

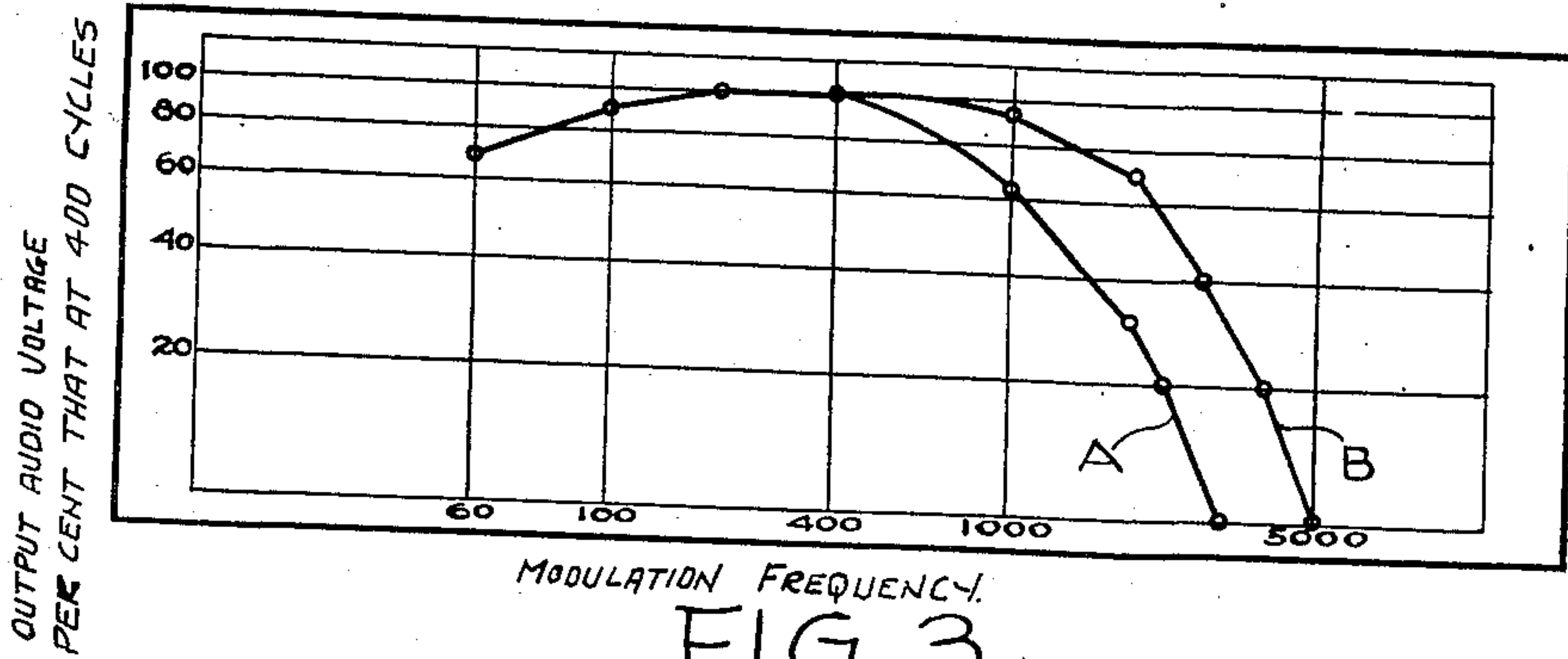
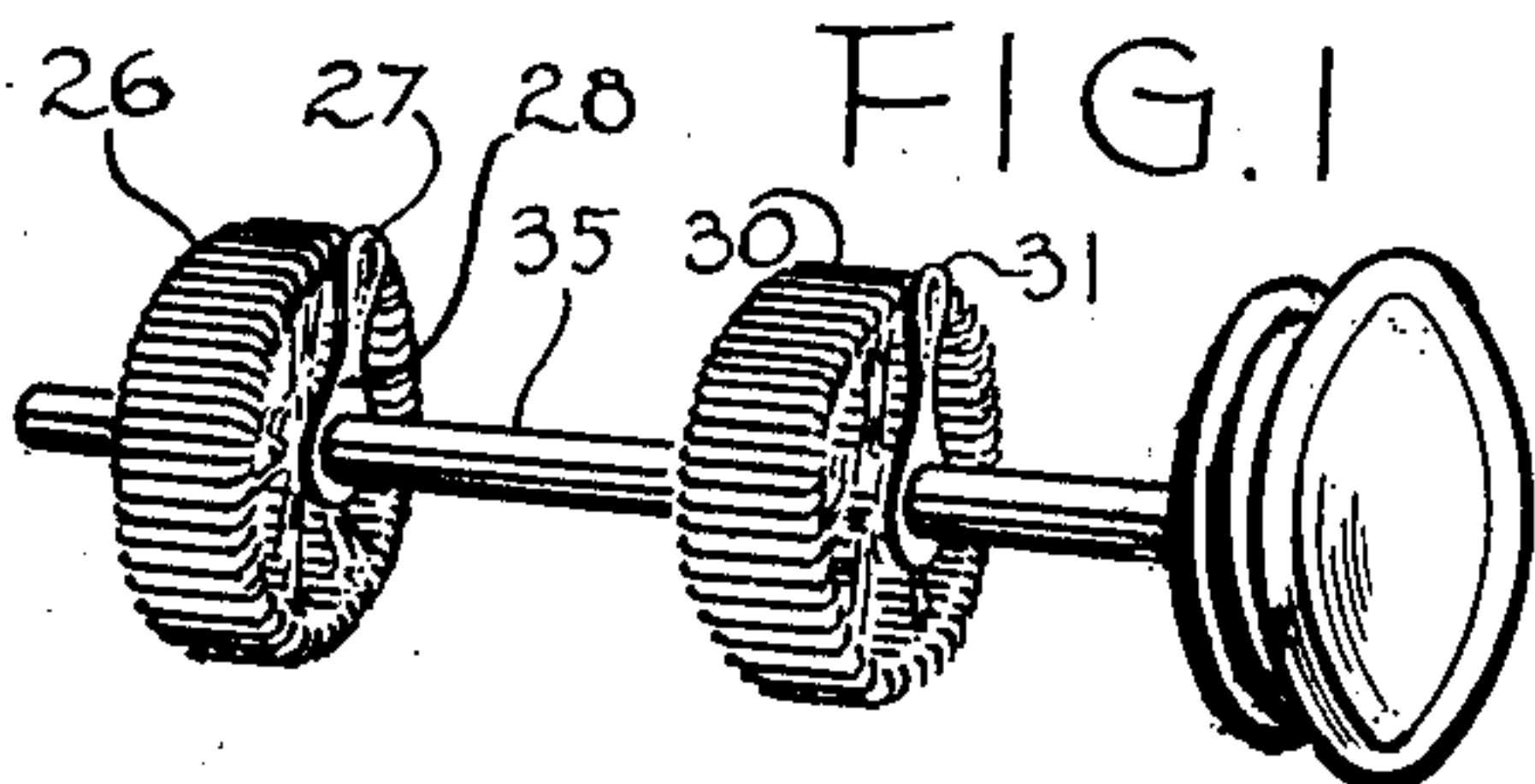
