Sept. 22, 1925. 1,554,345

E. HABANN

TELEPHONE SYSTEM WITH HIGH FREQUENCY OSCILLATIONS

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Fig. 1.

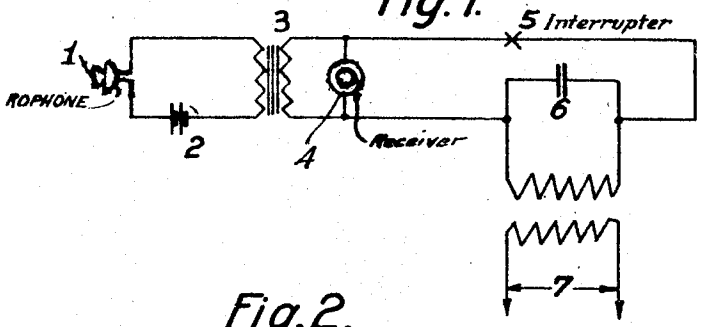
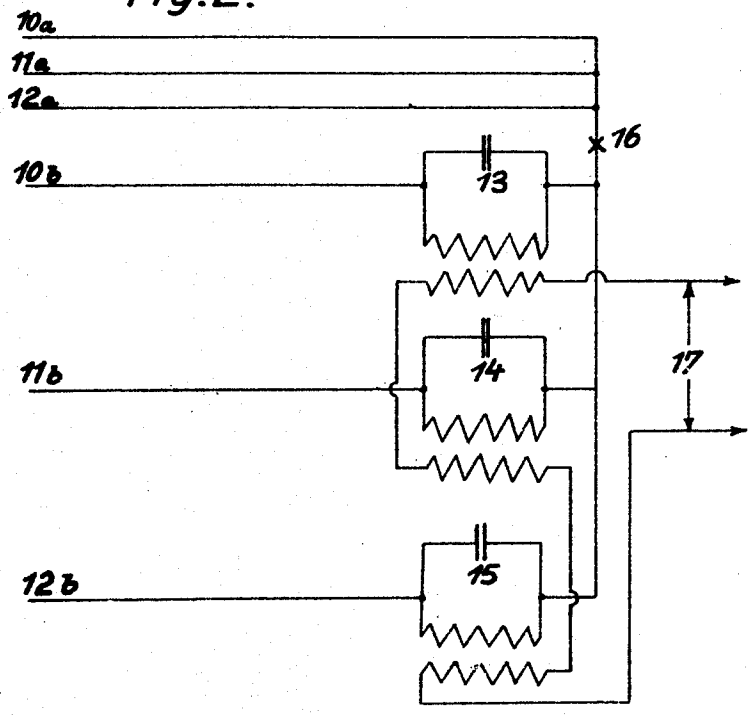


Fig. 2.



Inventor Erich Habann
by Hubert A. Gill
Attorney

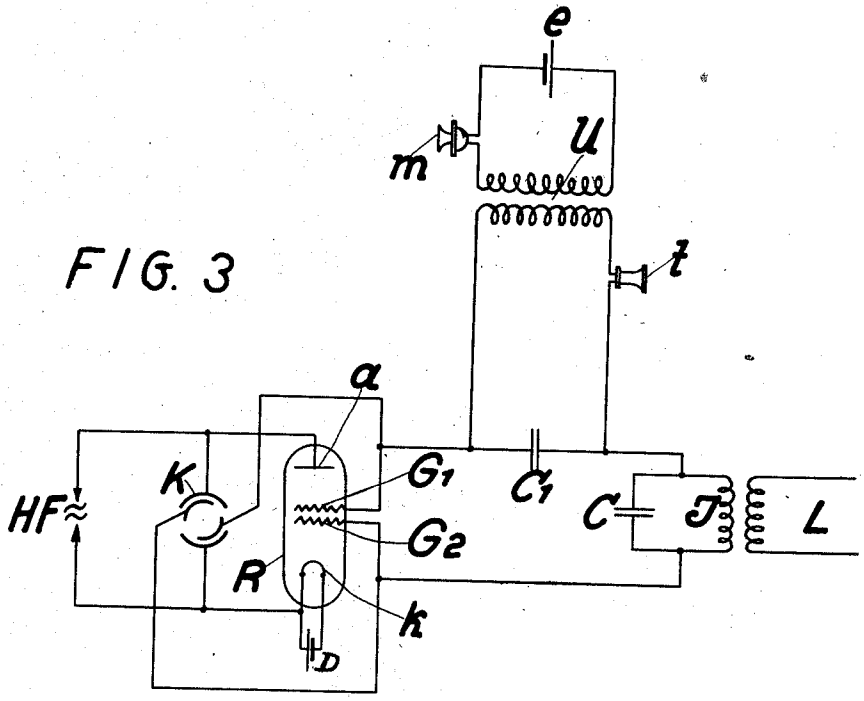
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FIG. 3



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Fig. 4.

