Oct. 21, 1947. W. C. ROGERS 2,429,370

RADIO RECEIVER AND THE LIKE

Filed Nov. 30, 1942 2 Sheets-Sheet 1

Fig. 1.

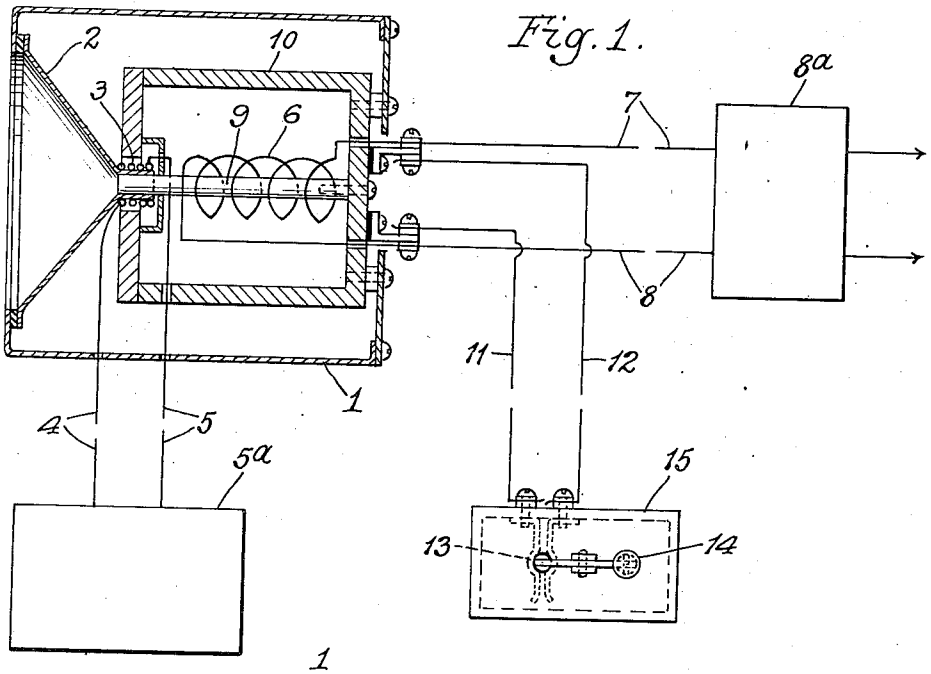


Fig. 2.

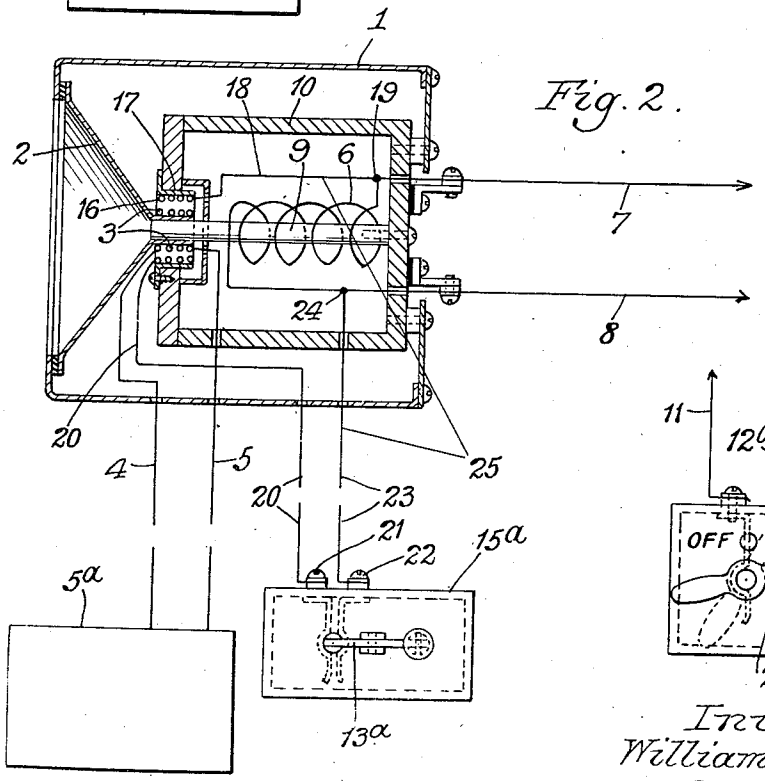
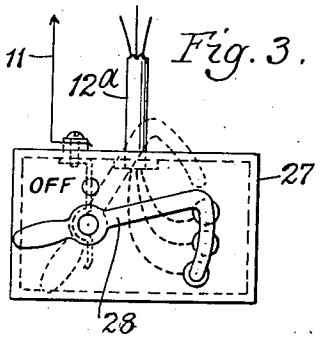


