July 16, 1940. R. BLACK, JR 2,208,206

INTELLIGENCE TRANSMITTING CIRCUIT

Filed May 19, 1938

FIG. 1

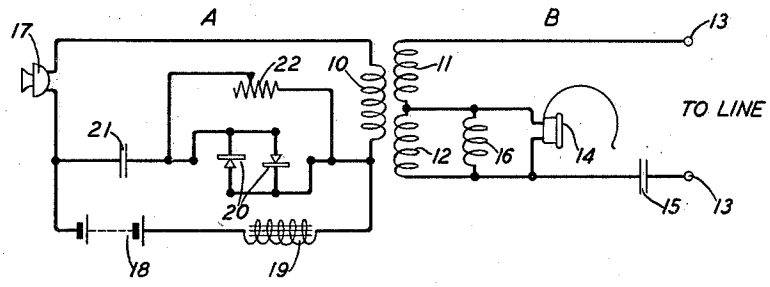
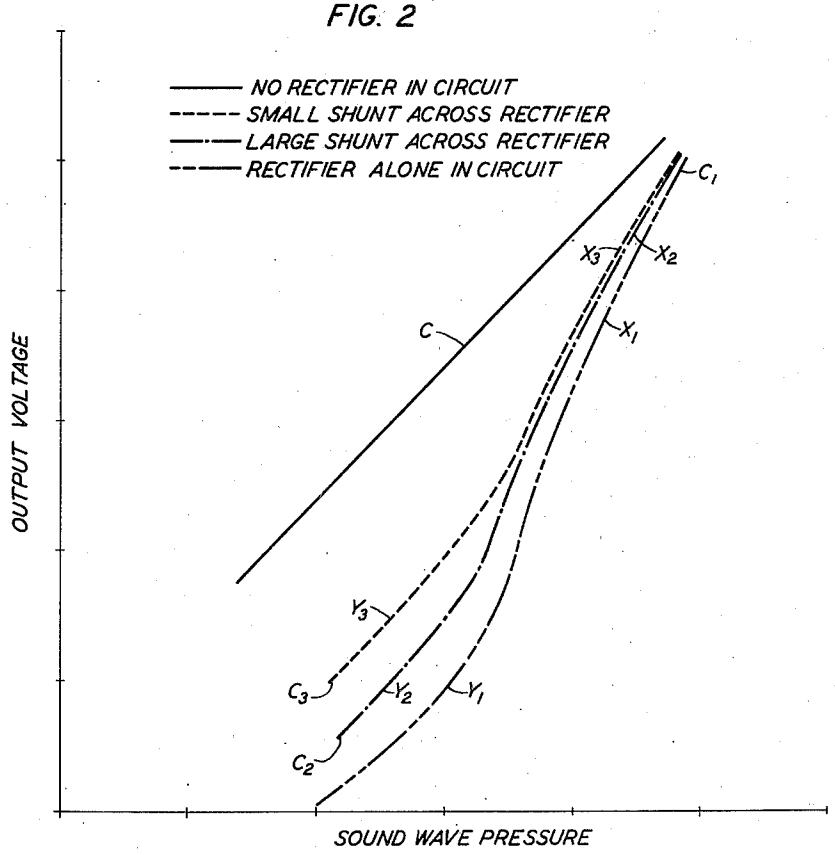


FIG. 2



INVENTOR
R. BLACK, JR.

BY

Walter C. Kiesel
ATTORNEY

Patented July 16, 1940

2,208,206

UNITED STATES PATENT OFFICE

2,208,206

INTELLIGENCE TRANSMITTING CIRCUIT

Robert Black, Jr., Maplewood, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application May 19, 1938, Serial No. 208,770

13 Claims. (Cl. 179—81)

This invention relates to intelligence transmitting circuits and more particularly to telephone operators' circuits.

Telephone substation and operators' circuits, as is known, include a transmitter or microphone having a vibratile element, such as a diaphragm, responsive to pressure waves, the transmitter or microphone functioning to translate sound waves into corresponding voltage variations in the telephone circuit. The magnitude of such variations is generally directly dependent upon the intensity or pressure of the waves acting upon the vibratile element or diaphragm, throughout a fairly wide range of pressures so that faithful translation of speech may be obtained by a number of users of the same instrument and for different intensities of speech. However, in some installations, such as in central offices, the transmitter is operated in a field of extraneous pressure waves, attributable to room and other noises, which produce corresponding variations in the voltage across the output terminals of the circuit. These variations may interfere with the intelligibility of the speech being transmitted and may result in low fidelity and unfaithful transmission. Consequently, entirely clear communication between the operator and, for example, a subscriber may not be attained. In addition, such variations may introduce objectionable side tone effects in the operator's circuit and thereby interfere with reception by the operator of speech over the telephone line.