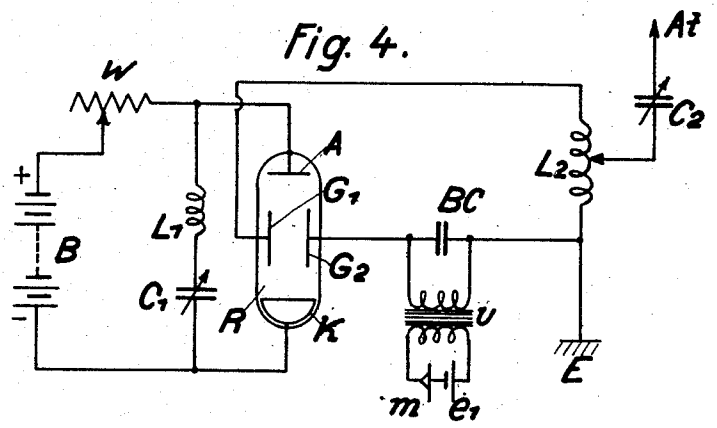


Fig. 5.

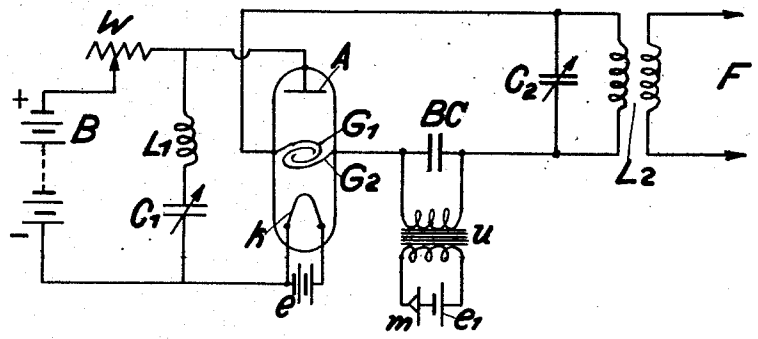
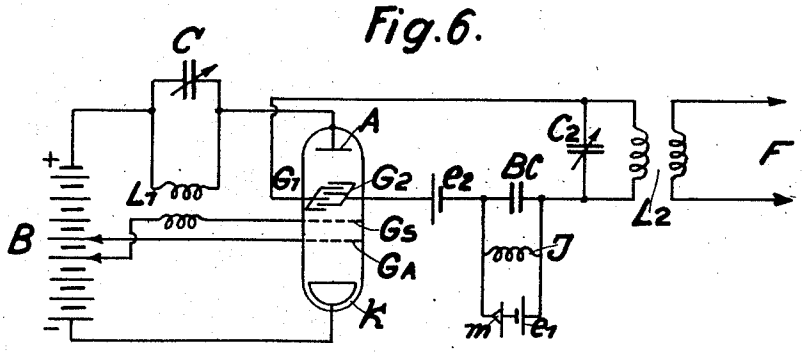


Fig. 6.



Inventor: Erich Habann.
by Hubert A. Gibbs.
Attorney

Patented Sept. 22, 1925. 1,554,345

UNITED STATES PATENT OFFICE.

ERICH HABANN, OF WAIDMANNSLUST, NEAR BERLIN, GERMANY.

TELEPHONE SYSTEM WITH HIGH-FREQUENCY OSCILLATIONS.

Application filed August 22, 1921. Serial No. 494,400.

To all whom it may concern:

Be it known that I, ERICH HABANN, residing at Waidmannslust, near Berlin, Germany, have invented certain new and useful Improvements Relating to Telephone Systems with High-Frequency Oscillations, for which I have filed applications in Germany 4th March, 1919, 25th October, 1919, and 18th November, 1919; in Denmark 23rd March, 1921, in Great Britain 14th March, 1921, in Spain 26th March, 1921, in Japan 1st of June, 1921, in Switzerland 8th April, 1921, in Holland 21st March, 1921, in Italy 28th March, 1921, in Sweden 31st March, 1920, and March 17th, 1921, in Austria 30th August, 1921, in Hungary 26th August, 1921, in Belgium 30th March, 1921, and in France 25th March, 1921, of which the following is a specification.

