Nov. 26, 1935. J. W. MYERS ET AL 2,022,477

OUTPUT REGULATOR

Original Filed April 20, 1929 2 Sheets-Sheet 1

Fig. 1.

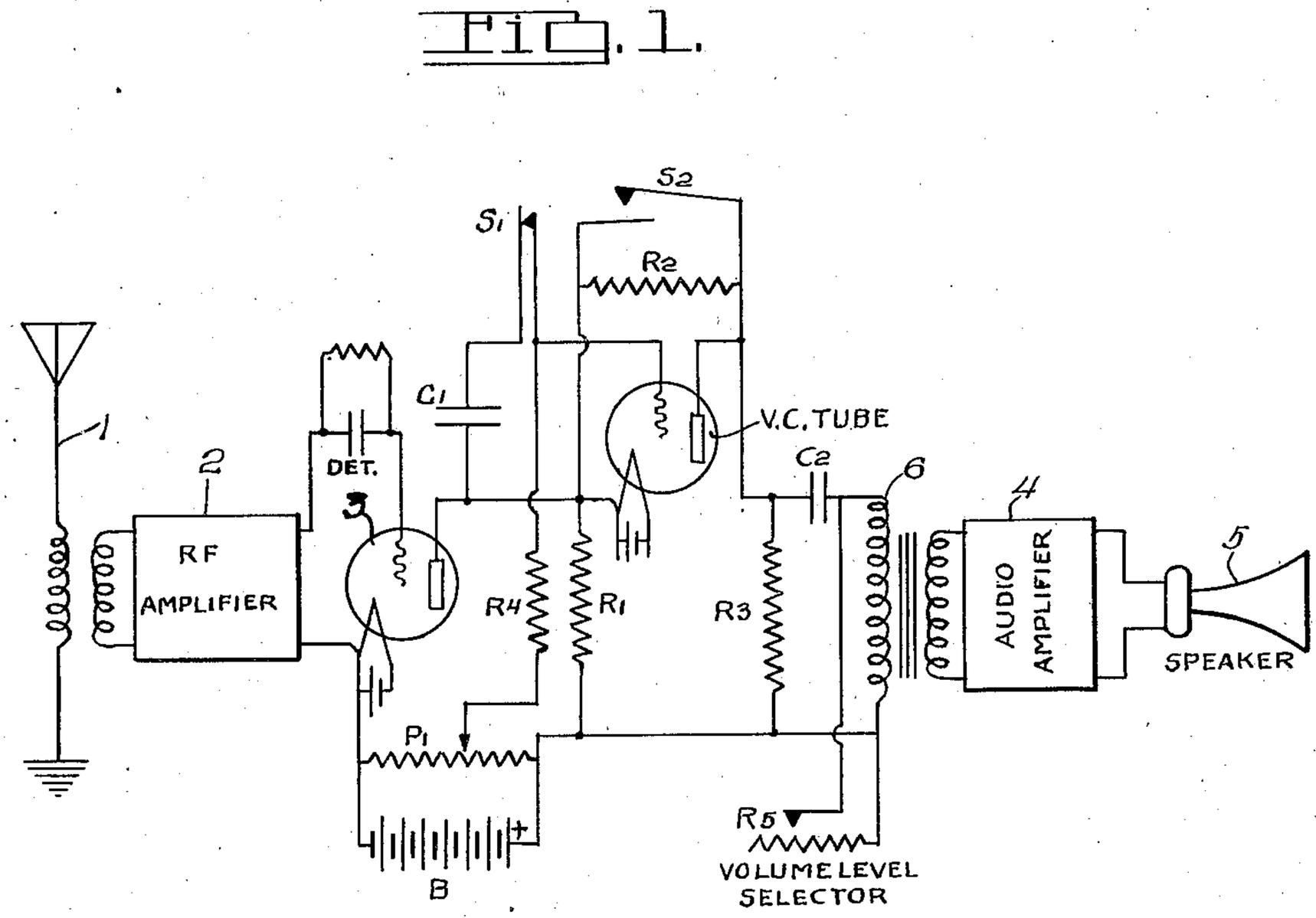
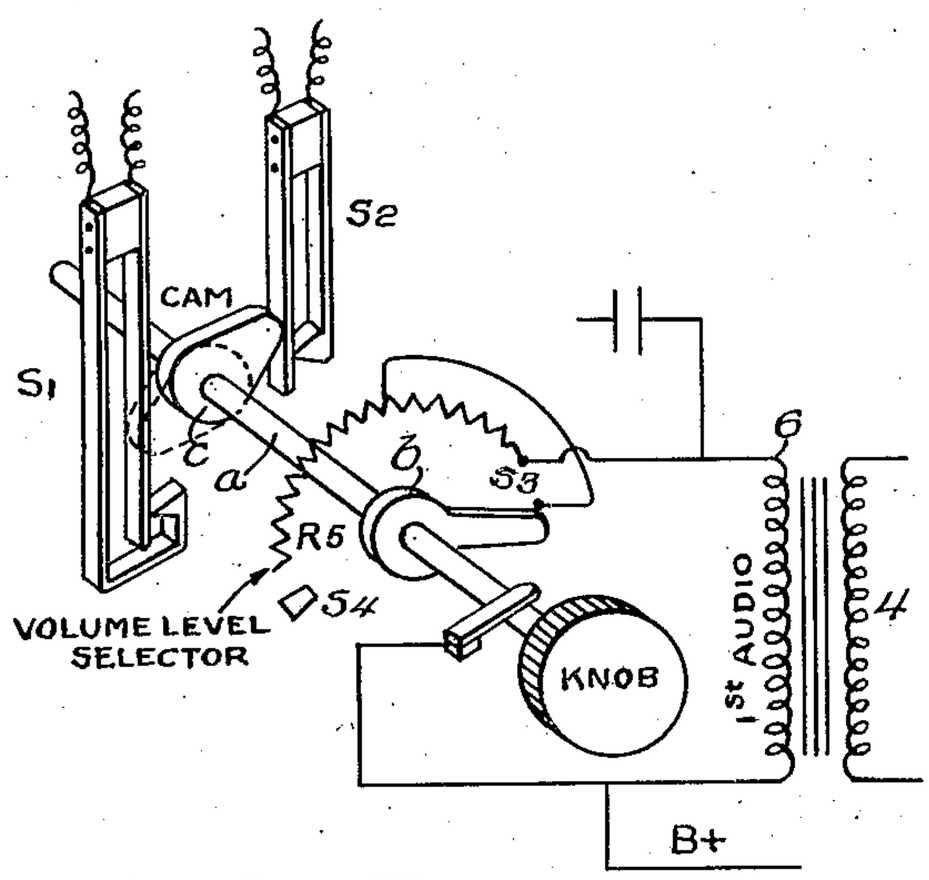