Fig. 3.



Inventor
William C. Rogers
by Parker & Carter
Attorneys.

Oct. 21, 1947. W. C. ROGERS 2,429,370

RADIO RECEIVER AND THE LIKE

Filed Nov. 30, 1942 2 Sheets-Sheet 2

Fig. 4.

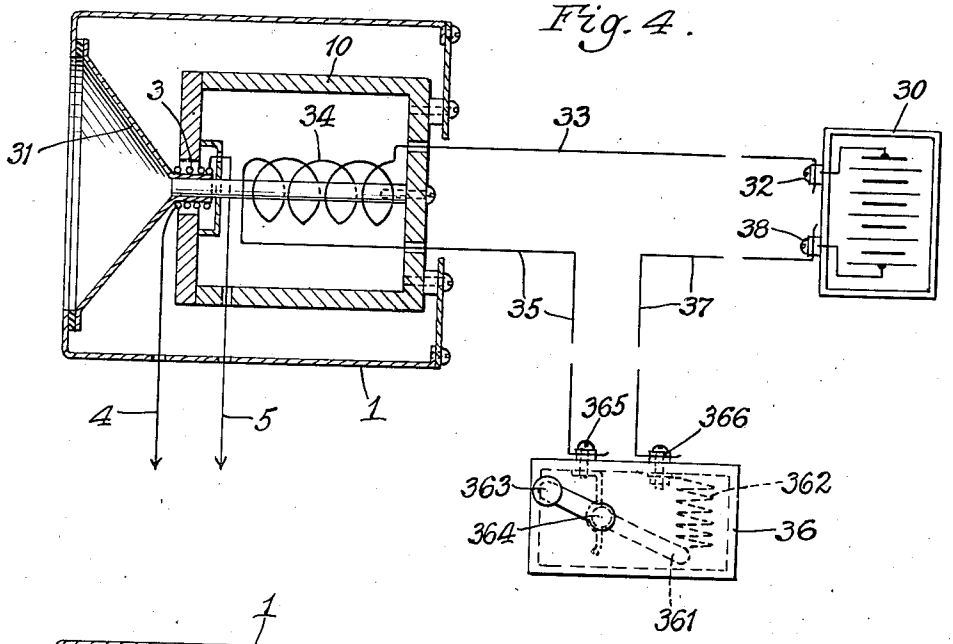
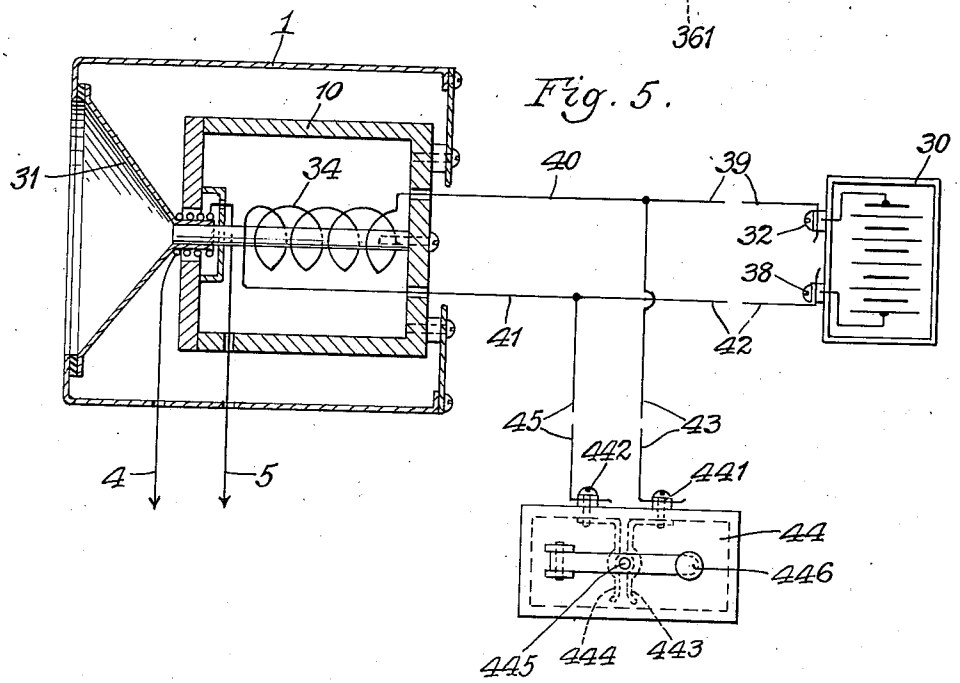


