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[45] **Mar. 25, 1975**

[54] **VERMIN CHASING AND CONTROLLING**

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[51] **Int. Cl.** **H04b 11/00**

[58] **Field of Search** ..... 181/.5 NF, .5 R; 340/384 R, 15

[56] **References Cited**

UNITED STATES PATENTS

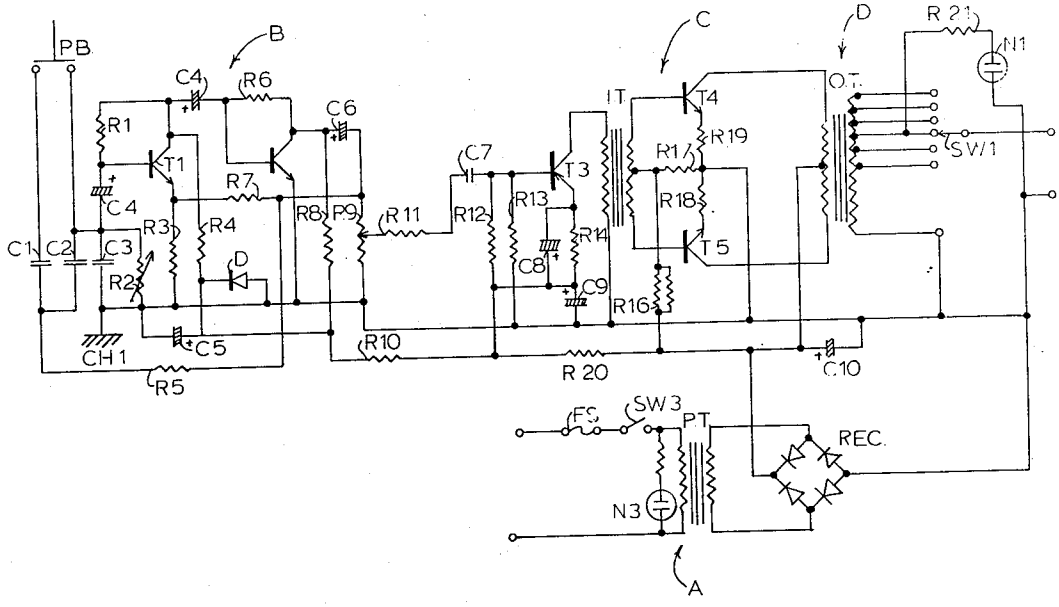
2,922,999	1/1960	Carlin	340/384 R
3,058,103	10/1962	Evans	181/.5 NF
3,305,824	2/1967	Brooks	181/.5 NF
3,503,039	3/1970	Aniskovicz	181/.5 NF
3,615,162	10/1971	Barber	340/15

Primary Examiner—Maynard R. Wilbur
Assistant Examiner—N. Moskowitz
Attorney, Agent, or Firm—James C. Wray

[57] **ABSTRACT**

A vermin chasing and controlling system has a power supply which steps down and rectifies available line voltage and supplies the voltage to an oscillator which produces an ultrasonic frequency of approximately 17.5 kHz and to one or more parallel amplifiers which are connected to the oscillator. Output transformers connect the amplifiers to multiple speaker heads which are connected according to the size, layout and operation characteristics of the space to be controlled against vermin infestation. Secondaries of the output transformers have multiple taps, one of which is selected by a selector switch according to the number of speaker heads on ouput lines. An indicator circuit having a neon lamp and ballast resistor connected in series is connected to an intermediate tap and one end of the secondary for indicating malfunctions of the amplifier, oscillator or speaker heads. A plurality of speaker heads, usually from six to fifteen, are connected in series to the secondary of the output transformer. Each head has a ballast resistor and neon lamp connected parallel to the speaker head for indicating malfunction of the particular speaker head. A push button on the oscillator couples a capacitor in parallel to an oscillator capacitor for reducing the frequency to an audible frequency for tests of the system.