Fig. 3.



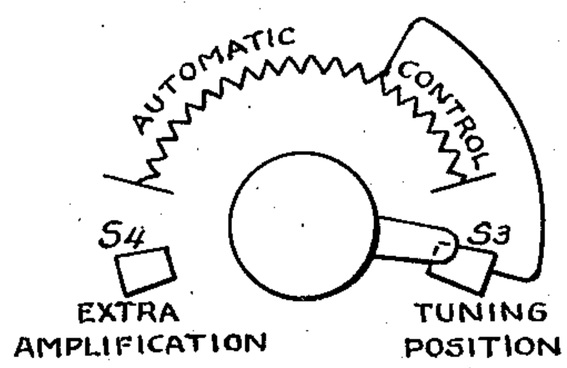


Fig. 2.

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Fig. 4.

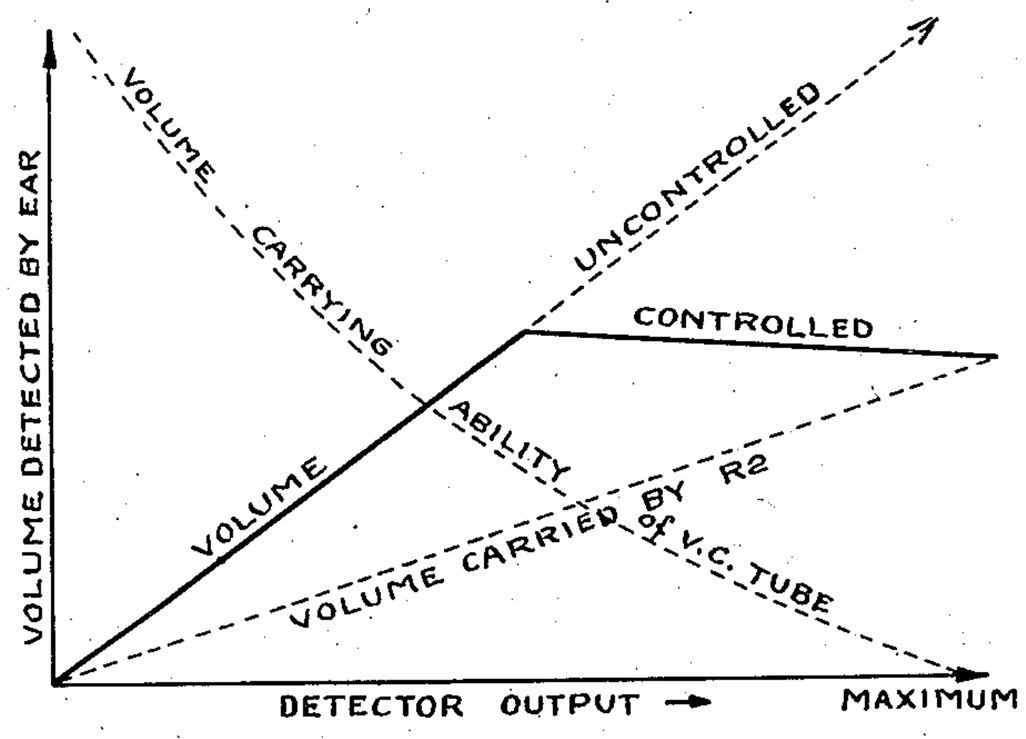
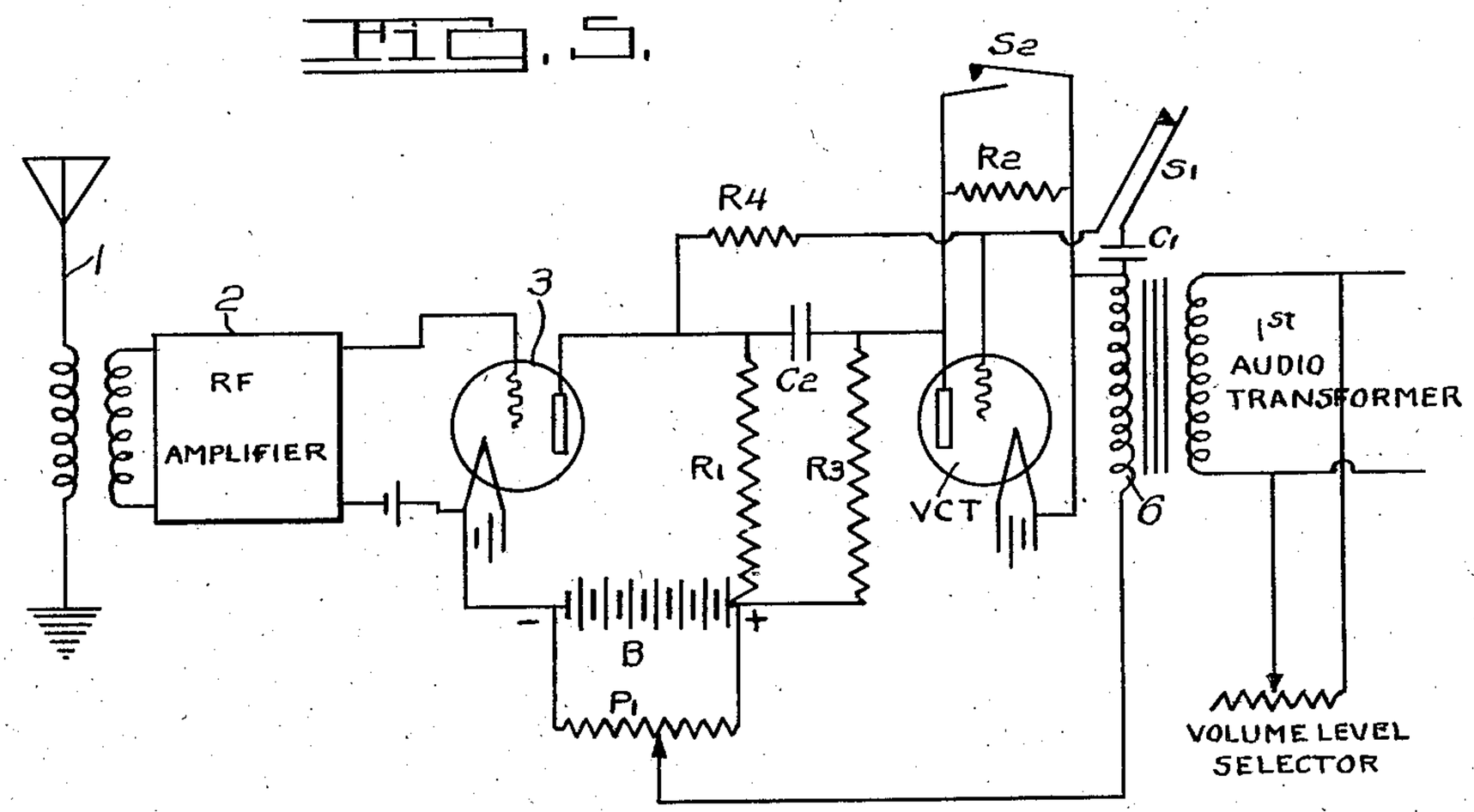