Fig. 5.



Inventor
William C. Rogers
by Parker & Carter
Attorneys.

Patented Oct. 21, 1947

2,429,370

UNITED STATES PATENT OFFICE

2,429,370

RADIO RECEIVER AND THE LIKE

William C. Rogers, Weston, Vt.

Application November 30, 1942, Serial No. 467,292

1 Claim. (Cl. 179—1)

1

My invention relates to improvement in radio receivers and the like and has for one object to provide a new and improved means for muting radio sound output.

Another object of the invention is to provide means for muting radio sound output without in any way affecting the frequency impressed on the sound-carrying current or requiring changes in circuits conducting current to energize or actuate or build up the sound output of the radio receiver means as distinguished from the circuits conducting current independently to amplify sound output.

Dynamic speakers for radio, public address systems and the like habitually include a movable coil attached to some kind of a resonant or vibratory element such as a diaphragm to which the coil imparts vibrations. The movable coil which receives audio frequency current from the radio or public address system, is mounted in a magnetic speaker field which is usually energized or developed by a speaker field coil, the energizing current for which comes from any suitable source of power which may or may not be associated with the radio or public address system. The intensity of the sound delivered by the dynamic speaker depends upon the reaction between the intensity of the field of the movable coil armature and the intensity of the field of the fixed magnet of the loud speaker.

In the past, the effort has been made to mute the speaker by controlling the intensity of the output voice circuit current, the control being applied either to the voice circuit between the audio transformer and the voice output terminals or further back in the system as the case may be. Experience has taught, however, that such controls while they do control the power of the sound current also tend to and frequently do distort the frequency of the sound current so as to produce less satisfactory sound effects.

I propose to accomplish the muting of the system by controlling the movement of the sound or voice coil. This can be done by introducing a suitable switch in series with a shunt in parallel with the power circuit or even by including in series with such shunt a coil integral with the frame of the speaker and adapted to set up a counter magnetic field to that of the movable voice coil. Both these methods of solving the problem have in common that they apply only to the magnetic fields reacting in the speaker and the means for controlling the movement of the coil in these fields, and they leave the wiring of the audio circuit, as well as that of the radio

2

and speaker circuits absolutely undisturbed and unaffected.

Obviously if one of the reacting speaker fields is reduced in intensity, the sound emitted by the speaker will be reduced, assuming no change in output of the radio receiver means, so by either of the means above referred to, I am enabled without in any way interfering with, changing or controlling the frequency or pitch of the receiver sound output, to mute or control the volume of sound emitted by the speaker.