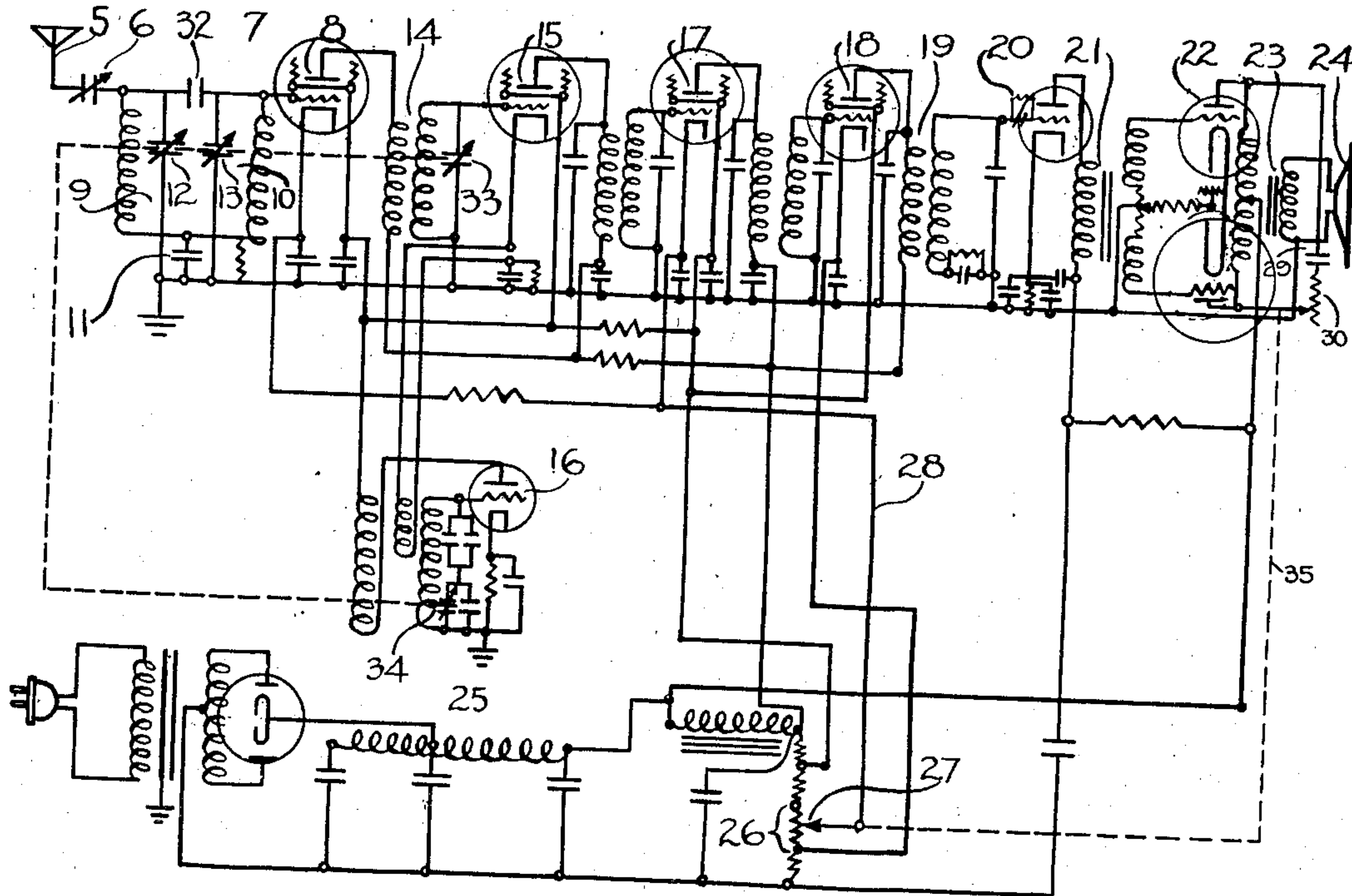
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RADIO SIGNAL RECEIVING SYSTEM