Fig. 5.



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UNITED STATES PATENT OFFICE

2,022,477

OUTPUT REGULATOR

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Application April 20, 1929, Serial No. 356,680
Renewed July 25, 1934

6 Claims. (Cl. 250—20.45)

Our invention relates to a process and apparatus for automatically controlling the output of a radio signal-receiver in which there is a modulated carrier-frequency.

Objects of our invention are:

To maintain a substantially constant signal-level output, even with wide fluctuations in carrier strength above a predetermined minimum;

To provide means which will, while functioning to limit volume at high signal intensities, be capable of increasing volume at low signal intensities;

To suspend automatic control and limit the maximum signal strength, for the purpose of tuning the receiver by ear to complete resonance with the carrier, which may not be easily done if the output regulator is functioning;

To provide an output regulator that shall discriminate accurately as to the carrier input intensities that it will block or pass, thus permitting extremely low frequency modulation and demodulation of a carrier which is otherwise modulated and employed, as for instance a telegraphic code imposed on a frequency carrying a musical program.

Our invention may be used with grid leak and condenser detection or where C-bias or plate detectors are employed.

In the accompanying drawings:

Figure 1 is a diagrammatic representation of an apparatus, with grid leak detection, embodying our invention and that may be used in the process thereof.

Figure 2 is a detail perspective view, partly diagrammatic, of adjusting mechanism.

Figure 3 is a front elevation of the mechanism of Figure 2.

Figure 4 is a diagram illustrating the operation of the apparatus by the coordinates of various curves.

Figure 5 is a view similar to Figure 1, employing C-bias or plate detectors.

1 is an antenna, or source of high frequency energy. **2** is the amplifier for the high frequency energy. **3** is a detector for rectifying the modulated carrier frequency, in the well known manner. R^1 is a high resistance across the rectifier **3**.

VC is the volume-control tube. **4** is an audio-frequency amplifier and **5** is a signal-translating device, such as a loud speaker.

Referring in the first place to Figure 1. The grid of the volume control tube is connected through a condenser C^1 with the plate of the rectifier **3**. S^1 is a switch in said connection. Said grid is connected through a high resistance R^4 with a potentiometer P^1, which is shown as extending across the B-battery, by means of which the voltage of the grid may be selected and maintained.

R^2 is a high resistance interposed in a circuit between the filament and plate of the tube VC and S^2 is a normally open switch by which said resistance may be short circuited.

R^3 is a high resistance connecting the plate of the tube VC with the B-battery. C^2 is a condenser in the line from the plate of the VC tube beyond the resistance R^3 and **6** is the primary of the transformer of the audio-amplifier, connected into the circuit beyond the condenser C^2. R^5 is a variable resistance extending between the ends of the coil **6**. By varying the resistance R^5 the volume passing through the audio-amplifier may be regulated.

The resistance R^5 may be adjusted and the switches S^1 and S^2 may be operated by the apparatus illustrated in Figures 2 and 3, in which *a* is a shaft, which may be rotated by a knob on its outer end. *b* is an arm on the shaft *a*, adapted to make contact with different points along the resistance R^5 and to pass beyond the ends of said resistance. S^3 is a contact point beyond one end of the resistance R^5 and S^4 is an engaging point for the shaft *a*, beyond the other end of said resistance.

The contact point S^3 is connected with a suitable point intermediate the ends of the resistance R^5, as shown in the drawings.

c is a cam upon the shaft *a*, which closes the switch S^2, when said shaft is turned to the position at which the arm *b* engages the contact point S^3, as shown in full lines in Figure 2, and opens the switch S^1 when turned to the position indicated by broken lines in said figure, at which position the arm *b* may engage the point S^4.

