May 25, 1948. L. A. DE ROSA 2,441,958

COMMUNICATION SYSTEM

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Fig. 1.

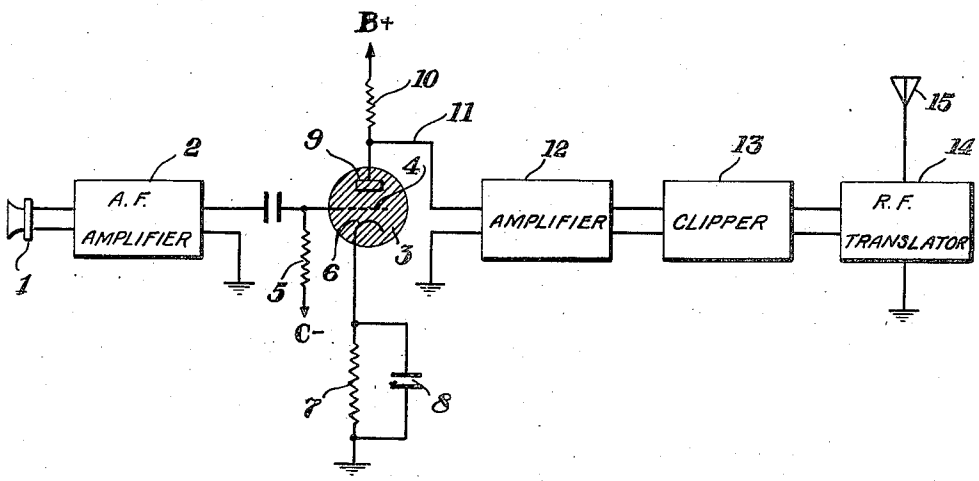
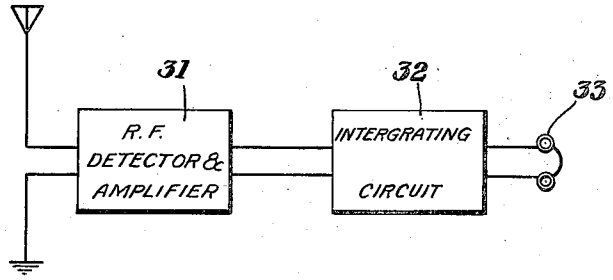


Fig. 3.



INVENTOR.
LOUIS A. DE ROSA

BY Percy P. Lantzy

ATTORNEY

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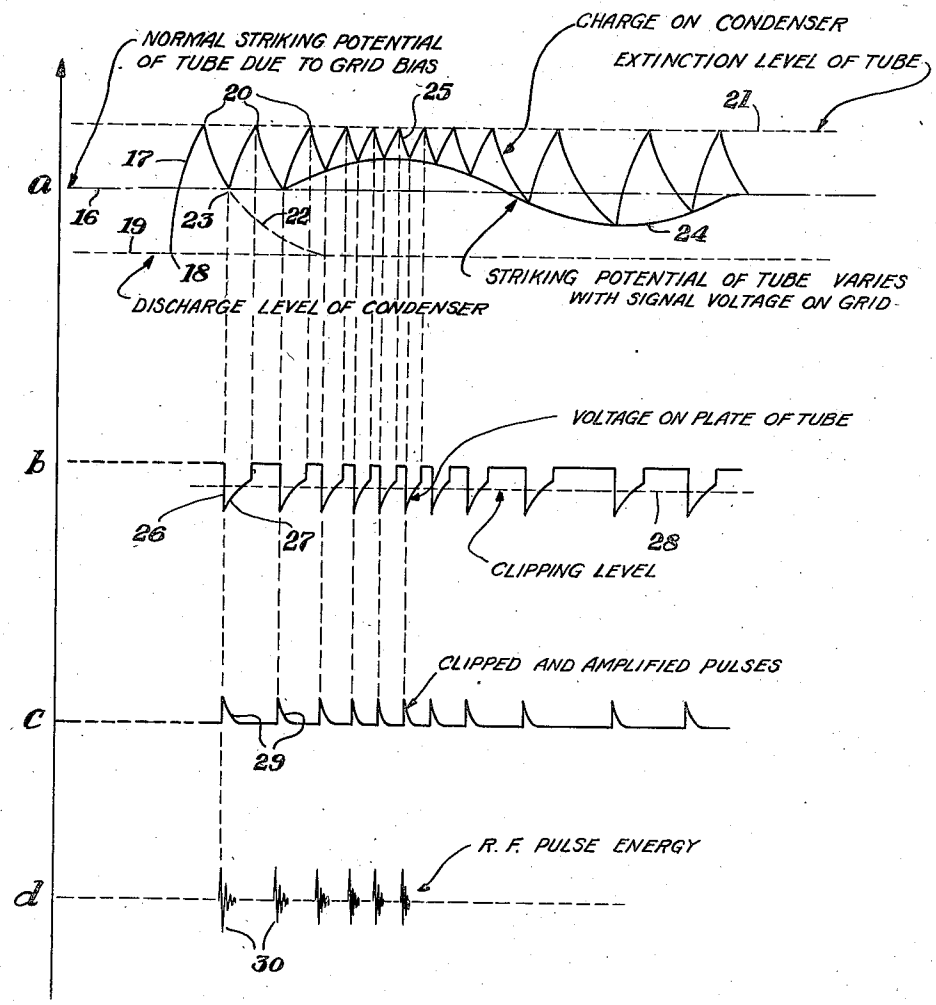
Fig. 2.