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RADIO SIGNAL RECEIVING SYSTEM

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This invention relates to signaling systems and more particularly to radio signaling systems.

It has been proposed in such systems to provide an arrangement whereby the tone may be controlled by means in which the high, the low, or the intermediate audio frequencies may be reduced in amplitude or minimized at will. Such a tone control device has resulted in an undue emphasis on certain portions of the audio frequency spectrum with the result, for example, if the bass portion of the spectrum is emphasized by the exclusion of the higher frequencies, articulation becomes very poor due to the absence of a large portion of the necessary high audio frequencies, whereas if the so-called high audio frequencies are emphasized due to the exclusion of a portion of the bass, articulation is clear, but the naturalness of tone is destroyed due to the elimination of the low audio frequencies; while if only the intermediate audio frequencies are reproduced both articulation and naturalness of tone are sacrificed.

Following the teachings of the present invention, however, it has been found that in the reproduction of weak radio signals where the maximum sensitivity of the radio receiver is required, the amplification of foreign noises along with the signals results in undesirable effects. It has been found in the reproduction of such weak signals, especially from long distance stations, that the amplitude of the foreign noises may become equal to or greater than that of the desired signal so that satisfactory reproduction of the desired signal is not possible. These foreign noises have been found to predominate at the high audio frequencies.

In accordance with the present invention, it is, therefore, proposed in the case of strong signals to reproduce the audio frequencies of such a signal without any tone control, while in the case of long distance or weak signals where it is necessary to adjust the sensitivity control to increase the sensitivity of the radio receiver, the tone control is rendered effective to by-pass the higher audio frequencies at which the foreign noises predominate. A further feature of the invention includes the provision in a radio receiving system of an interacting sensitivity control device and a tone control device such that when the sensitivity control device is adjusted to approach the maximum sensitivity of the radio receiver the tone control device is effective to by-pass or otherwise eliminate certain of the higher audio frequencies, that is, the relation of the sensitivity control device and the tone con-

trol device are so arranged that the effectiveness of the tone control device is directly proportional to the adjustment of the sensitivity control device for increased sensitivity.

For a clearer understanding of the invention, reference is made to the drawing in which Fig. 1 is a diagrammatic showing of a radio receiving system and a power supply device therefor in which system there are provided a combined sensitivity control device and tone control device of the present invention; Fig. 2 is a view of the combined tone control device and sensitivity control device suitable for use in the system of Fig. 1; and Fig. 3 is a chart indicating the results obtained when the tone control device is effective and ineffective.

Referring especially to Fig. 1, the invention is there shown incorporated in a radio receiver of the so-called superheterodyne type, although it will be understood that it may be applied with equal utility to a radio receiver of the so-called tuned radio frequency type. In this figure, 5 designates an antenna having in series therewith an adjustable capacitor 6. This antenna system is linked by a coupling unit, generally designated 7, to the input of a screen grid radio frequency amplifying stage including a vacuum tube 8 of the screen grid type. It is unnecessary to describe the coupling unit 7 except to state that it comprises two resonant circuits 9 and 10 coupled together by fixed capacitors 11 and 12, the independent coupling of which becomes more effective at lower frequencies and at high frequencies respectively. The resonant circuits 9 and 10 are tuned by two variable capacitors 13 and 14 having their rotors, together with the rotors of capacitors 15 and 16 of the first detector and oscillator, mounted on a common shaft for adjustment from a single control. Thus by means of the amplifying stage just referred to an incoming signal intercepted on the antenna 5, is amplified at its original frequency. The output of the vacuum tube 8 in this stage is coupled by means of the radio frequency transformer 17 to the input of a so-called first vacuum tube detector 18, tuned by capacitor 19, which cooperates with a vacuum tube oscillator 20, tuned by capacitor 21, to translate the frequencies of the incoming signals to a predetermined intermediate frequency in the present instance assumed to be 175 kilocycles.

The incoming signal when its frequency is thus changed is amplified in a multistage intermediate frequency amplifier herein represented as having two amplifying stages, connected in cascade, gen-

erally designated 17 and 18. The incoming signal when amplified to a desired amount in the intermediate frequency amplifier is introduced by a radio frequency transformer 19 into the input circuit of a second vacuum tube detector 20 which functions to translate the signal amplified at intermediate frequencies into audio frequencies corresponding to the modulation of the original selected signal. The output of this last-mentioned detector is coupled by means of an audio frequency transformer 21 to the input of an audio amplifier 22 comprising two vacuum tubes connected according to the well-known push-pull arrangement. The output of the audio amplifier is linked by means of a transformer 23 to a loud speaker generally designated 24.