In general it is important to emphasize the following:

1. That muting is secured by controlling the movement of the voice coil;

2. That this movement depends on the magnetic fields set by the radio output sound carrier current and the power current flowing through the voice coil and field coil respectively of the loud speaker;

3. That the control of the power current can be effected by a switch in series with a shunt;

4. That the sound-carrier current and the power current being conventionally derived from the same source of power are basically in phase but not in frequency the same;

5. That only the amplitude of the phase is affected by the controlling means, leaving the frequency impressed by the audio transformer, etc. of the receiver means unchanged.

This is a continuation in part of my co-pending application Serial Number 428,064, filed January 24, 1942, for "Radio receivers and the like."

My invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 shows diagrammatically a part of the voice current generating and transmitting the system and the power circuit together with suitable means for attenuating the field;

Figure 2 illustrates a modified form of the invention;

Figure 3 illustrates a further modification;

Figure 4 illustrates a conventional resistance-in-series arrangement; and

Figure 5 illustrates the novel shunt-in-parallel arrangement.

Like parts are indicated by like characters throughout the specification and drawings.

1 is a speaker housing, having a diaphragm 2. 3 is a voice or movable coil. Conductors 4, 5, in series with the voice coil lead to the audio side of a conventional radio sound unit 5a. 6 is a field coil. Conductors 7, 8, lead to the secondary of a power unit 8a.

9 is a core for the field coil, the core and field being supported on a frame 10. 11, 12 are shunt wires extending to a shunt switch 13 adapted to be controlled by a hand button 14 in a switch housing 15. The wires 11 and 12 are relatively long and enable the operator to place the switch housing 15 at any suitable point removed from the speaker.

A modification of my invention is illustrated in Figure 2, in which a counter electromotive coil 16 shown in a collar 17 attached to the frame 10 of the speaker housing 1, and coupled inductively with the movable voice coil 3. The lead 18 from the inner terminal of the coil 16 connects with the power circuit lead 7 at the inner terminal 19 of the field coil 6. The lead 20 from the outer terminal of the coil 16 connects at a convenient distance with the terminal 21 of the switch housing 15*a*, and thence through the on-off switch 13*a* to the terminal 22 and lead 23 to the junction 24 with the power circuit lead 8 from the outer terminal of the field coil 6. The lead 18, the coil 16, the lead 20, the switch 13*a*, the lead 23, all are in series in a shunt circuit 25 across the power circuit leads 7 and 8 as shown.

The total resistance of the field coil and shunt circuits as above described required to mute the sound to a desired volume, is readily obtained for stock radio signal transmission devices, by resorting to electrical measurements and practical construction. The prime purpose of the shunt is to suppress a signal of acceptable volume and reduce it to a lower volume in which its character is just distinguishable, when the signal assumes an objectionable character.

It is evident that, when the shunt switch is closed, the flow of current through the shunt circuit will by-pass a part of and decrease the power delivered to the loud speaker via the usual lead wires and field coil thereof, and thus decrease the number of lines of force in the magnetic field in which the movable voice coil of the speaker assembly vibrates. This decrease of the lines of force decreases the volume of sound without changing the speech frequency or pitch impressed by the output of the receiver. The decrease of current through the field coil or increase of the current through the counter electromotive coil decreases the amplitude of the vibrations of the movable voice coil.

It is evident also that the switch may be made to throw into the shunt circuit, two or more shunt circuits of different conductivities or throw all of them into one shunt circuit of large conductivity.

It is also evident that when the switch is turned off, that normal delivery of power and consequent volume of sound will be instantly resumed. Further, these changes from normal to lower volumes of sound and the reverse, are accomplished without danger of overheating tubes, coils or other resistances of the radio device, but that the shunting of current from the field coil of the speaker, tends to lower temperature generally.