The operation of the above described apparatus is as follows:

If we represent the audio-volume by vertical ordinates and the output volume of the detector tube **3** by horizontal ordinates we may represent the volume carrying ability of the tube VC by the broken line curve of Figure 4, and in the same way the carrying capacity of the resistance R^2 would be indicated by the lower slanting broken line. The actual volume carried in the neighborhood of the volume required is represented by the full straight approximately horizontal line which may be obtained by adding the ordinates of the other two lines.

As the volume of the detector tube output increases, the cathode voltage of the VC tube rises,

so that the grid voltage, determined by the connection through R^4, becomes more negative, relative to that of the cathode and the space current capacity of the VC tube is thereby progressively diminished, while the carrying capacity of the resistance R^2 increases as indicated. When the sum of these capacities becomes equal to the volume being transmitted, as indicated by the break in the full straight line, no further increase of transmitted volume will be permitted and the volume transmitted may be somewhat diminished beyond this point, as indicated by the small downward incline of the transmitted volume line beyond the point Z.

If it is desired to tune the apparatus accurately by ear, the shaft *a* is turned until the arm *b* engages the contact point S^3 and the cam *c* closes the switch S^2 thus short-circuiting the resistance R^2 and VC tube.

Should the volume be too small the shaft *a* may be turned until the cam *c* opens the switch S^1 and the VC tube will then amplify the signal current transmitted.

By omitting the high resistance R^2, which may be in practice about 100,000 ohms, it is possible to use the circuit as a high frequency relay, which is quick to respond to small changes in carrier strength. The circuit will pass full carrier strength up to a predetermined amount but with a further slight increase the output of the circuit will drop to practically nothing.

If a C-bias or plate detector is substituted for the grid-leak and condenser detector in Figure 1 and high resistance R^2 is omitted the circuit will function as a relay of opposite characteristics, that is to say the output will be practically nothing until a certain predetermined carrier strength has been reached, at which point the signal will be passed while if the carrier strength falls slightly it will at once disappear entirely. If the signal strength is caused to be slightly raised or lowered at the transmitter, a relay circuit of this type may be used to detect these fluctuations, which may constitute a signal.

What we claim is:

1. In a system passing a modulated carrier wave of varying intensity, a detector tube, a battery circuit joining the filament and plate of said tube and having an impedance therein, and a three electrode control tube having its cathode connected to the plate side of said impedance, and its grid connected into said circuit upon the filament side of said impedance through a resistance and with the plate side of said impedance through a condenser, so as to be at a fixed potential statically but to change its potential dynamically with said cathode so as to permit the cathode to change its operating potential with reference to its grid as the detector plate current changes with carrier wave input, whereby the impedance of said control tube to an audio signal current is altered to compensate for variations in the intensity of the incoming signal modulated carrier wave in the audio frequency circuit.

2. In a signal receiver the combination of a volume control tube, means for short circuiting said tube, a volume adjusting means and means whereby said adjusting means shall operate said short circuiting means when adjusted for a predetermined volume level.

3. In a radio receiver, the combination with a radio frequency amplifier, a detector, and an output device, of receiver volume control means comprising a manually adjustable resistance for determining the audio level at said output device, automatic volume control means for substantially minimizing fading effects due to variations in the strength of received carrier waves, switch means adjustable to control the operation of said automatic means, and a common control member for simultaneously rendering operative both said switch means and said adjustable resistance.

4. In a receiver as defined in claim 3, said adjustable resistance including an intermediate tap and an adjustable element, said common member being adapted to adjust said switch means to position to render said automatic volume control means inoperative when said adjustable element is connected to said tap.

5. In a radio receiver, the combination with a radio frequency amplifier, a detector, and an output device, of receiver volume control means comprising a manually adjustable attenuator resistance connected across the detector output for regulating the audio frequency attenuation between the detector and the output device, means preceding the output device for amplifying received signals, a device for controlling the amplifying operation of said amplifying means, and a common control member for simultaneously operating said controlling device and said adjustable resistance.

6. In a radio receiver, the combination with a radio frequency amplifier, a detector, and an output device, of receiver volume control means comprising a manually adjustable resistance for regulating the audio transmission between the detector and the output device, means preceding the output device for amplifying received signals, a device for controlling the amplifying operation of said amplifying means, and a common control member for simultaneously operating said controlling device and said adjustable resistance, an automatic volume control arrangement for preventing effects due to variations in the strength of receiver carrier waves, a switch means for controlling the operation of said automatic arrangement, and said common member being arranged alternatively to actuate said controlling device or said switch means.

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