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H. O. ROOSENSTEIN ET AL

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RADIORECEIVER

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Fig. 1

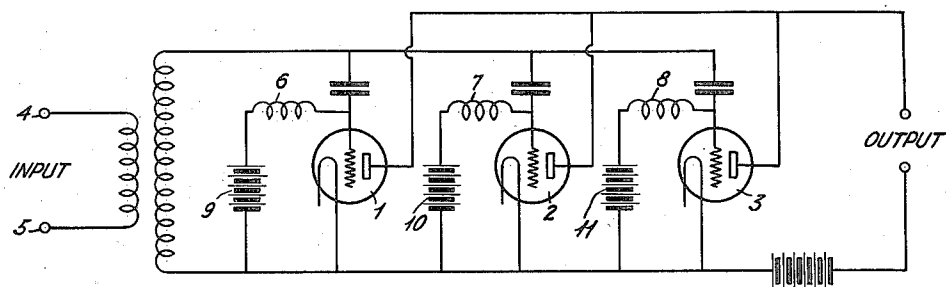
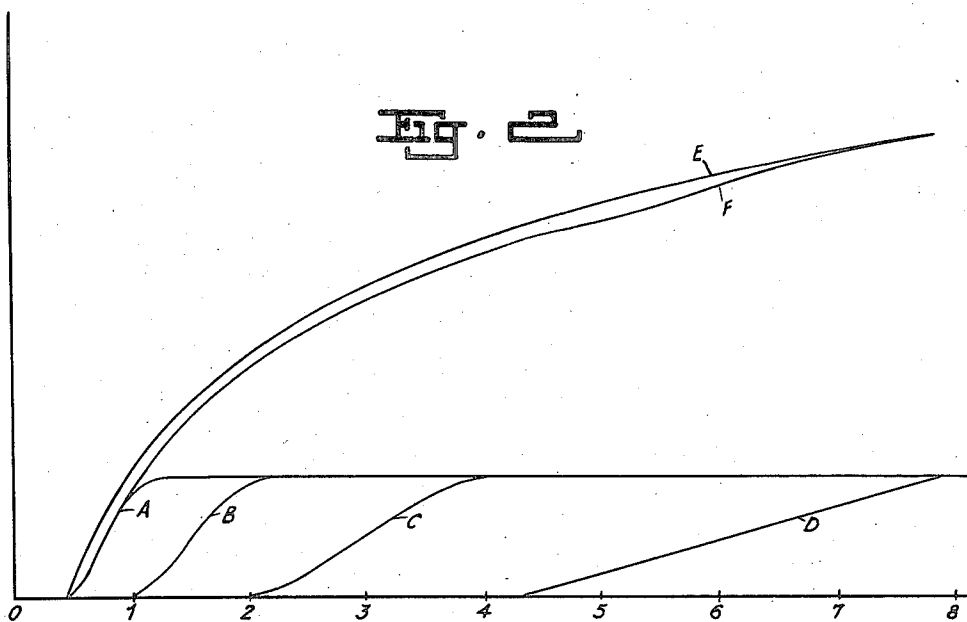


Fig. 2



INVENTOR
HANS O. ROOSENSTEIN
WILHELM RUNGE
BY *H. S. Runge*
ATTORNEY

UNITED STATES PATENT OFFICE

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RADIORECEIVER

Hans O. Roosenstein and Wilhelm Runge, Berlin, Germany, assignors to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a corporation of Germany

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1 Claim. (Cl. 250—27)

For a great many purposes it is desirable to use receivers whose volume is governed by the degree of modulation of the incoming signals or oscillations rather than the amplitude thereof. In order to attain this end it has heretofore been suggested to use automatic amplifier controlling means; but these complicate the receiver apparatus and they involve often a time-lag that is inadmissible.

Now, according to the present invention the desired end is attained by providing in the stage wherein the modulated radio frequency is rectified and the audio frequency is formed, steadily acting rectifier means which possess a characteristic of suitable form. The rectifier characteristic, i. e., the curve which represents the instantaneous value J of the current obtained at the rectifier output end as function of the radio frequency potential input E may be represented approximately by this relation:

$$J = C \cdot \log \text{not } E + i_0 \quad (1)$$

If, then, the potential E of the incoming signal varies at the ratio $(1+k) : (1-k)$; where k the degree of modulation, the rectified current in accordance with the said formula will vary between these limits:

$$J_1 = C \log \text{not } (E \cdot (1+k))$$

and

$$J_2 = C \log \text{not } (E \cdot (1-k))$$

The amount of this variation may be calculated to be

$$J_1 - J_2 = C \log \text{not } \frac{1+k}{1-k}$$

The value of the variation $J_1 - J_2$ governs the volume of the incoming signal in the receiver. What the above formula shows is that for the chosen form of the rectifier characteristic the said variation is solely dependent upon the degree of modulation as expressed by the symbol k , while it is independent of the amplitude E of the incoming signal. For the purposes of the present invention there is suited a rectifier in which the relation of the instantaneous values of the applied or impressed voltage e and ensuing current i during the positive half-cycle is logarithmic in nature, say

$$i = P \cdot \log \text{not } e + i_0$$

while the strength of the current during the other half-wave is constant. For it will be seen that if upon such a rectifier there impinges an alternat-

ing current potential $E = A \sin \omega t$, the mean value J of the rectified current is calculated on basis of this formula:

$$J = \frac{1}{T/2} \int_0^{T/2} \{ [P \cdot \log \text{not } (A \sin \omega t)] + i_0 \} dt.$$