One general object of this invention is to improve the intelligibility of speech transmission in telephone circuits.

More specifically, one object of this invention is to discriminate between sound waves corresponding to the speech to be transmitted and other waves attributable to extraneous noises whereby the sound waves will be translated with high fidelity and waves attributable to room noises will be materially or entirely suppressed.

In accordance with one feature of this invention, a device having a non-linear resistance characteristic, such as a copper oxide rectifier element, is associated with the transmitter so that the translation or input-output characteristic of the circuit is altered and the efficiency of translation at pressures corresponding to undesired and extraneous noises is reduced.

In accordance with another feature of this invention, means, such as a device having a substantially linear resistance characteristic, is connected in circuit with the rectifier element for allowing alteration of the input-output characteristic of the circuit to obtain most faithful translation of speech and maximum suppression, in effect, of extraneous noises, for the particular locations at and the particular conditions under which the transmitter is operated.

The invention and the foregoing and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a circuit diagram illustrating an operator's circuit illustrative of one embodiment of this invention; and

Fig. 2 is a graph showing typical translation characteristics obtainable, in accordance with this invention, for the operator's circuit illustrated in Fig. 1.

Referring now to the drawing, the telephone operator's circuit shown in Fig. 1 comprises a transmitter mesh A and a receiver mesh B, including and coupled by an induction coil having three windings 10, 11 and 12. The receiver mesh B has terminals 13 adapted to be connected to a telephone line, and includes a receiver 14 connected across the winding 12, a condenser 15 in series with the windings 11 and 12, and one winding 16 of a repeater coil, connected in shunt with the receiver 14. The receiver 14 may be of any well-known type and construction.

The transmitter mesh A comprises a transmitter 17, a source, such as a battery 18, and a suitable retardation coil 19, defining a series circuit with the winding 10. The transmitter may be of any type and construction. For example, it may be a carbon granule transmitter of the general construction disclosed in Patent 2,042,822, granted June 2, 1936, to Arthur F. Bennett and William L. Tuffnell.

When the vibratile element or diaphragm of the transmtter 17 is actuated by sound waves, corresponding variations in the voltage across the winding 10, and hence across the output terminals 13, are produced, the magnitude of the variations being dependent upon the intensity of the sound waves. In a particular and typical operator's circuit, the voltage across the terminals 13 varies substantially linearly with wave pressure as indicated by the line C in Fig. 2, wherein the abscissae represent sound wave pressures and the ordinates represent voltages across the output terminals 13. The slope of the line C is substantially unity. That is, the line is at substantially 45 degrees, so that substantially equal increments in voltage result from similar increments in sound wave pressure, throughout a wide range of pressures.

In some installations, as noted heretofore, for example, in central offices, the transmitter is operated in a field of sound waves attributable to extraneous and room noises. Some of these waves act upon the diaphragm or vibratile element of the transmitter 17 and produce corresponding variations in the potential across the output terminals 13. These variations alone or superimposed upon the variations resulting from speech waves translated by the transmitter may produce objectionable disturbances in the telephone line, cause distortion in the speech translated, and hence may result in a decrease in the quality of the speech transmitted. It has been ascertained that generally most of the sound waves attributable to extraneous and room noises and resulting in the effects noted above are of relatively low pressures as compared with those ordinarily and usually produced by a person speaking into the transmitter.

In accordance with this invention, the objectionable effects of extraneous and room noises are overcome in a large measure by altering the input-output characteristic of the circuit so that, in effect, a discrimination between such noises and the sounds to be transmitted is obtained. In one illustrative embodiment, shown in Fig. 1, a device having a non-linear resistance characteristic is connected in circuit with the transmitter for thus altering the input-output characteristic.

Specifically, this device may comprise one or more dry disc rectifier units 20, such as copper-copper oxide rectifier units, the resistance of which, as is known, decreases as the potential across the terminals thereof increases. As illustrated in Fig. 1, two rectifier units connected in opposing multiple and across the source 18 and coil 19, may be employed. A condenser 21 preferably is connected in series with the rectifier units in order to prevent the flow of a direct current through the rectifier.

It has been found that when suitable rectifiers are thus connected, as shown by the line C_1 in Fig. 2, the input-output characteristic of the operator's circuit includes two portions, X_1 and Y_1, having markedly different slopes. For example, at low pressures the slope of the characteristic, as indicated by the portion Y_1, may be substantially unity or less than unity whereas at higher pressures, as indicated by the portion X_1, the slope is greater than unity. Consequently, at higher pressures, which are those most generally prevalent as produced by the sound to be translated, the voltage variations across the output terminals 13 are considerably greater per unit of pressure increment, than the variations corresponding to equal increments in the low pressure range, wherein, as noted heretofore, the waves attributable to extraneous and room noises are found. Hence, in effect, a discrimination between the desired sound pressures and the undesired noise pressures is obtained.

