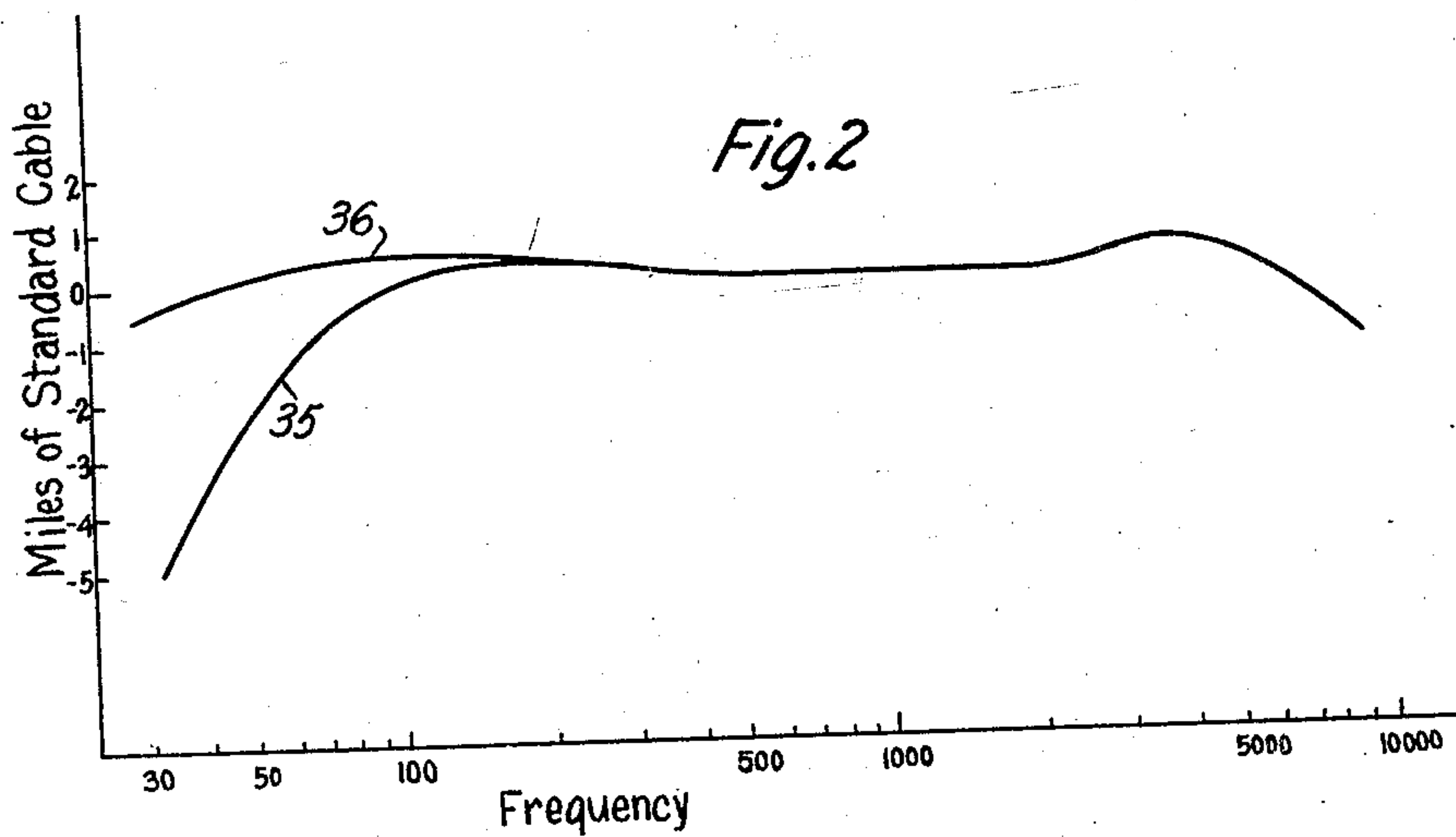
