 may be employed in a standard lamp or in wall-mounted or ceiling-hanging bedroom lights. The bridge rectifier BRI with the thyristor THY4 connected across it may be replaced by a triac. The means for determining the level of sound at which the lamp operates, i.e. the resistor VR1, may be connected in circuit between the first and second stages of the two stage amplifier or it may be connected in circuit between the output of the second stage transistor amplifier and the gate of the trigger thyristor THY1.

CLAIMS

1. A bedroom light control device for a mains operated bedroom light, which bedroom light control device comprises a microphone, a switching circuit for switching the bedroom light on and off in response to a non-continuous sound detected by the microphone, and an audio sensitive control member for controlling the sensitivity of the bedroom light control device to the sound, the switching circuit comprising a transformer for reducing the mains voltage, rectifier means for rectifying an A.C. output from the transformer and for producing a D.C. output, amplifier means for amplifying an A.C. output from the microphone, trigger means for producing an output signal consequent upon the microphone detecting the sound, a pulse transformer for receiving the output signal from the trigger means and for producing current pulses, bistable multivibrator means operable in consequence of signals received from the pulse transformer, and switch means for receiving signals from the bistable multivibrator means and for making or breaking a mains circuit for the bedroom light to cause the bedroom light to switch on and off.

2. A control device according to claim 1 in which the rectifier means includes a pair of diodes connected to the secondary winding of the transformer.

3. A control device according to claim 2 including a capacitor for receiving and smoothing the D.C. output from the pair of

diodes.

4. A control device according to any one of the preceding claims in which the amplifier means comprises first and second amplifier circuits.

5. A control device according to claim 4 in which the first amplifier circuit constitutes a Class A amplifier circuit, and in which the second amplifier circuit constitutes a Class AB amplifier circuit.

6. A control device according to any one of the preceding claims in which the trigger means comprises a series connected resistor and capacitor.

7. A control device according to any one of the preceding claims in which the operation of the pulse transformer is controlled by a control thyristor.

8. A control circuit according to any one of the preceding claims in which the bistable multivibrator means comprises first and second transistors and first and second thyristors, connected in circuit with diodes, resistors and capacitors, the first and the second thyristors converting an otherwise astable multivibrator means into the bistable multivibrator means.

9. A control device according to any one of claims 1 to 7 in which the bistable multivibrator means comprises first and second transistors connected in circuit with resistors and capacitors.

10. A control device according to any one of the preceding claims in which the switch means comprises a thyristor and a bridge rectifier.

11. A bedroom light control device for a mains operated bedroom light substantially as herein described with reference to the accompanying drawings.

12. A bedroom light whenever provided with a bedroom light control device as claimed in any one of the preceding claims.

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