13 Claims, 7 Drawing Figures



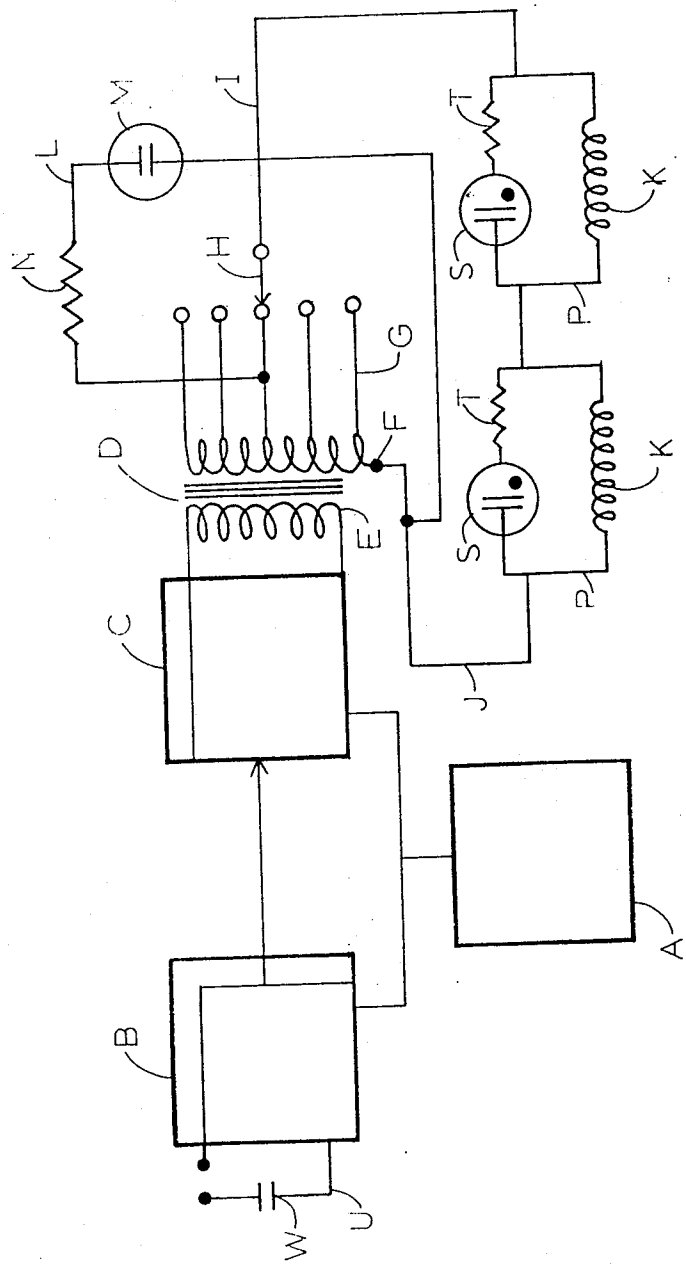


FIG. 1

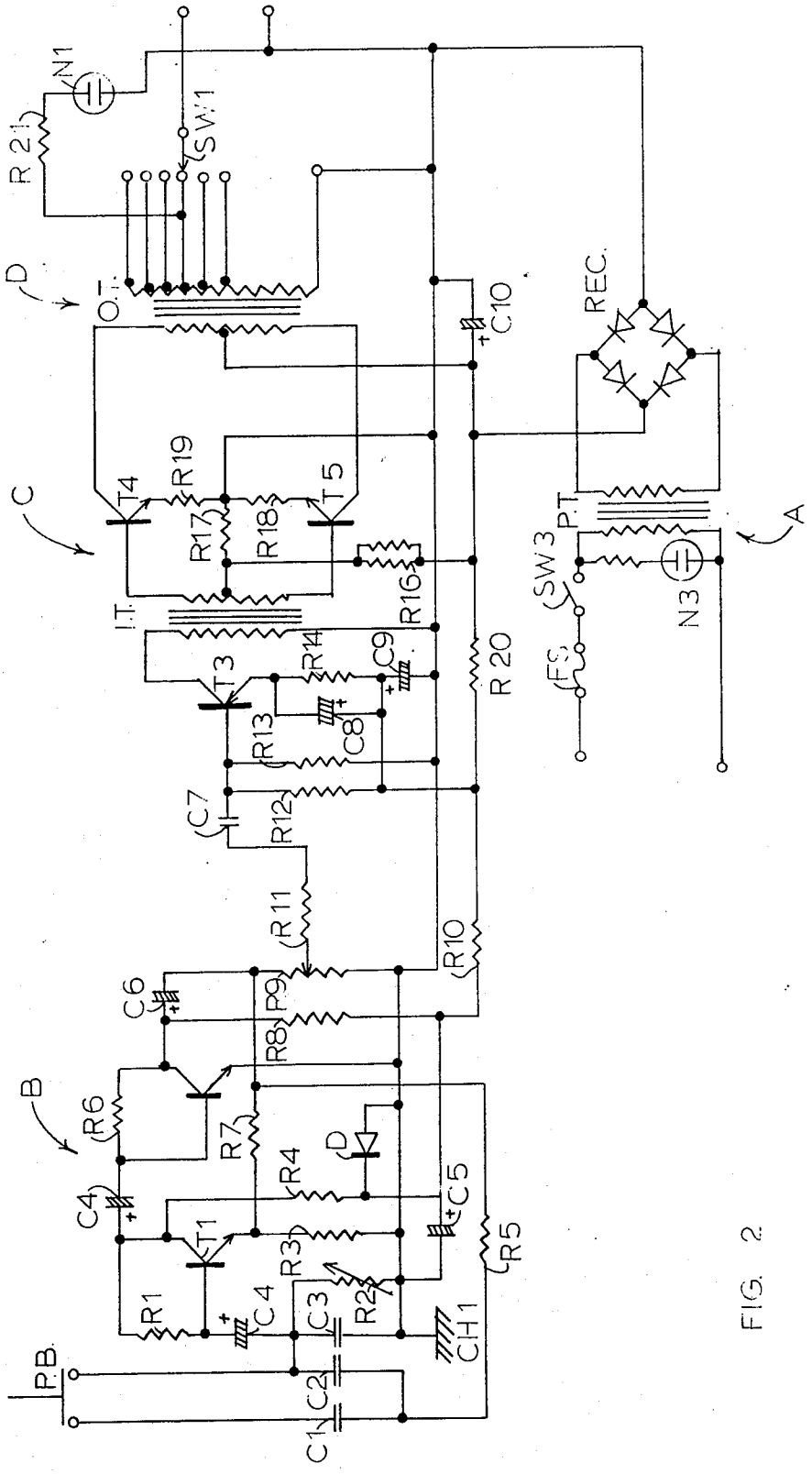

N1
R21
SW1
D
O.T.
C10
REC.
C
T4
R19
T5
R17
R18
R16
I.T.
R14
C9
T3
R20
R13
C8
C7
R12
R11
R10
C6
P9
R8
B
R6
R7
R4
D
C5
C4
T1
R3
R5
R1
C4
C3
R2
CH1
P.B.
C2
C1
SW3
P.T.
A
FS
N3