The invention relates to a system of telephony by means of high frequency oscillations wherein the transmission is effected either as wireless or—and this is preferable—by double wire line.

The methods hitherto known for telephony by means of high frequency oscillations are based on the principle that a particular high frequency generator produces damped or undamped oscillations which are transmitted in the line the amplitudes thereof being varied by the superimposed speaking currents.

The object of the invention is another method, wherein the low frequency speaking currents serve themselves for producing the high frequency oscillations. For this purpose the microphone currents, preferably after amplification, are divided into impulses by an interrupter, operating at a higher frequency than audible frequency, and are supplied in this interrupted form to an oscillating circuit which is thus excited and thus oscillates with its own frequency. Each circuit closure at the interrupter therefore sets up a high frequency wave train which is delivered by the oscillating circuit. The initial maximum amplitude value of this wave train correspond to the speaking current which is energy supplied to the interrupter at the moment of interruption. By this characteristic curve therefore speech oscillations are produced in the distant telephone by means of a rectifying or an integrating device such as a so called detector with the known circuits.

The number of impulses into which the speech curve is dissolved is made either equal to the number of oscillations of the oscillating circuit or less than these, but not greater, as otherwise it would be impossible for the oscillation of the circuit itself to take place in the period between two impulses. On the other hand care should also be taken that the oscillations in the oscillating circuit do not cease between two impulses as otherwise a loss of energy would be caused. Care must therefore be taken to have a sufficiently small damping of the oscillating circuit and according to the invention this may be effected by providing a second oscillating circuit of small damping which is coupled between the first oscillating circuit and the line.

As the high frequency oscillation, which acts as carrier for the speech, does not have a constant amplitude, oscillations of a higher range, which would otherwise be associated therewith and would disturb the speech, are avoided. An important advantage of the invention however consists in that the oscillations only enter the distant line when speaking into the telephone. It is therefore unnecessary to render the interrupter or the oscillating circuit inoperative or disconnect it from the line in order to prevent interference from neighbouring lines, but the device is always kept ready for operation.

The interrupter may either be a mechanical or electromagnetic interrupter (contact wheel) or even a liquid interrupter, further, however, it may, according to the invention, be also formed as a discharge tube as will be described hereinafter with reference to Figures 3–6. According to the invention this tube is combined with an oscillating circuit in such a manner that it forms in itself a high frequency generator which supplies the necessary continuous current or low frequency alternating current for its operation.

Figures 1 and 2 of the drawings show firstly the basic principle of the invention for single and multiplex transmission wherein a suitable interrupter of the first mentioned type is used. In Figs. 3 to 6 an ionization valve is used as interrupter.

In Figure 1 the low frequency speaking currents produced by means of the microphone 1 and the local battery 2 are transmitted to the oscillating circuit 6 by a transformer 3, with which a telephone 4 is ar-

ranged in parallel, through an interrupter 5. The oscillating circuit consists of a capacity and a self inductance, is tuned to the desired high frequency and is coupled to the transmitting means 7 (antennæ, distant cable).

Figure 2 shows a multiplex system with three auxiliary apparatus. The speaking curves derived from the auxiliary apparatus 10, 11 and 12 are dissolved into impulses by the common means 16 but are transmitted by the leads 10^a and 10^b, 11^a and 11^b, 12^a and 12^b, to the oscillating circuits 13, 14, 15, which are tuned to different wave lengths and in their turn are coupled to the distant cable 17 or an antenna.

The impulses supplied by the interrupter may, when the interrupter runs and should run comparatively slowly, first be conducted to a frequency transformer which increases the number of impulses in the known manner.

Figure 3 shows an arrangement according to the invention wherein a cathode tube R is employed as an interrupter. In this case an ionization space is provided between the anode *a* and the glowing cathode *k* of the tube R, this ionization space being supplied by a suitable high frequency wave generator HF. The ionization interval is arranged in air or in a gas and any type of known discharge tube may be used. Instead of the glowing cathode a cathode of alkali metal and a rare gas filling may be used. In the ion stream which passes from the cathode *k* to the anode *a*, are disposed two middle electrodes G_1, G_2. For the sake of clearness these are shown in the drawing as one above another. These middle electrodes are preferably formed as grids or spirals which lie in the same plane, without contacting with one another. In this manner a disturbing potential difference between these electrode in the ion stream is avoided. To the electrodes *a*, *k* and G_1, G_2 are connected the layers of a rotary condenser K which serves for compensating any residue of potential difference between the grids G_1, G_2, when no speaking current is imparted thereto. The battery D supplies the heating current for the glowing cathode *k*.