It will be noted also, by comparison of the lines C and C_1, that although the use of the rectifier units results in some decrease in the efficiency of the circuit, the decrease is much more pronounced at the lower pressures than at the higher.

The decrease in efficiency and also the extent of the range of pressures against which discrimination is effected may be controlled in accordance with the invention by providing a linear resistance element 22 in shunt with the rectifier units. The effects of a shunt linear resistance upon the input-output characteristic are illustrated by the lines C_2 and C_3 in Fig. 2, each of which includes a substantially linear portion (Y_2 or Y_3) of substantially unity slope and a slightly concave upward portion (X_2 or Y_3) having a slope greater than unity. In the specific circuits utilized, the shunt linear resistance resulting in the characteristic illustrated by the line C_2 was fairly large (of about 450 ohms) and that resulting in the characteristic illustrated by the line C_3 was smaller (of about 200 ohms).

From these lines, it will be seen that the magnitude of the shunt linear resistance 22 affects the efficiency of the circuit and also determines the slope of the upper portion of the characteristic so that it allows determination of the range of pressures against which discrimination is desired. The range of pressures corresponding to extraneous and room noises will vary with locations of the transmitter. The resistance 22 may be variable and adjusted so that maximum suppression, in effect, of the noises at any particular location is attained.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims. For example, although the non-linear resistance device has been described as comprising copper-copper oxide rectifier units, other devices having similar properties may be employed.

What is claimed is:

1. A telephone circuit comprising a series circuit including a telephone transmitter of the carbon granule type, a battery and an output coil, and a branch circuit including a condenser and a non-linear resistance in series, said branch circuit having one end connected to a point between said transmitter and said battery and the other end connected to a point between said battery and said coil.

2. A telephone circuit comprising a closed series circuit including a telephone transmitter and a biasing source for said transmitter, and a circuit in shunt with said source including a blocking condenser and a pair of rectifiers connected in opposing multiple and in series with said condenser.

3. A telephone circuit in accordance with claim 2 comprising a linear resistance in shunt with said rectifiers.

4. In an operator's circuit, a closed transmitter mesh comprising an output coil, a telephone transmitter and a two-way non-linear resistance all connected in series, a source of current for said transmitter connected across points in said mesh on opposite sides of said resistance, and a blocking condenser between said source and said resistance.

5. In an operator's circuit, a transmitter mesh as defined in claim 4 including a linear resistance in shunt with said non-linear resistance.

6. An intelligence transmitting circuit comprising a mesh including a transmitter and an output element, said transmitter being operable to translate sound waves into electrical impulses and thereby to produce variations in the voltage across said element, means for decreasing the efficiency of said transmitter, as determined by relative voltage changes across said element with respect to sound wave pressures at said transmitter, non-uniformly throughout a range of sound wave pressures, the decrease being greatest

throughout a range of low wave pressures, and means for varying the decrease in efficiency.

7. A telephone circuit comprising a transmitting circuit including an output element and a transmitter operable to translate sound waves into voltage variations across said output element, said transmitter having a rising wave pressure-output voltage characteristic, the output voltage being measured across said element, means in circuit with said transmitter for increasing the slope of said characteristic through a portion thereof without altering the slope of a lower portion thereof, whereby substantial discrimination between pressures corresponding to said portions is effected, and means for altering the slope of said first portion.

8. In an operator's circuit, a transmitter mesh including a transmitter in series with a pair of unidirectional non-linear resistances connected in opposing multiple.

9. In an operator's circuit, a transmitter mesh in accordance with claim 8 comprising a linear resistance in shunt with said non-linear resistances.

10. In an operator's circuit, a transmitter mesh including an output winding, a source of current and a transmitter in series, and a shunt path across said transmitter and said winding including a pair of copper oxide rectifiers connected in opposing multiple and a blocking condenser in series therewith.

11. In an operator's circuit, a transmitter mesh in accordance with claim 10 comprising a linear resistance directly in shunt with said rectifiers.

12. In an operator's circuit, a series circuit including a transmitter, a source of current and an output element, and a branch circuit having one end connected between said transmitter and said source and the other end connected between said source and said element, said branch circuit including a pair of unidirectional non-linear resistances connected in opposing multiple.

13. In a telephone operator's circuit, a circuit including a transmitter, a source of direct current and a winding of an induction coil serially connected, and a branch circuit having one end connected between said transmitter and said source and the other end connected between said source and said coil, said branch circuit including a unidirectional non-linear resistance and a linear resistance in shunt thereto.

ROBERT BLACK, JR.