In the lower left hand corner of this figure, there is represented a power device 25 for supplying cathode, anode and grid voltages to the several vacuum tubes and field voltage for the loud speaker in accordance with the accepted practice.

In the present arrangement, the sensitivity control device, by which the volume or magnitude of the reproduced signal is controlled, comprises means for varying the grid bias of the radio frequency amplifying tube 8 and the grid bias of the first intermediate frequency amplifying tube 17. This means for varying the bias includes a 400 ohm resistor unit 26 engaged potentiometer fashion by a wiper 27 connected over conductor 28 to the grids of the mentioned tubes. Thus when the wiper 27 is adjusted upward (clockwise) as shown in this figure, the negative bias of these grids is decreased and the amplification of these tubes is proportionally increased. Whereas when the wiper is moved downward (counter-clockwise), the negative bias is increased and the amplification of the mentioned vacuum tubes is proportionally decreased.

In accordance with the present invention, it is proposed in the case of weak signals where it is necessary to operate the sensitivity control device so that the mentioned tubes 8 and 17 amplify in the maximum portion of their range, to eliminate certain of the higher frequencies, especially those where foreign noises are particularly disturbing. In order to accomplish this result, an adjustable by-pass network for the higher audio frequencies is incorporated in the audio system of the radio receiver. According to one form, this by-pass includes a fixed capacitor 29 which may be of the value of .1 microfarad in series with an adjustable resistor 30 of a maximum value of 100,000 ohms. This network including the capacitor 29 and the variable resistor 30 in series, are connected across the terminals of the primary winding of the audio transformer 23. The adjustable element or wiper 31 of the resistor 30, however, is so mounted on a shaft 35 in common with the wiper 27 of the resistor 26 that as the wiper 27 is moved upward to decrease the bias on the mentioned amplifying tube and, therefore, increase the sensitivity of the radio receiver, the wiper 31 is moved downward (counter-clockwise) so that the impedance of the resistor tends to render the capacitor 29 ineffective until it is entirely ineffective when the wiper 31 is in the lowermost position, a condition graphically represented by curve B of Fig. 3. However, when the wiper 27 of the sensitivity control device is moved downward to increase the sensitivity of the radio receiver, the wiper 31 is moved upward (clockwise), thereby reducing the impedance of the resistor 30 until

when the wiper is in its uppermost position, the resistor is then completely ineffective. In this condition, the capacitor 29 serves as a by-pass for the higher audio frequencies including the disturbing noise frequencies, which, therefore, do not reach the loud speaker 24 and are not reproduced, as is graphically represented by curve A of Fig. 3. It will be understood that in the chart Fig. 3 the curves are plotted with the ordinates based on the percentage of output audio voltage as compared with that at 400 cycles and with the abscissa based on modulation frequency.

Although the invention has been shown applied to a radio receiver of the superheterodyne type, it will be readily understood how it may be applied to a radio receiver of the tuned radio frequency type since it is merely necessary to so interconnect the existing sensitivity control device of whatever type and the tone control device herein disclosed in such a manner that when the sensitivity control device is turned upward to give an increased sensitivity, the high audio frequency by-pass or tone control device becomes more effective, and when the sensitivity control device is turned down to decrease the sensitivity of the radio receiver, the high audio frequency by-pass or tone control device is rendered less effective until its effectiveness is almost entirely negligible. Also while the tone control device has been shown incorporated in an audio amplifier of the so-called push-pull type, it is also effective in other types of audio amplifiers in which the audio amplifying tubes are connected in tandem by means of audio transformers. In such an arrangement, the tone control device including the capacitor 29 and the variable resistor 30 in series are preferably connected across the terminals of the secondary winding of one of the audio transformers.

