April 22, 1924. 1,491,170

K. ROTTGARDT

VARIABLE ELECTRIC RESISTANCE

Filed Dec. 5, 1921

Fig. 1.

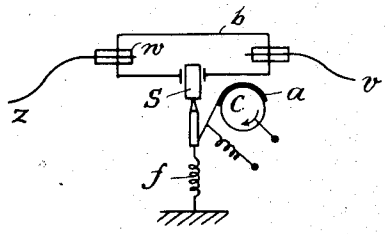
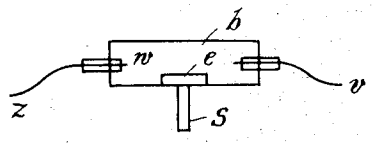


Fig. 2.



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UNITED STATES PATENT OFFICE.

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VARIABLE ELECTRIC RESISTANCE.

Application filed December 5, 1921. Serial No. 519,922.

To all whom it may concern:

Be it known that I, KARL ROTTGARDT, engineer, residing at Dahlem, near Berlin, Germany, have invented certain new and useful Improvements in Variable Electric Resistance, of which the following is a specification.

The invention relates to variable electric resistance devices, and is directed, more particularly, to improvements in microphonic repeaters.

The object of the invention is the provision of a microphonic repeater or amplifier which will function without distortion, or at least with less distortion than results from similar devices heretofore known.

It is well known that acoustic diaphragms of all types have natural periods and that they respond to and reproduce sound waves of different frequencies with different degrees of efficiency and that on this account it is impossible to reproduce sound extending over a wide range of the musical scale with anything like exactness.

When, for example, sound waves are impressed upon a transmitter having an acoustic diaphragm and then reproduced by a receiver likewise having an acoustic diaphragm, some of the notes are distorted both at the transmitter and at the receiver, due to the fact that the diaphragms of both the transmitter and receiver do not respond in proper proportion to those notes. If, then, a microphone repeater including a diaphragm is interposed in the transmission line between the transmitting and receiving stations, it is evident that still further distortion is likely to result from the same inherent defect in the repeater diaphragm. Thus it will be seen that if several such repeaters were interposed in the line, the distortion might be carried to such an extent that the signals would become unintelligible. The present invention does not aim to eliminate the diaphragms at the transmitting and receiving stations, but it does contemplate the elimination of the diaphragms at the intermediate repeating stations so that the distortion which would otherwise result therefrom is substantially or entirely eliminated at these repeating stations.

In its preferred embodiment the invention contemplates the provision of a microphonic repeater comprising a receptacle containing carbon granules or other equivalent variable resistance material and a plunger adapted to oscillate in response to electrical signaling impulses, such as voice currents, and to thereby vary the pressure between the carbon granules, thus effecting resistance variations corresponding with the electrical signaling waves. In other words, the repeater element of this invention is a carbon microphone in which a plunger is substituted for the usual diaphragm—the plunger having no natural operating period as in the case of the diaphragm. A device of this kind is incapable of responding to sound waves with sufficient energy to render it useful as a transmitter, but in combination with a relay of the type described in British Patent No. 144,761, it is capable of operating efficiently as a repeater.

In the accompanying drawing,

Fig. 1 is a diagrammatic illustration of one embodiment of the invention; and

Fig. 2 is a diagrammatic illustration of an alternative embodiment.

b is a receptacle, preferably of non-conducting material, into which the terminals of conductors V and Z extend. The space W within the receptacle *b* is filled with carbon granules or equivalent material, and a plunger S is arranged so that it may be freely oscillated to effect changes of pressure between the carbon granules and thus effect corresponding resistance variations between the terminals of the conductors V and Z. It will be seen that the plunger S performs the same function as the diaphragm of an ordinary microphone, but this plunger has no effective natural period. The relay which is arranged to operate the plunger S in response to electrical voice signals and the like which it is desired to repeat, consists of a constantly rotating disc C which, as is clearly described in the aforementioned British patent, may consist of any one of several materials which are characterized by their poor conductivity, such as slate or agate. A metal band *a* bears against the periphery of the disc C and is restrained by the spring *f*. The incoming leads of the transmission line are shown in Fig. 1, one side of the line being connected to the disc C and the other to the band *a*. The band *a* is variably attracted to the disc C in response to the incoming signaling current, and accordingly the friction between the disc C and band *a* is varied. In response to this variable friction the plung-

er S is oscillated, as will be readily apparent, and these oscillations of the plunger correspond with the incoming signal variations. The signals are thus repeated with increased amplitude into the outgoing circuit including the conductors V and Z. The relay for operating the repeater may have many different forms, as is clearly set forth in the aforementioned British patent, but inasmuch as this relay per se forms no part of the present invention, it is thought to be unnecessary to describe it in any detail herein.

The modified embodiment of the invention shown in Fig. 2 differs from that of Fig. 1 only in that the plunger S is provided with a head E having a considerable area.

In the appended claims the term "carbon granules" should be construed as including all equivalent materials whether they are in the form of granules or otherwise, as, for instance, a plurality of superimposed carbon discs.

I claim:

1. A microphonic repeater comprising a variable resistance element, and a plunger adapted to be oscillated in accordance with signals to be repeated.

2. A microphonic repeater comprising a receptacle, carbon granules contained in said receptacle, an oscillatory plunger inserted in said receptacle adapted upon being oscillated to vary the pressure between said granules.

3. In combination, a microphonic repeater comprising a variable resistance element and an oscillatory plunger adapted to vary the resistance through said resistance element in accordance with signal currents to be transmitted, and a relay for operating said plunger in accordance with said signals, said relay comprising a continuously rotating member and a relatively stationary member in frictional engagement therewith, said stationary member being connected with said plunger for transmitting oscillatory movements thereof, the arrangement being such that the frictional engagement between said rotating member and said relatively stationary member varies in accordance with the transmitted signals.

In testimony whereof I affix my signature.

DR. KARL ROTTGARDT.