FIG. 2

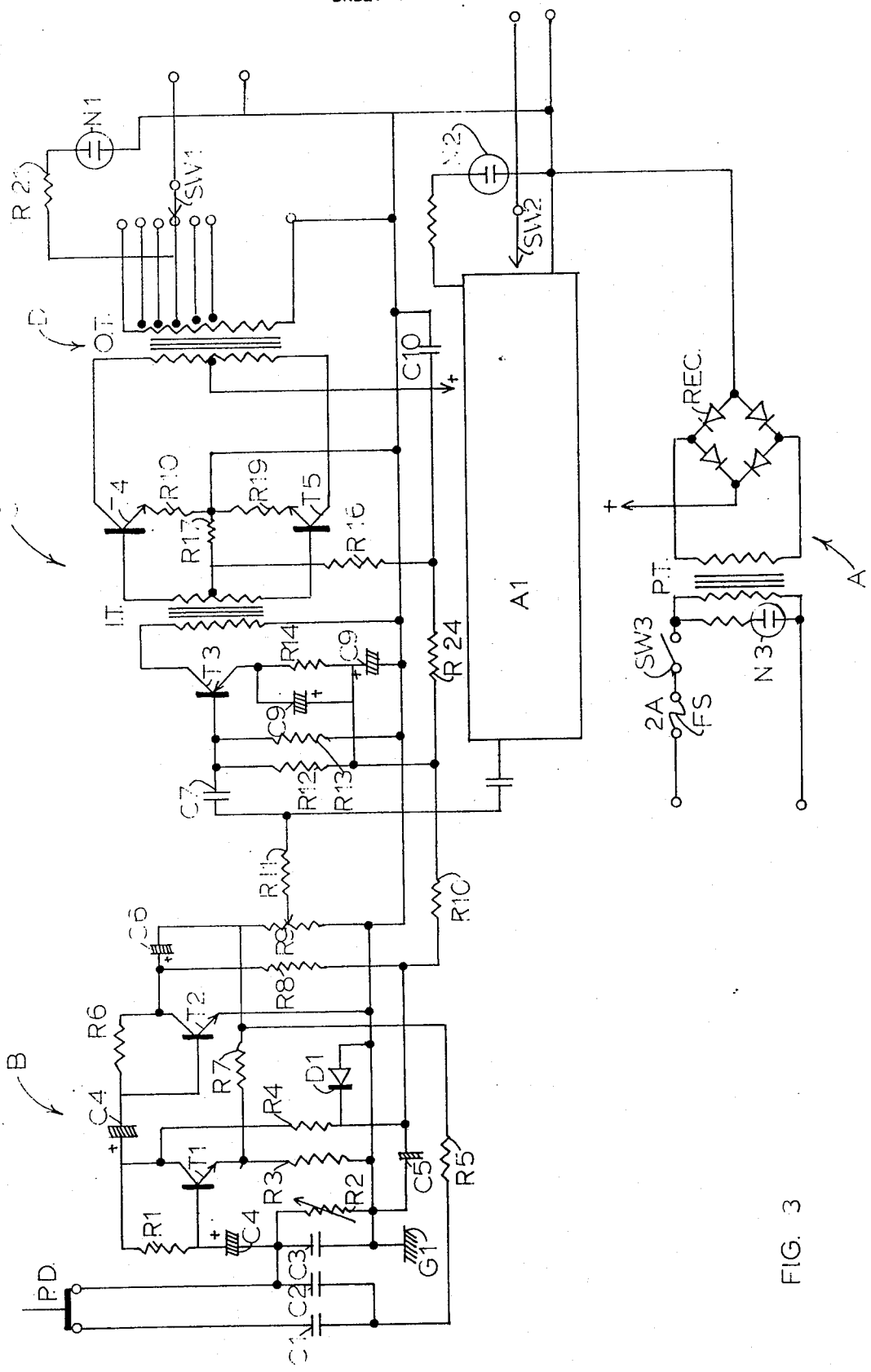

N1
SW1
R 21
SW2
O.T.
C10
REC.
T4
R10
R19
T5
R17
R16
I.T.
T3
R14
C9
R 24
A1
PT
SW3
2A
FS
N 3
A
C7
R12
R13
R11
R1C
C6
R9
R8
T2
R6
R7
D1
B
C4
R4
T1
R3
R2
C5
R5
R1
C4
C3
C2
C1
G1
PD

FIG. 3

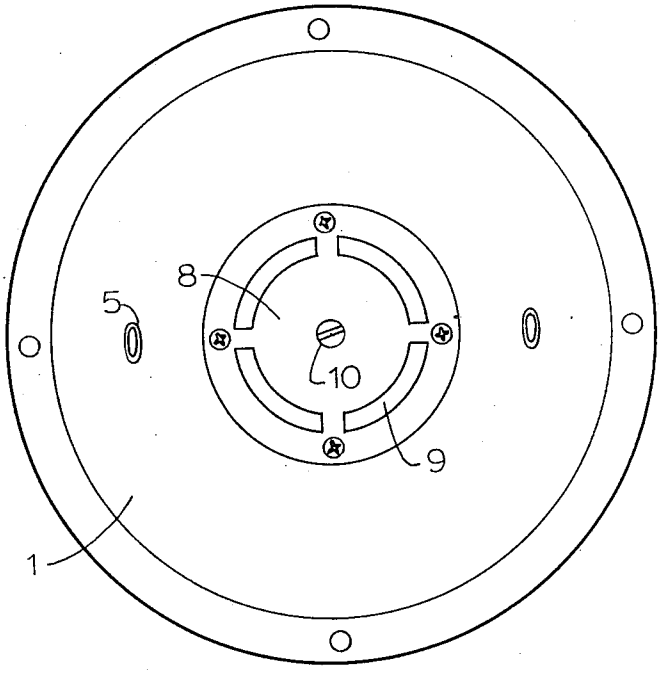
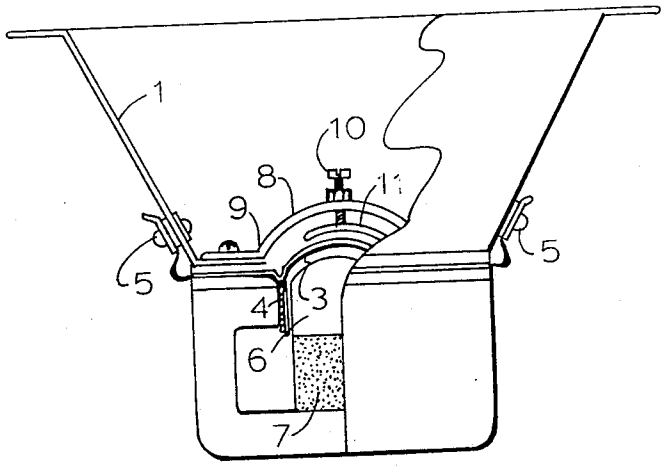