In the circuit of the grids G_1, G_2 is arranged an oscillating circuit CJ and a condenser C_1, which couples up the speaking apparatus TM.

The apparatus TM consists of the usual auxiliary apparatus with microphone *m*, microphone battery *e*, telephone *t* and transmitter *u* in the known manner. The oscillating circuit CJ is directly coupled to the distant line L so as to avoid the use of a separate transformer.

The operation is as follows: As soon as the high frequency source HF has been put into circuit, ions pass from *k* to *a* in the valve. These thus connect the grids G_1, G_2 together electrically, but this at first does not produce a current in the circuit C_1, C, J, D. Currents only occur in this circuit when speaking into the microphone of the apparatus TM, which however in rhythm with the high frequency are closed at G_1, G_2.

The oscillating circuit CJ is thus actuated in the same rhythm and transmits the high frequency waves into the line L. These waves have a rising and falling amplitude of which the curve illustrates the speaking oscillation.

In the distant receiver this curve is rendered audible as speech by known means.

The arrangement of the electrodes forming the interrupting space at the same potential may also be such that two entwined spirals are used as electrodes, or one electrode—with any one shape—may surround the other completely or partially. The plane or longitudinal axis of these electrodes need not be at right angles to the connecting line of the other electrodes (*k*, *a*) producing the ionization, whilst, for example, two plate shaped electrodes may be so arranged opposite one another that they form between them an interrupting space lying transversely to the stream of ions. Two grids of the type hereinbefore described may have their plane disposed in the ion stream.

Instead of heating only one of the electrodes, which form the ionization space, as described, both these electrodes may be heated. Both may also be of the same material, for example, alkali metal. The electrodes forming the interrupting space may be of any suitable material.

In Figure 4 the tube R is filled with rare gas and is provided with an anode A, which is connected to the positive pole of a battery B over a resistance or damping coil W, an alkali metal cathode K connected to the negative pole of the same battery B, and finally with two middle electrodes G_1, G_2, which are in the form of plates, for example, and have their surface in the direction of the ion stream passing from K to A. Between K and A is a branch provided with a self inductance L_1, and a capacity C_1, which helps to form the known Poulsen oscillating circuit. The two middle electrodes G_1 G_2 are each provided at the end of a transmission coil L_2 which is variable and serves for coupling to the antenna which is earthed at E. The antenna contains a variable condenser C_2. These parts are used in the usual manner. In the circuit of the middle electrodes G_1 G_2 is a block condenser BC and parallel therewith a transformer coil *u* of which the corresponding primary coil is in the circuit of a microphone *m* and the corresponding battery e_1.

The operation is as follows: When the tube is in circuit and the microphone is not spoken into, the tube produces from the current of the battery B, in consequence of the co-operation of the oscillating elements L_1, C_1 a high frequency pulsating ion stream from K to A, which uniformly influences both electrodes G_1 G_2 without producing a potential difference between them. As soon, however, as the microphone is spoken into, such a potential difference occurs and now a high frequency alternating current is set up in the circuit of the coil L_2 which passes from K through G_1 L_2 BC, G_2 to A or vice versa according to the potential at the time at G_1 G_2. This current is transmitted to the antenna which thus continuously radiates waves only during actual speaking but not during the word pauses. By this restriction to the period of speaking the oscillations of the circuit L_1 C_1 are prevented from influencing the distant or neighbouring receivers.

The energy radiated by the antenna is practically the energy of the battery B converted into high frequency by the oscillating circuit L_1 C_1.

Figure 5 shows a circuit arrangement wherein the tube is provided with a glowing filament cathode K which is supplied by a battery *e*. The middle electrodes G_1 G_2 are formed for example as entwined spirals. This is for the purpose of increasing the necessary traversing potential at each oscillation, whereby a higher charging of the condenser C is obtained and the oscillating energy of the circuit LC, and thus also the energy produced by the tube is increased. In this case the high frequency is transmitted to a distant line F by a coupling by means of an oscillating circuit L_2 C_2 which at the same time transforms the high frequency into the required wave for the line. Such a second oscillating circuit allows of quite a general regulation of the frequency, without it being necessary to vary the oscillating circuit L_1 C_1 of the tube.