Now, this integral may be written also in this form:

$$J = \frac{P}{T/2} \left[T/2 \log \text{not } A + \int_0^{T/2} (\log \text{not } \sin \omega t + i_0) dt \right]$$

In this equation it is only the first part that is a function of the amplitude A of the alternating current potential E ; and it will also be noted that this dependence fulfills the logarithmic condition as laid down in Equation (1).

Rectifiers in which the relation between the instantaneous values of the current i and the impressed (applied) potential e obeys approximately a logarithmic law may be designed in various ways according to this invention. For instance, the incoming alternating current potentials may be used for the modulation of a luminous source by making use of the property that the number of electrons released by the said light source inside a photo-electric cell is with close approximation a logarithmic function of the luminous intensity.

In the way of purely electrically acting rectifiers there could be employed gaseous-discharge tubes with utilization of the saturation phenomena occurring in such discharges. The characteristic curve of standard or normal thermionic tubes presents in the upper knee the desired logarithmic curvature, though only inside a relatively small range. Since this is inadequate for the desired purposes it is recommendable to combine the rectifier actions of several tubes having different saturation potentials, different operating potentials, etc. By the judicious selection of these working data or factors it is feasible to secure an arrangement which has the required large logarithmic operating range.

As a result the rectified amplitude becomes independent of the amplitude of the signal as long as the same stays within the logarithmic range. On the other hand, it is proportional to the degree of modulation inside the whole range. From the above it is apparent that an arrangement possessing the requisite logarithmic characteristic is obtainable by suitable combination of several rectifiers of any desired kind at all, provided that they are suitably combined so that the resultant characteristic curve of all the rectifiers varies substantially logarithmically.

Referring to the drawing, Figure 1 illustrates

one manner of utilizing discharge tubes in accordance with the present invention, and Figure 2 illustrates, graphically, the resultant rectifier characteristic which may be obtained by combining four parallel tubes having individual characteristics.

Figure 1 shows an embodiment comprising the use of a plate rectifier. In this scheme three tubes denoted by 1, 2, and 3 are employed whose grids by way of blocking condensers are fed with the same radio frequency potential. Suitable biasing potentials are supplied to the tubes by way of the chokes 6, 7, 8, from the batteries 9, 10, and 11. These batteries are of dissimilar size, and also the slopes of the characteristic curves of the tubes 1, 2, 3, are to be chosen conveniently.

Figure 2 shows the resultant rectifier characteristic (F) of four paralleled tubes which have the individual rectifier characteristics A, B, C, and D. The resultant characteristic for the sake of comparison is shown together with the logarithmic curve E, and it will be noted that the discrepancies between the two graphs are but small.

In order to obtain tubes of the desired characteristics a method similar to that disclosed in the proceedings of the I. R. E., December 1930, page 2102, may be utilized. It is to be understood that the characteristics of the various tubes may be obtained in a purely experimental way, as by varying the width of the mesh of a grid of the tube and the thickness of the grid rods.

The circuit schemes disclosed in the present invention are fundamentally different from the super-regenerative scheme known in the prior art whose rectifying characteristic exhibits likewise an approximately logarithmic shape if properly adjusted. However, in certain types of super-regenerative receivers this shape is not attained by the form of the characteristic of a steadily acting rectifier, on the contrary, it is due to the periodic change in sensitivity of the system. Ex-

periments have demonstrated that the initiation as well as the decay of the oscillations in such a receiver is able to happen inside an interval of time which is small compared with the period of the "pendular" or periodic frequency. As a result the amplitude of the oscillation in such a super-regenerative receiver is practically always equal to the crest amplitude or to zero. Since intermediate values arise only during very short periods it is only the crest value of the rectifier current that is of interest. The fact that the means value of this current is a logarithmic function of the incoming field intensity is due to that the time interval during which the arrangement is in a stage of oscillation is a logarithmic function of the incoming field intensity.

We claim:

In combination with a source of signal modulated radio frequency waves, a plurality of thermionic tubes each having anode, cathode and control grid, said tubes having different input potential-output current characteristic curves, each tube being provided with an alternating current input circuit, a common output circuit connected with the anodes of all of said tubes, means for simultaneously impressing signal waves from said source in like phase upon the input circuits of all the tubes, separate batteries connected between the control grid and cathode of each tube for biasing the control grid of each of said tubes relative to the cathode of the respective tubes so that the tubes become operative successively in accordance with the amplitude of the signal waves, the biasing potentials applied to the control grids of the tubes being related to the characteristics of the various tubes so that the total resultant characteristic curve varies substantially logarithmically.

WILHELM RUNGE.

HANS O. ROOSENSTEIN.