FIG. 5

FIG. 4



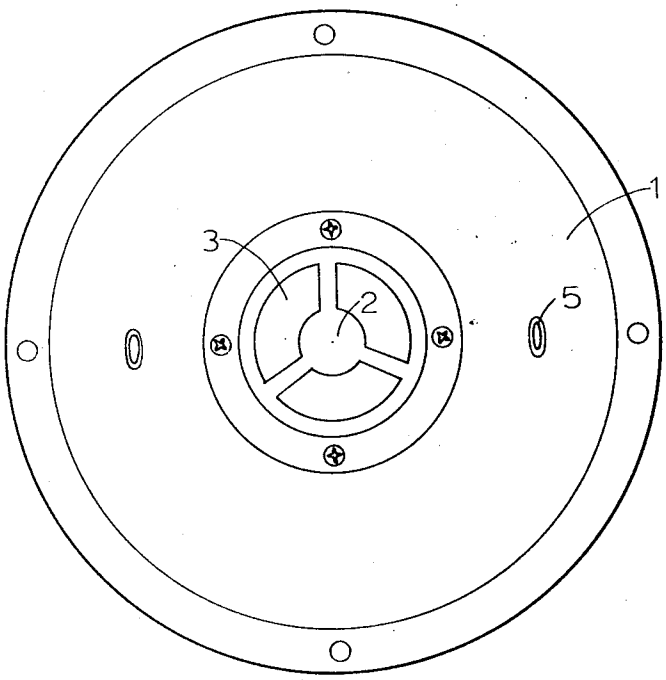
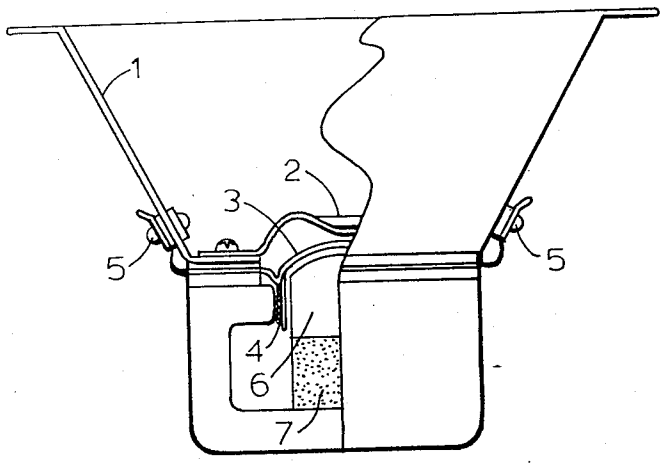


FIG. 7

FIG. 6



VERMIN CHASING AND CONTROLLING

BACKGROUND OF THE INVENTION

It has been determined that vermin, particularly rats, have a high sensitivity to ultrasonic wave radiation, particularly within predetermined frequencies. Continued exposure to ultrasonic frequencies causes dysfunction of biological characteristics causing rats great discomfort and ultimately death. The flooding of spaces such as warehouses with appropriate frequencies and power levels of ultrasonic wave radiation thus has the effect of ridding the spaces of vermin and rats by chasing the rats away from the spaces or exterminating the vermin.

The flooding of protected spaces with wave radiation of the appropriate frequency and power in a manner to avoid creating dead spaces which are havens for the vermin and to avoid powers or frequencies which are non-injurious to vermin or non-discomforting and at the same time to avoid frequencies and power levels which are discomforting or injurious to humans requires careful control.

Preferably, spaces are flooded by the use of multiple speaker heads. The wide dispersal of the speaker heads and their susceptibility to damage may create situations of ineffectiveness which are first appreciated upon the recurrence of damage or other evidence.

The positioning of the speaker heads around a warehouse renders their detection and inspection difficult. Because the speakers operate with ultrasonic waves, it is difficult to determine the speakers are actually operating. Because the entire system works with ultrasonic waves, it is difficult to detect whether the system is operating. System malfunction over an extended period results in reinfestation of the premises.

When the operator of a system becomes concerned over the system operation, it is often necessary to send a skilled electronics technician to the protected premises and to supply the technician with complex testing equipment. The result is a great expenditure in time and may be unnecessary.

If it is determined the system is malfunctioning, a great deal of time may be required in locating the particular source of the malfunction.

Because the size and shape and characteristics of a premises to be protected may vary from characteristics of other premises, it is necessary to use different equipment to provide the same degree of intensity and coverage. One amplifier which is suitable for use with a particular number of speakers may not be suitable for use with a varied number of speakers.

SUMMARY OF THE INVENTION

The present invention overcomes the problems which continue to exist in ultrasonic vermin chasing and controlling systems of the prior art by providing a system which readily adapts to spaces of different sizes and characteristics by providing from 6 to 30 speaker heads operating at uniform power and frequency outputs. Indicators are provided to immediately indicate system malfunction and to pinpoint malfunctioning speaker heads. An audible system is provided to test the entire system for operation.

Tuned and equalized speakers with vibration boards and equalizers and permanent magnet pole pieces of similar shapes radiate the ultrasonic energy at maximum output levels and omnidirectionally. Each speaker is equipped with a parallel connected neon indicating lamp and ballast resistor for indicating malfunction of that particular speaker. When an employee searches the equipment for the malfunctioning speaker, it is only necessary to look for the small indicating lamps rather than to test the speakers individually with complex electronic testing equipment.