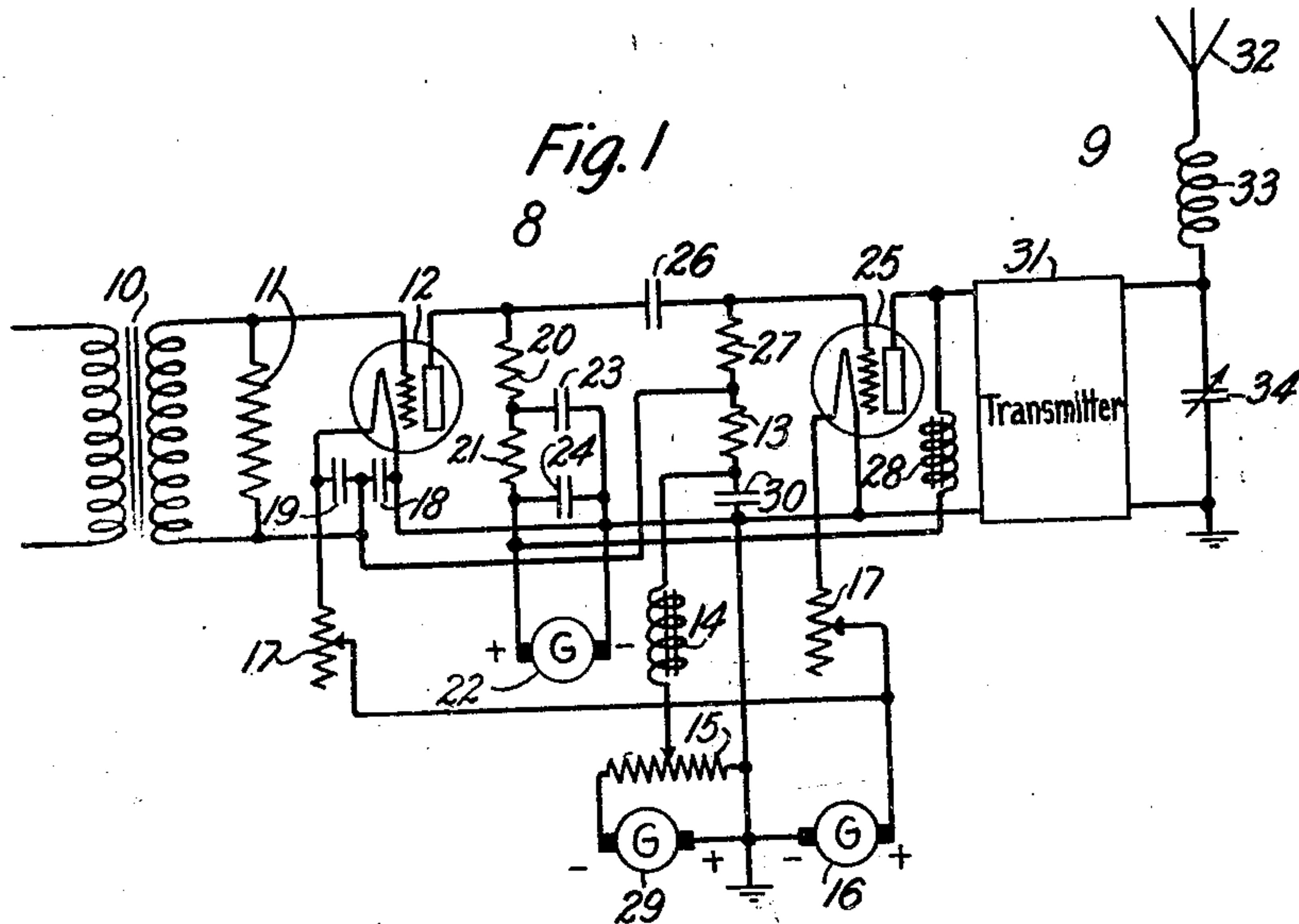