INVENTOR.
LOUIS A. DE ROSA

BY Percy P. Lantzy

ATTORNEY

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2,441,958

COMMUNICATION SYSTEM

Louis A. de Rosa, West Brighton, N. Y., assignor to Federal Telephone and Radio Corporation, New York, N. Y., a corporation of Delaware

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3 Claims. (Cl. 179—171.5)

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My invention relates to communicating systems, and more particularly to a simplified form of pulse generating system that is particularly suited for use in portable transmitters.

There are many instances where radio transmitting equipment must be kept within certain prescribed limits both as to weight and to the number and variety of circuit elements employed. While this is often the case in apparatus intended for use on aircraft, it is almost universally true in regard to portable transmitters of the type intended for short range operation. The use of but few parts not only keeps the overall weight of these transmitters low but replacement or repair thereof is greatly facilitated. Furthermore, a reduction in the number of circuit elements utilized correspondingly reduces the possibility of electrical or mechanical failure of the transmitter.

It is accordingly an object of the present invention to provide a simplified form of pulse generating system having relatively few parts.

It is a further object of the present invention to provide a method of, and modulator means for, generating pulses the recurrence rate of which is varied in accordance with the envelope of the signal representing the intelligence to be transmitted.

The above and other objects I accomplish by systems incorporating an electron discharge tube of the gas-filled type. By applying audio signals to the grid of this tube, the striking potential of the tube is caused to vary in accordance with the envelope of the signal. A resistance-condenser combination having a small time constant relative to the period of the highest modulating frequency to be employed is connected in the cathode circuit of the tube so that the condenser will charge while the tube is conducting and will begin to discharge as soon as the extinction potential of the tube is reached. Due to the variation in the striking potential as a result of the audio signal, however, this striking potential will be reached at different points along the discharge curve of the condenser. Thus the striking recurrence of the tube will be at a rate determined by the grid voltage which, in turn, represents the instantaneous magnitude of the signal energy.

Further operational details will be found in the following detailed description of the invention and from the drawings, in which;

Fig. 1 is a schematic circuit diagram of a preferred form of signal pulse transmitting system in accordance with the present invention;

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Fig. 2 is a set of curves useful in explaining the operation of the system of Fig. 1; and

Fig. 3 is a schematic circuit diagram of one form of receiving system that may be employed in conjunction with the transmitting system of Fig. 1.

In the circuit of Fig. 1 is shown a pulse transmitting system including a microphone or other sound pick-up device 1 connected to an amplifier 2. A gas-filled triode 3 such, for example, as an RCA 884 has its grid 4 connected through a coupling condenser to the output of amplifier 2. A resistor 5 provides a negative bias from voltage C— on grid 4 for a purpose to be hereinafter described.

Between the cathode 6 of triode 3 and ground is connected a resistor 7 of fairly high value, say for example 75,000 ohms. A condenser 8 is shunted across resistor 7.

Anode 9 of triode 3 is provided with a D. C. potential of positive polarity from a suitable source. For the purpose of illustration, let this plate potential be equal to 150 volts. Between anode 9 and the source of plate potential is connected a resistor 10 of fairly low value, say 500 ohms.

A lead 11 connects the anode 9 of triode 3 to an amplifier 12. The output of amplifier 12 passes through a clipping circuit 13 to an R. F. translator 14 and is then transmitted from antenna 15.

Triode 3 has a certain striking potential. This potential varies in accordance with the grid bias on the tube. In the case of the RCA 884 with a plate voltage of 150 volts taken as an example, the tube will become ionized when the grid bias is approximately —15½ volts.

Assume that tube 3 becomes conductive. In the curve *a* of Fig. 2, the normal striking potential of the tube with constant grid voltage due to its bias is indicated by the horizontal line 16. When tube 3 first becomes conductive in any transmitting sequence, there is, of course, no charge on condenser 8, and such no charge condition is represented on wave 17 by point 18 at the zero charge axis 19.

When tube 3 becomes conductive, current flows through said tube and charges condenser 8.