The indicators are ballasted neon lamps connected across a part of the secondary of the output transformer to indicate an excess voltage condition which in turn indicates failure of one or more speaker heads, or the oscillator-amplifier system. In the case of the speaker failure, the operator simply looks for a lighted speaker and replaces that speaker, placing the equipment back in operating condition.

When the operator suspects that the system may not be operating at all, he merely pushes a button on the oscillator, changing the output frequency from a 17.5 kHz ultrasonic frequency to a 8.75 audible frequency, which immediately reassures the operator that the system is functioning correctly.

In accomplishing the board objectives of the invention, a power supply is connected to drive an oscillator and amplifier, which in turn drives a selected multiple number of speakers. The oscillator is selected to create ultrasonic frequencies which are suitable for chasing or killing vermin, particularly rats. A useful frequency is 17.5 kHz. In the present invention the oscillator is equipped with a push botton controlled extender which halves the frequency to an audible range, example 8.75 kHz. A power supply supplies the oscillator and one or more amplifiers. The amplifier drives the primary of an output transformer. The secondary of that transformer has multiple taps, one of which is selected by a rotary switch according to the number of speakers used in the output line. An indicator spans part of the secondary for indicating system malfunction. Preferably the indicator is a neon lamp and a ballast resistor connected in series to an intermediate tap and to one end of the secondary, for indicating an excess voltage level at that tap, which is caused by system malfunction, such as by failure of one or more speakers.

Each speaker head is equalized to produce the maximum decibel output. In the preferred embodiment, each speaker has an equalizer partially overlying the vibration board and apparatus for holding the equalizer appropriately spaced from the board. A failure indicating circuit in parallel to the coil has a neon lamp and ballast resistor. The lamp is lit when the coil and speaker fail.

One object of the invention is the provision of a vermin chasing and controlling system which employs a selectable number of speaker heads.

Another object of the invention is the provision of a vermin chasing and controlling system which has an audible frequency override for testing the effectiveness of the speakers.

Another object of the invention is the provision of a vermin chasing and controlling system employing indicators at a main control device for indicating system malfunction.

Another object of the invention is the provision of speaker head indicators for indicating malfunction of individual speakers.

Another object of the invention is the provision of a vermin chasing and controlling system using selectable number of equalized speakers with maximum ultrasonic energy.

These and other objects and features of the invention are apparent in the disclosure which includes the drawings and the specification, which is the foregoing and ongoing description and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic detail of the vermin chasing and controlling system of the present invention.

FIG. 2 is a schematic wiring diagram of an ultrasonic wave creating and checking apparatus for use with a selected number of speaker heads.

FIG. 3 is a schematic diagram of a two channel amplifier system for doubling the number of available speaker heads.

FIG. 4 is a partially cutaway side elevational detail of an equalized speaker used in the system of the present invention.

FIG. 5 is a front elevational detail of the speaker shown in FIG. 4.

FIG. 6 is a partially cutaway side elevational detail of an adjustable equalizer ultrasonic speaker head used in the present system.

FIG. 7 is a front elevational detail of the speaker shown in FIG. 6.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to FIG. 1 power supply A is connected to supply power to oscillator B and amplifier C. An output transformer D has a primary E connected as the output of amplifier C. Secondary F has a plurality of taps G, one of which is selected by a rotary selector switch H to supply power through output lines I and J to supply a selected number of series connected speakers K.

An indicator circuit L in the main control has a neon lamp M and a ballast resistor N connected in series to one end of the secondary F and to one intermediate tap for indicating a system malfunction.

Indicator circuits P are connected in parallel to coils of speakers K for indicating speaker head malfunction. Neon lamp S and ballast resistors T are connected in series across the coil so that neon lamp S light when the speaker is malfunctioning, thereby identifying the speaker which is causing the problem.

To insure that the entire system is working, the oscillator is provided with an audible override circuit U, which has a push botton V to selectively couple capacitor W to the oscillator, thereby reducing its frequency output from an ultrasonic frequency to an audible frequency.

Referring to FIG. 2, a power supply generally indicated by the letter A has a fuses FS leading from input terminals to a switch SW3. A lamp N3 with a ballast resistor indicates an operating condition of the system. A power transformer PT changes the 112 to 120 two-amp 50 or 60 cycle supply current to a 25-volt four-amp current. A rectifier smoothes the current to a direct current which is supplied to the oscillator and to the amolifier.

Oscillator B has a capacitor C3 of a value of 0.002 and a variable resistor R2 of 4.8 kilo ohms. C4 is a ten microfared capacitor. R1 has a value of 100 kilo ohms. Transistors T1 and T2 are preferably 2 sc–1032 transistors, and resistors R3 and R4 have values of one kilo ohm. Ten microfared capacitor C4 and 40 kilo ohm resistor R6 are connected between the collectors of transistors T1 and T2. 8.2 kilo ohm resistor R7, one kilo ohm resistor R8. 50 kilo ohm resistor R9, 10 microfared capacitor C6 and the 9-volt diode D1 complete the oscillator circuit.