In a preferred form, the shunt takes the shape of a relatively long copper wire. One end of the wire is attached to each of the poles of the field coil. The manually controlled switch intermediate the two ends of the wire is at a point removed from the radio. The user having tuned the radio to the station he wants to hear at a volume he wants, then can control future operations of the radio so far as the single station to which he is tuned, by manipulating the switch. If he does not want to listen to the program that is coming in at the time he can close the shunt

circuit and as a result, the current reaching the field coil will be reduced in power, the audible signals will be reduced in volume and while the radio remains in operation, tubes warm, properly tuned, he will not be annoyed with the noise of the program he does not want to hear. When the time comes that he wants to listen to the program, he opens the shunt switch, the current then passes through the field coil and the signals come back to the original volume.

This manipulation of the shunt switch will, of course, have no effect whatever on the pitch of the sound transmitted by the radio or public address system. The volume of sound will be maintained in pitch, that is, in frequency while diminished in loudness, that is, in amplitude.

A further improvement involving the use of a cable lead 12*a* Figure 3, enclosing a plurality of shunt wires of varying resistance or even the same resistance with a multi-point switch housing 27 making it possible to move the contact arm 28 so as to close the shunt circuit through one or more of these shunt wires, making it possible for the user to increase or decrease the conductivity of the shunt without going to the radio, merely by manipulating the switch on the shunt or control circuit to vary the audible volume of the signal. With the multi-point switch housing 27 installed in place of the shunt switch housing 15 as illustrated in Figure 1, he might tune his radio to the desired station, with the shunt at an intermediate control contact, then if he wanted to increase the muted loudness, he would decrease the number of cable shunt wires, or, if he wanted to decrease the muted loudness he would increase the number of such wires. The multi-point switch housing 27 and cable 12*a* are also adapted for substitution for the shunt switch housing 15*a* and the lead 23 illustrated in Figure 2, but the effect of increasing conductivity is to increase the current in the counter electromotive coil 16 and thus decrease the volume of sound; while a decrease of such conductivity increases the sound.

That there is a great improvement in the results obtained by the simple shunt method over the complex conventional series method of controlling movements of a voice coil, is evidenced by considering the following statements:

Whether the source of electric energy is a local power plant and such energy transmitted through a power transformer or is a battery source, the potential maintained at the output power terminals is constant. For purposes of this explanation, the well known equation

$$C=\frac{E}{R}$$

is considered in the form, $E=CR$, in which E is a constant electromotive force and C and R variables of current and resistance, respectively. To satisfy the constant value of E, as R increases C decreases and vice versa.

In Figure 4 of the accompanying drawings a conventional source of power and sound amplification are indicated by the battery 30 and a dynamic loud speaker 31.

From the terminal 32 of the battery 30, the power circuit in Figure 4 is shown to include in series a lead 33, the field coil 34, the lead 35, the variable resistance 36, the lead 37 to the terminal 38 through the battery back to terminal 32 as shown. The variable resistance 36 includes a contact finger 361, a resistance coil 362, over which the finger 361 may travel, a handle 363 and

a connection between the pivot 364 of the handle and the terminal 365 in contact with the lead 35. The terminal 366 in contact with the coil 362 and the lead 37 respectively results in a controllable resistance in series arrangement whereby the current applied to the coil 34 is controlled by the variable resistance 36.

In Figure 5, the circuit includes the battery 30, a terminal 32, conductor 39, conductor 40, coil 34, conductor 41, conductor 42, terminal 38, battery 30. Thus current from the battery 30 energizes the coil 34. Conductor 43 leads from conductor 39 to terminal 441. Conductor 45 leads from conductor 41 to terminal 442. Switch blades 443, 444 are associated respectively to the terminals 441, 442 and a switch plug 445 may be manipulated by the handle 446 to close the circuit or to open it as the case may be. When the switch is closed, we have a shunt-in-parallel in contrast with the series resistance of Figure 4. In each case the speaker 31 and coil 3, conductors 4 and 5 leading to radio sound unit 5a are shown though 5a is not illustrated in Figures 4 and 5.