While the by-pass network or high audio frequency filter herein disclosed is especially satisfactory, the invention is not limited to this specific form but any type of high audio frequency filter or high frequency tone control device may be employed.

What I claim is:

1. In a radio receiver provided with radio frequency sensitivity control means, a tone control means, means for simultaneously operating said devices to reproduce the higher audio frequencies in inverse proportion to the radio frequency sensitivity of the radio receiver.

2. In a radio receiver, a radio frequency amplifier, a detector and an audio amplifier, a sensitivity control device for determining the amplification of said radio frequency amplifier, a high frequency audio by-pass network in said audio amplifier, and a single actuating means for proportionally changing the adjustment of said sensitivity control device and said by-pass network.

3. In a radio receiver including a radio frequency amplifier a detector, and an audio amplifier linked to said detector by means of a transformer, an adjustable sensitivity control device for said radio frequency amplifier, a tone control device comprising a high audio frequency by-pass network connected across the terminals of said transformer, and means for simultaneously changing the adjustment of said sensitivity control device and said high audio frequency by-pass network.

4. In a radio receiver including a detector and an audio amplifier linked to said detector by means of a transformer, an adjustable sensi-

tivity control device for said radio receiver, a tone control device comprising a high frequency by-pass network connected across the terminals of the primary winding of said transformer, and means for simultaneously changing the adjustment of said sensitivity control device and said high frequency by-pass network.

5. In a radio receiver comprising a vacuum tube amplifier arranged to amplify frequencies above audibility, a detector coupled to said amplifier, an audio amplifier linked to said detector by a transformer, a sensitivity control device for said first-mentioned amplifier, a tone control device comprising a capacitor and an adjustable resistor connected in series across the terminals of said transformer, and means for simultaneously changing the adjustment of said sensitivity control device and said resistor.

6. In a radio receiver comprising a vacuum tube radio frequency amplifier, frequency translating means for translating a signal amplified by said amplifier to an intermediate frequency, an intermediate frequency amplifier coupled to said translating means, a detector coupled to said intermediate frequency amplifier, an audio frequency amplifier coupled to said detector by an audio transformer, a sensitivity control device for said radio frequency amplifier and said intermediate frequency amplifier, a tone control device in said audio amplifier, and common means for simultaneously changing the adjustment of said sensitivity control device and said tone control device.

7. In a radio receiver comprising a vacuum tube radio frequency amplifier, frequency translating means for translating a signal amplified by said amplifier into an intermediate frequency, an intermediate frequency vacuum tube amplifier coupled to said frequency trans-

lating means, a detector coupled to said intermediate frequency amplifier, an audio frequency amplifier coupled to said detector by an audio transformer, a sensitivity control device including means for varying the bias on the vacuum tubes of said radio frequency amplifier and said intermediate frequency amplifier, a tone control device comprising a capacitor and an adjustable resistor connected in series across the terminals of said transformer, and means for simultaneously changing the adjustment of said sensitivity control device and said resistor.

8. In a modulated carrier wave receiver, the combination with a high frequency amplifier, a detector, an audio frequency amplifier, and means for controlling the amplification of said high frequency amplifier, of a tone control for regulating the transmission of audio frequency currents, and means interconnecting said amplification control means and said tone control for simultaneous operation, said interconnecting means being arranged so as to operate the amplification control means to increase the amplification factor while simultaneously operating the tone control means to diminish the transmission of high audio frequencies and vice versa.

9. In a modulated carrier wave receiver, the combination with a high frequency amplifier, a detector, an audio frequency amplifier and means for controlling the amplification factor of said high frequency amplifier, of a tone control for regulating the transmission of audio frequency currents, and means interconnecting said amplification control means and said tone control means for varying the width of the band of reproduced audio frequencies inversely as the magnitude of received radio frequency signal energy.

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