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O. O. CECCARINI
SIGNAL TRANSMISSION SYSTEM

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UNITED STATES PATENT OFFICE

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SIGNAL-TRANSMISSION SYSTEM

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This invention relates to signal transmission systems and more particularly to means for equalizing the attenuation of signal waves in transmission paths.

Heretofore, numerous arrangements and devices have been devised for the purpose of enabling signal waves to be transmitted over paths having frequency selective properties without unfavorable discrimination between components of different frequencies composing the transmitted waves. A general principle which has been applied in many systems includes the idea of compensating in some manner for the unequal attenuation of signal components to produce a uniform attenuation of all the components.

The present invention provides an arrangement operating according to the general principle referred to above and adapted to produce results not obtained with the arrangements hitherto known.

An object of this invention is to equalize the attenuation of different components of signal waves in transmission paths.

A further object is to produce equalized attenuation of signal waves by changing the relative transmission level of certain components of the waves with respect to the level of other components of the waves.

An additional object is to eliminate irregularities in the transmission of signal wave components and to prevent the introduction of undesired variations in the signal waves.

A further object is to equalize the transmission of signal components in a path including space discharge tubes and to prevent the introduction of extraneous variations in the transmitted waves by variations in the energy sources of the tubes.

A feature of the invention relates to a selective attenuating path included in a radio transmitter for equalizing the attenuation of signal wave components.

A further feature is the provision of an impedance and a condenser in shunt thereto for equalizing the attenuation of waves transmitted through a system of space discharge tubes and arranged also to cooperate with certain other elements to filter out rip-

ples in the current supplied to the tubes by an energizing source.

A further feature is a system of space discharge amplifiers coupled by an element having the property of differently attenuating components of waves transmitted through the amplifiers to compensate for unequal attenuation of other portions of the system.

This invention provides broadly a selectively attenuating impedance network, included as an element of a system of space discharge tubes. The network is such that its impedance varies inversely with frequency over a given range and in one case it may consist of a resistance, a portion of which is shunted by a condenser, included in the path between certain electrodes of the space discharge tubes. The condenser may also be and preferably is arranged so as to form an element of a filter for a space current source, for example, a direct current generator. The network functions to compensate for the attenuation of the rest of the circuit and thereby renders the attenuation of all frequencies uniform. As illustrated, the network is included in the audible frequency circuit of a radio broadcasting transmitter.

In the drawings: Fig. 1 illustrates a radio transmitter embodying the invention,

Fig. 2 is a graph illustrating the effect of the network when employed in the circuit of Fig. 1.

The circuit illustrated in Fig. 1 includes an audible frequency portion 8 and a high frequency portion 8 includes transformer 10 and space discharge tubes 12 and 25 with their associated circuits and apparatus. The high frequency portion 9 includes the transmitter 31 and antenna circuit 32, 33, 34. The input transformer 10 is preferably of the step-up type with a magnetic core and has terminals associated with its primary winding for connection to any source of signals such as a microphone circuit, a wire line or the like. This secondary winding of transformer 10 may be shunted by a resistance 11 and is included in the input circuit of the space discharge amplifier tube 12.

This circuit is connected between the tube control electrode and cathode and may be traced from the control electrode through the secondary winding of transformer 10 and resistance 11 in parallel, resistance 13, choke coil 14, potentiometer 15 to ground at the cathode of the tube. The adjustable potentiometer resistance 15 is supplied with current by a direct current generator 29 to apply a suitable average potential upon the control electrode of tube 12. A by-path for signal frequency waves is provided by condensers 18 and 19, the adjacent plates of which are connected to the terminal of the secondary winding of transformer 10 opposite to that connected to the tube control electrode and the opposite plates of which are respectively connected to the tube cathode.

A space current circuit for tube 12 is connected to its anode and cathode and includes resistances 20 and 21 in series with a space current generator 22. Resistance 21 is shunted by a condenser 23 and generator 22 is directly shunted by a second condenser 24. The anode of tube 12 is coupled to the control electrode of space discharge tube 25 by a condenser 26. In addition, a suitable average potential is impressed upon the control electrode of tube 25 by means of potentiometer 15. The circuit over which this potential is impressed is as follows: control electrode of tube 25, resistance 27, resistance 13, choke coil 14, potentiometer 15 to ground at the cathode of tube 25. Choke coil 14 and a condenser 30 are provided to filter out undesired variations in the voltage supplied by generator 29.

Heating current for the cathodes of tubes 12 and 25 is supplied by a generator 16 to which the cathodes of the tubes are connected in parallel, each cathode having connected in series therewith an individually adjustable resistance 17. The anode and cathode of tube 25 are connected to an external space current path including a signal frequency choke coil 28 in series with generator 22, and also to the input terminals of a radio transmitter circuit represented by block 31. This circuit may be of any desired type such as in general, like that disclosed in Patent No. 1,442,146 issued to R. A. Heising January 16, 1923. This radio transmitter may be connected to antenna 32 through a circuit including in series an inductance 33 and adjustable condenser 34, the antenna circuit being connected to ground.

The resistances 20 and 21 and the condenser 23, which constitute an impedance network, are preferably so proportioned relatively to one another that the impedance of the network for a given band of frequencies varies inversely with frequency. The condensers 23 and 24 and resistance 21 also constitute elements of a filter for suppressing ripples in the current supplied by generator 22.