Assume that in series with the power circuit, Figure 4, the variable resistance 36 is set at the resistance required to control the strong currents as has been heretofore tried. In $E=CR$, with E constant and R placed at a fixed value, C also becomes fixed. Any change of R produces also a reciprocal change in the C that energizes the coil 34, and because of the series circuit and no means present for the power current entering the field coil to escape a head on collision with the counter electromotive force set up by the changes of current through the field coil, there is a recoil check or click of audio frequency range transmitted through the voice coil to the output sound. When there is a considerable change made in the resistance in the power series circuited illustrated in Figure 4 as by opening an air gap in such series circuit, the "loading" will cause damage both to the delicate voice coil or further back in the radio-audio receiver means.

On the other hand, I commence control of the power supply separately after the sound transmitter has been tuned to a desired sound volume and frequency, and when it is desired to decrease such sound volume. In this case, illustrated in Figure 2, when the switch 44 is closed, the power current through the field coil 34 is decreased, and a current equal to such decrease flows through the shunt circuit. The shunt is adapted to bypass completely this decrease of current and in no way resists the whole power current as would a resistance placed in series with the main power circuit. Thus the electromotive force set up in the field coil 34 when the shunt in parallel is used not only meets with less opposition from the exciting current but also is cushioned in its effects, while that induced when a resistance in series is used not only meets with maximum opposition but is hard hitting. The shunt evidently serves as a conductance rather than as a resistance to part of the whole power current, and is therefore not a resistance to the passage of the whole power current. It is evident that the shunt is readily adapted to impose cushioned minimum changes in the power current flowing through the

coil 34 and the resulting changes in the intensity of the loud speaker field at "make" as at break in using the switch 44, Figure 5, is also a cushioned minimum.

Among the improvements obtained by using the shunt, as above disclosed, first, a minimum change in field energy, uniformly repeatable by manually operating a remote, shunted switch; second, a second path as a means for minimizing the effects of the counter electromotive force set up in the field coil 34 at the time of the changes made in the power current; third, a positive means for controlling the annoying "load" shocks accompanying a change of power current, and for eliminating danger of sparking across condensers, destroying delicate parts in the closely related sound receiving and transmitting means.

That the second improvement above claimed is a novelty is evident from the discovery that the shunt means is adapted to cushion the effects of changes in field strength transmitted by the field coil 6, both when the switch is put "on" or "off."

Though the total current in the power circuit remains unchanged, the actual current through the field coil is decreased by the "make" of the shunt. This decrease sets up a direct electromotive force in the field coil 34 which assists rather than opposes passage of the decreased current. Instantly following the "make" of the shunted switch, the flow of current through the shunt commences and adjusts itself. This adjustment though instantaneous, takes relatively longer than does the adjustment of current through the coil, because in the coil the E. M. F. set up is direct and assists the passage of a decreased current through the coil. And by the "break" of the shunt, though the power current is increased, the counter E. M. F. opposes the increased flow through the field coil 34, and minimizes impulses to the voice coil.

I claim:

In combination with a speaker for radio and the like, means for generating a magnetic field including a field coil and means for energizing it, a voice coil located within the field means for amplifying audio frequency current for the voice coil independently of the field coil energizing means, and means for muting the speaker including a shunt across the terminals of the field coil, and a manually controlled resistance means for selectively varying the shunt and the field energizing means within the speaker, said resistance means being electrically independent of said amplifying means.

WILLIAM C. ROGERS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,532,513	Pridham	Apr. 7, 1925
1,569,411	Thomas	Jan. 12, 1926
1,992,021	Whelan	Feb. 19, 1935
1,787,392	Moore	Dec. 30, 1930
1,887,065	Pointer	Nov. 8, 1932