When the charge on condenser 8 reaches the first point indicated at 20 on wave 17, the potential drop across triode 3 is reduced to the point where extinction of the discharge in tube 3 occurs. This extinction level is shown in Fig. 2 as a horizontal line 21. Upon extinction of tube 3, condenser 8 starts to discharge through resistor

7 to ground. Since resistor 7 is of a fairly high value as above mentioned, this discharge follows the exponential curve indicated in part by the broken line 22.

However, as condenser 8 discharges, cathode 6 becomes more negative with respect to anode 9, or, in other words, the potential difference across the tube rises. When the discharge curve of condenser 8 reaches the striking level 16 at point 23, tube 3 again becomes conductive, and current flows through tube 3 to again build up the charge on condenser 8 to the level 21, Fig. 2. Thus, it will be seen that the condenser 8 is not normally completely discharged to the zero level 19.

The horizontal line 16 represents the normal striking potential of tube 3 as determined by its bias, in the present example approximately $-15\frac{1}{2}$ volts. In the above-described operation it has been assumed that the grid voltage is of constant value, in which case the series of points 20 representing periodic maximum charged conditions of condenser 8 will be equally spaced apart in time, this spacing being, of course, determined by the time constant of the resistance-condenser combination 7—8 as well as by the operating characteristics of, and the voltages on, the particular tube employed.

If now an audio signal voltage is applied to grid 4 from microphone 1 through amplifier 2, the normal striking potential of tube 3 will be varied. This is illustrated by the wave 24 of curve *a*, which shows the signal voltage superposed on the grid bias voltage. Due to this variance in the striking potential, the time during which condenser 8 discharges before the striking potential is reached will vary correspondingly. As shown for example in portion 25 of wave 17, the discharge time of the condenser is appreciably shortened, resulting in a change in the recurrence rate of points 20 along extinction level 21.

Each time that tube 3 strikes, a voltage pulse is produced in the output circuit 11 as shown in the curve *b* of Fig. 2. This pulse has a sharp leading edge 26 produced when the tube strikes, followed by a curved trailing edge 27. As soon as the tube becomes extinguished, anode 9 immediately takes the potential of the positive source.

Due to the fact that the pulses of curve *b* are produced during conduction of tube 3, these pulses will be spaced apart in time an amount approximately equal to the spacing of points 20 representing the corresponding chargings of condenser 8 to the extinction level 21 of the tube. Since the spacing of points 20, as above described, is determined by the shape of the signal curve 24, the recurrence rate of the pulses will also be in accordance with this signal curve.

The pulses of curbe *b* are amplified by an amplifier 12 and then clipped at a level such as 28 by a known clipping circuit 13 to result in the series of pulses 29 of curve *c*. The clipping circuit 13, however, may be omitted if desired, the pulses of curve *b* in that case being applied direct to translator 14. The pulses of curves *b* or *c*, as the case may be, are used to modulate a carrier wave in a conventional translating device 14 whereby a series of pulses 30 of R. F. energy as shown in curve *d* is produced for transmission from antenna 15.

To receive the pulses produced by the circuit of Fig. 1, a system such as shown in Fig. 3 may be employed. This system comprises an R. F. detector and amplifier 31 which may be of any suitable type. The output of detector and amplifier 31 is applied to an integrating circuit 32 which reproduces the envelope of the original audio wave as applied to grid 4 of triode 3 in Fig. 1. The audio wave may then be used to energize a reproducing apparatus such as the phones 33.

While I have described above the principles of my invention in connection with specific system, it is to be clearly understood that this discription is made by way of example only and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claims.

I claim:

1. A pulse modulator system comprising a freely-running relaxation oscillator including a grid-controlled gaseous discharge tube, an anode-cathode circuit coupled to said tube, a source of potential coupled to the anode-cathode circuit of said tube, time-constant means coupled to the anode-cathode circuit and including a condenser adapted to be normally charged and discharged at a rate controlled by the potential on the grid of said tube, means for biasing said grid to normally ignite said tube at a given rate, to thereby normally produce pulses of a given repetition rate in the anode-cathode circuit thereof, a source of varying amplitude audio frequency signal voltages, and means for applying said voltages to the grid of said tube to vary its rate of ignition and consequently the repetition frequency of said pulses.

2. A pulse modulator system according to claim 1 wherein said time constant means is a circuit including a resistor in parallel with said condenser, said circuit being connected in series in the anode-cathode circuit, said condenser being charged upon ignition of said tube and discharged through said resistor.

3. A pulse modulator system according to claim 1, further including a clipper for clipping away the base portion of said pulses to thereby produce on its output, peaked pulses modulated in time in accordance with the amplitude of the signal voltages.

LOUIS A. DE ROSA.

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