It is a characteristic of space discharge tube systems, particularly when they include elements of large inductance, to cause unequal attenuation of wave components of different frequencies transmitted there-through. For example the magnetic core transformer 10 and the low frequency choke coil 28 in combination with amplifiers 12 and 25 tend to cause unequal attenuation of signal waves in the circuit. Since the amplifiers 12 and 25 amplify the signal wave components of different frequencies substantially equally the resultant waves supplied to transmitter 31 would be distorted were it not for the action of the equalizers 20, 21, 23, in compensating for the unequal attenuation.

The operation of the invention will be better understood by reference to the graph of Fig. 2 wherein the curve 35 represents approximately the relative attenuation characteristic for different frequency components of a circuit, similar to that illustrated in Fig. 1, which does not include the resistances 20 and 21 and condenser 23. For frequencies from 30 to 100 cycles the attenuation of the circuit is much greater than for frequencies from 100 cycles to 5,000 cycles. In order to equalize the attenuation over the range from 30 to 100 cycles, for example, the network including resistances 20 and 21 and the condenser 23 is provided. The effect of this network upon the attenuation characteristic of a circuit such as shown in Fig. 1 is illustrated approximately by the curve 36 of Fig. 2. These curves 35 and 36 represent the relative attenuation rather than the absolute attenuation of the circuit. Curve 36 shows that the variation in attenuation over the range of frequency from 30 to 5,000 cycles, when the network 20, 21, 23 is employed, is only about one-fifth as great as the corresponding variation when frequencies of the same range are supplied to a similar circuit which does not include the attenuation equalizing network.

In a practical circuit in which the invention was embodied the elements of the attenuation equalizer which were found to give results proportionate to those illustrated by the curves of Fig. 2, had the following values: resistance 20—5,000 ohms, resistance 21—25,000 ohms, condenser 23—0.5 microfarad, condenser 24—1.0 microfarad. The generator 22 supplied current at a potential of 2,000 volts. The tube 12 had an impedance measured between its cathode and anode of approximately 5,000 ohms. The voltage supplied to the control electrode of the tube by potentiometer 15 was approximately 70 volts.

Although this invention has been described in connection with a specific circuit arrangement, it is clear that the principles

involved are capable of application to numerous other arrangements and accordingly this invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. A system for transmitting a wide band of frequencies comprising an electric discharge device having an anode and a cathode, and a non-resonant impedance network connected between the anode and cathode and comprising only resistance and capacity elements, said elements being so proportioned as to give said system an overall frequency-transmission characteristic which is substantially uniform throughout said band of frequencies.

2. An amplifier circuit for amplifying a wide band of frequencies in the audio-frequency range comprising an electric discharge device having an input circuit and an output circuit, an electrical source for supplying direct current to said output circuit, and a network connected in series with said source, said network comprising a resistance element and a capacity element connected effectively in shunt thereto, these elements being so proportioned with respect to one another and to the impedance characteristics of the remainder of the circuit as to give said circuit a substantially uniform frequency-transmission characteristic throughout said band of frequencies.

3. An amplifier circuit for amplifying a band of frequencies of which the ratio of the higher frequency to the lower frequency is of the order of 150 to 1 comprising an electric discharge device having an input circuit and an output circuit, an input transformer associated with said input circuit and a non-resonant network connected in shunt to said output circuit and comprising a capacity element and a plurality of resistance elements to the exclusion of inductance elements, one of the resistance elements being connected in series with a parallel circuit comprising the capacity element and another of the resistance elements, these elements being so proportioned with respect to one another and to the impedance characteristics of the remainder of the circuit as to give an amplification which is substantially uniform throughout said band of frequencies.

4. An amplifier circuit for amplifying a band of frequencies of which the ratio of the lower frequency to the higher frequency is of the order of 150 to 1 comprising an electric discharge device having an input circuit and an output circuit, a source of space current for said circuit, and a network connected in series with said source in said output circuit to prevent fluctuations in the space current, said network comprising a capacity element and a plurality of resistance elements, one of the resistance ele-

ments being connected in series with a parallel circuit comprising the capacity element and another of the resistance elements, these elements being so proportioned with respect to one another and the impedance constants of the circuit as to give an amplification which is substantially uniform throughout said band.

In witness whereof, I hereunto subscribe my name this 12th day of June, A. D., 1925.

OLINDO O. CECCARINI.

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