In Figure 6 the tube is provided with a potassium cathode K, an anode A, two grids G_S G_A and two additional electrodes G_1 G_2 which are formed as entwined grids or grates (finger grids). The tube is supplied by a battery B and is reactively coupled to the oscillating circuit L_1 C_1 in the known manner by the grid G_S. Also in this case the high frequency current produced in the tube does not influence the grides G_1 G_2 which are at the same potential, as long as they remain at the same potential, whilst a strong actuation occurs as soon as the microphone *m* is spoken into as the grids thus become different relative potential. In this case the microphone with its battery e_1 is in parallel with an induction coil J and a block condenser BC, whereby a battery e_2 compensates the battery e_1 in the circuit of the electrodes G_1 G_2. The high frequency current taken from the tube is in this case also transmitted to an oscillating circuit L_2 G_2 as in Figure 5 which is coupled to the distant cable F and transmits into the latter a high frequency alternating current which is the carrier for the speaking sounds.

A special type of tube is not required for the purpose of the invention. The tube can be filled with a gas such for example, as a rare gas, or metal vapour, (for example a rare gas) or with metal vapor (for example mercury vapour). The known electrode arrangements are applicable with their proper advantages. For example instead of using a constantly heated cathode, a continuously glowing cathode in rare gas may be used.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is.

1. A high frequency transmitting station for telephony, consisting of an oscillating circuit without current generator being switched therein, a local microphone circuit coupled with the said oscillating circuit, a communication line coupled with the said oscillating circuit, a current interrupter device actuating with a number of interruptions above audible range and adapted to interrupt the alternating microphone currents transmitted into the oscillating circuit and means for avoiding the continuous local microphone current from being transmitted into the interrupter and oscillating circuit, substantially as described.

2. A high frequency transmitting station for telephony, consisting of an oscillating circuit without current generator being switched therein, a local microphone circuit coupled with the said oscillating circuit a communication line coupled with the said oscillating circuit, a mechanical rotary current-interrupter actuating with a number of interruptions above audible range and adapted to interrupt the alternating microphone currents transmitted into the oscillating circuit and means for avoiding the continuous local microphone current from being transmitted into the interrupter and oscillating circuit, substantially as described.

3. A high frequency transmitting station for telephony, consisting of an oscillating circuit without current generator being switched therein, a local microphone circuit coupled with the said oscillating circuit, a communication line coupled with the said oscillating circuit, an ionization tube actuating as current interrupter with a number of interruptions above audible range, and adapted to interrupt the alternating micro-

phone currents transmitted into the oscillating circuit and means for avoiding the continuous local microphone current from being transmitted into the interrupter and oscillating circuit, substantially as described.

4. A high frequency transmitting station for telephony, consisting of an oscillating circuit without current generator being switched therein, a local microphone circuit coupled with the said oscillating circuit, a communication line coupled with the said oscillating circuit, an ionization tube arranged in series with the said oscillating circuit and adapted to interrupt the alternating microphone currents transmitted into the oscillating circuit with a number of interruptions above audible range and means for avoiding the continuous local microphone current from being transmitted into the interrupter and oscillating circuit, substantially as described.

5. A high frequency transmitting station for telephony, consisting of an oscillating circuit without current generator being switched therein, a local microphone circuit coupled with the said oscillating circuit, a communication line coupled with the said oscillating circuit, an ionization tube with two middie electrodes, the two end-electrodes being connected through an alternating current source, the said middle electrodes being arranged in series with the said oscillating circuit and adapted to interrupt the alternating microphone currents transmitted into the oscillating circuit with a number of interruptions above audible range and means for avoiding the continuous local microphone current from being transmitted into the interrupter and oscillating circuit, substantially as described.

6. A high frequency transmitting station for multiplex telephony, consisting of a plurality of oscillating circuits, none of which possesses a current generator, a plurality of local microphone circuits, each one coupled with one of the said oscillating circuits, a communication line coupled with all of the oscillating circuits, a current interrupter commonly arranged to interrupt all the alternating microphone currents transmitted into the oscillating circuits with a number of interruptions above audible range and means for avoiding the cintinuous local microphone current from being transmitted into the interrupter and oscillating circuit, substantially as described.

In testimony whereof I have affixed my signature.

ERICH HABANN.