A push button PB connects parallel 0.002 capacitor C1 and 0.001 capacitor C2 and 8.2 kilo ohm resistor R5 to the oscillator circuit for halving the frequency to an audible frequency.

One kilo ohm watt resistor R10 and 220-ohm one-quarter watt resistor R20 provide the approriate power to the oscillator and amplifier from the power supply. One microfared capacitor C10 acts as a filter.

The output of the oscillator is picked up on resistor R9 by a variable tap through 2 kilo ohm resistor R11. 0.004 microfared capacitor C7 passes the ultrasonic or sonic frequency to the base of transistor T3 which is preferably a 2 sb–167 transistor. Bias provided by 5.6 kilo ohm resistor R12 and 8.2 kilo ohm resistor R13, and the circuit is completed by 30 microfared capacitor C8 for 90-ohm resistor R14 and 470 microfared capacitor C9. The transistor collector and emitter are connected to the primary of an input transformer whose output is divided between 2 sd–175 transistors T4 and T5. R17 is a 50-ohm one-half watt resistor. R18 and R19 are one-ohm one-fifth watt resistors. R16 is a 500-ohm 5 watt resistor. Collectors of transistors T4 and T5 are connected to the primary of an output transformer. The secondary of the output transformer D has multiple taps, one of which is selected by switch SW1 for impressing the voltage of the secondary on the output lines shown at the right of the schematic. Neon lamp N1 and ballast resistor R21 having a one mega ohm resistance are connected to the secondary between a first end and intermediate tap for indicating excessive voltage characteristics which is indicative of system malfunction.

The system of FIG. 2 is similar to the system of FIG. 3. The latter has a second amplifier A1 which is connected through a capacitor to the output of the oscillator. The second amplifier is supplied with power from the power supply in the same manner as in the FIG. 2 embodiment. Amplifier A1 has an output transformer and a switch SW2 which selects one tap of multiple taps in a secondary of the output transformer. An indicating lamp N2 and a ballast resistor provide an indicator circuit for showing malfunctions of the second channel including the plural speakers. The coupling of a second amplifier and channel to the rat chasing and controlling system provides double the number of available speaker heads which may be used with the system.

Referring to FIG. 4 and FIG. 5, the numeral 1 generally represents the speaker horn. A vibration board 3 is driven by voice coil 4 which is connected to terminals 5. A pull piece 6 and a magnet 7 control the movement of the vibration board according to fluctuating current in the coil 4. A front cover 8 over the vibration board 3 has ultrasonic output holes 9 which are arranged in segmental shapes. A control screw 10 controls the position of equalizer 11.

In FIGS. 6 and 7 similar numbers represents similar features. A fixed equalizer 2 replaces the adjustable equalizer 11 in the FIG. 4 embodiment. The vibration board 3 has segmental hole access to the horn for producing omnidirectional ultrasonic waves of high intensity.

The use of the equalizer greatly enhances the output of the speaker in the ultrasonic range. For example, the equalizers shown in the drawings may increase the output of the speaker heads about fifteen decibels from

100 decibels to 115 decibels. The speaker output characteristics changed by the equalizer are greatly affected by the shape and location of the equalizer. The fixed equalizer in the FIGS. 6 and 7 embodiment is provided to deliver broad optimum characteristics. The adjustable equalizer 11 in FIGS. 4 and 5 is especially designed to be compatible with the vibration board 3. The pull pice 6 is also matched to the vibration board 3. Sound emitted from the output hole is omnidirectional, giving maximum efficiency to the speaker heads. Preferably the other curves of the pole piece, vibration board and equalizers are matched for maximum efficiency.

The present invention uses a single housing which mounts the power supply, vibrator and amplifiers. The housing has a cord with a plug for conventional alternating current supply. Terminals are provided for connection to a series of speakers and an off-on switch is provided, a green indicator lamp is provided to indicate the operating status of the equipment, and a red indicator lamp is provided in the housing for indicating malfunction of one amplifier channel. Rotary selector switches for each channel select the tap of the output transformer which is appropriate for the predetermined number of speakers to be used.

Impedance adjustment circuit and switch examples.

A 12 pole rotary switch is mounted through a hole in the rear of the amplifier. It is calibrated for six settings by manual adjustment.

This switch, the seven coil taps of the secondary side of the output transformer and one wire from the transformer to the positive output terminal are the impedance adjustment circuit.

The purpose of this circuit so created is to maintain by manual settings the correct ohmage, impedance and resistance and voltage output as related to the number of extension repeller speakers being driven by each channel of the amplifier.

Formula.

One extension repeller requires 16 impedance ohms or 13 d.c. ohms.

By setting the impedance adjustment switch at:

First position, a 96 impedance ohm output circuit is created for each channel, maintaining a 17.5 kHz frequency flow to six extension repellers per channel;

Second position, a 112 ohm output circuit is created, maintaining a 17.5 kHz frequency flow to seven extension repellers per channel;

Third position, a 120 ohm output circuit is created, maintaining a 17.5 kHz frequency flow to eight extension repellers per channel;

Fourth position, a 144 ohm output circuit is created, maintaining a 17.5 kHz frequency flow to nine extension repellers per channel;

Amplifier Output Voltage and Amps at Six Stage Settings Each Channel

Setting Positions	Extension Speakers	Amplifier Output Volts	Amps
Example 1			
1	6	79.98	3
2	7	93.31	3.5
3	8	106.64	4
4	9	119.97	4.5
5	10	133.33	5
6	15	199.95	7.5
Example 2			
1	2	26.66	1.0
2	3	39.99	1.5
3	4	53.32	2.0
4	5	66.65	2.5
5	6	79.98	3.0
6	8	106.64	4.0

Fifth positon, a 160 ohm output circuit is created, maintaining a 17.5 kHz frequency flow to 10 extension repellers per channel;

Sixth position, a 240 ohm output circuit is created, maintaining a 17.5 kHz frequency flow to 15 extension repellers per channel.

While the invention has been described with reference to sepcific embodiments, it will be obvious to those skilled in the art that modifications and variations may be made without departing from the spirit and scope of the invention. The scope of the invention is defined in the following claims.

I claim:

1. A vermin chasing and control ultrasonic wave generating system comprising a power source, an oscillator connected to the power source, an amplifier connected to the oscillator and to the power source, an output transformer having a primary connected to the amplifier and having a secondary, a plurality of output taps connected to the secondary at successively greater distances from the first end of the secondary, a multiple pole switch having an indexing pole connected to a second output line and having multiple poles connected severally to multiple taps of the secondary and having a selector for connecting the indexing pole with a selected pole of the multiple poles.

2. The vermin chasing and control apparatus of claim 1 further comprising a frequency reducing circuit connected in parallel to a circuit in the oscillator, and a normally open push button switch connected in completion of the frequency reducing circuit. whereby pushing the button completes the frequency reducing circuit, coupling the frequency reducing circuit to the oscillator and de-tuning the oscillator for producing audible sonic wave frequencies.

3. The vermin chasing and control apparatus of claim 1 further comprising indicator circuit connected to one end of the secondary and to a tap of the secondary, an indicator means mounted in the indicator circuit for producing a discernible indication of condition of the apparatus.

4. The vermin chasing and control apparatus of claim 3 wherein the indicator means comprises a neon lamp and ballast resistor connected in series in the indicator circuit for lighting the lamp when voltage in the circuit exceeds a predetermined maximum.

5. The apparatus of claim 4 wherein the indicator circuit is connected to a first end of the secondary and to a medial tap in the multiple taps of the secondary.

6. The apparatus of claim 1 further comprising a second amplifier connected to the power supply and to the oscillator in parallel to the first amplifier, a second output transformer having a primary and secondary, the primary being connected to the second amplifier and a second pair of output lines, one line in the second pair being connected to a first end of the secondary of the second output transformer, and a second line in the

second pair being connected to an elector of the multiple pole switch having multiple poles being severally connected to multiple taps of the secondary of the second output transformer for selectively coupling one of the taps to the second line in the second pair of output lines.

7. The vermin chasing and control apparatus of claim 1 further comprising a plurality of speaker heads connected in series to the output lines, each speaker head having a speaker indicator circuit connected in parallel to the speaker head.

8. The vermin chasing and control apparatus of claim 7 wherein the speaker indicator circuit comprises a neon lamp and ballast resistor connected in series in the speaker indicator circuit for indicating condition of the speaker.

9. The vermin chasing and control apparatus of claim 7 wherein from 6 to 15 speakers are connected in series to the output lines.

10. The vermin chasing and control apparatus of claim 7 wherein the speaker heads comprise heads having magnets, curved pole pieces, coils adjacent the pole pieces, curved vibration boards spaced outward from the curved pole pieces and curved equalizers spaced outward from the vibration boards.

11. The vermin chasing and control apparatus of claim 10 wherein the speakers heads further comprise vibration board covers with spaced segmental wave transmitting openings above the vibration boards.

12. The vermin chasing and control apparatus of claim 7 wherein from 1 to 15 speakers are connected in series to the output lines.

13. The vermin chasing and control apparatus of claim 7 wherein from 1 to 10 speakers are connected in series to the output lines.

* * * * *