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WIRELESS SYSTEM

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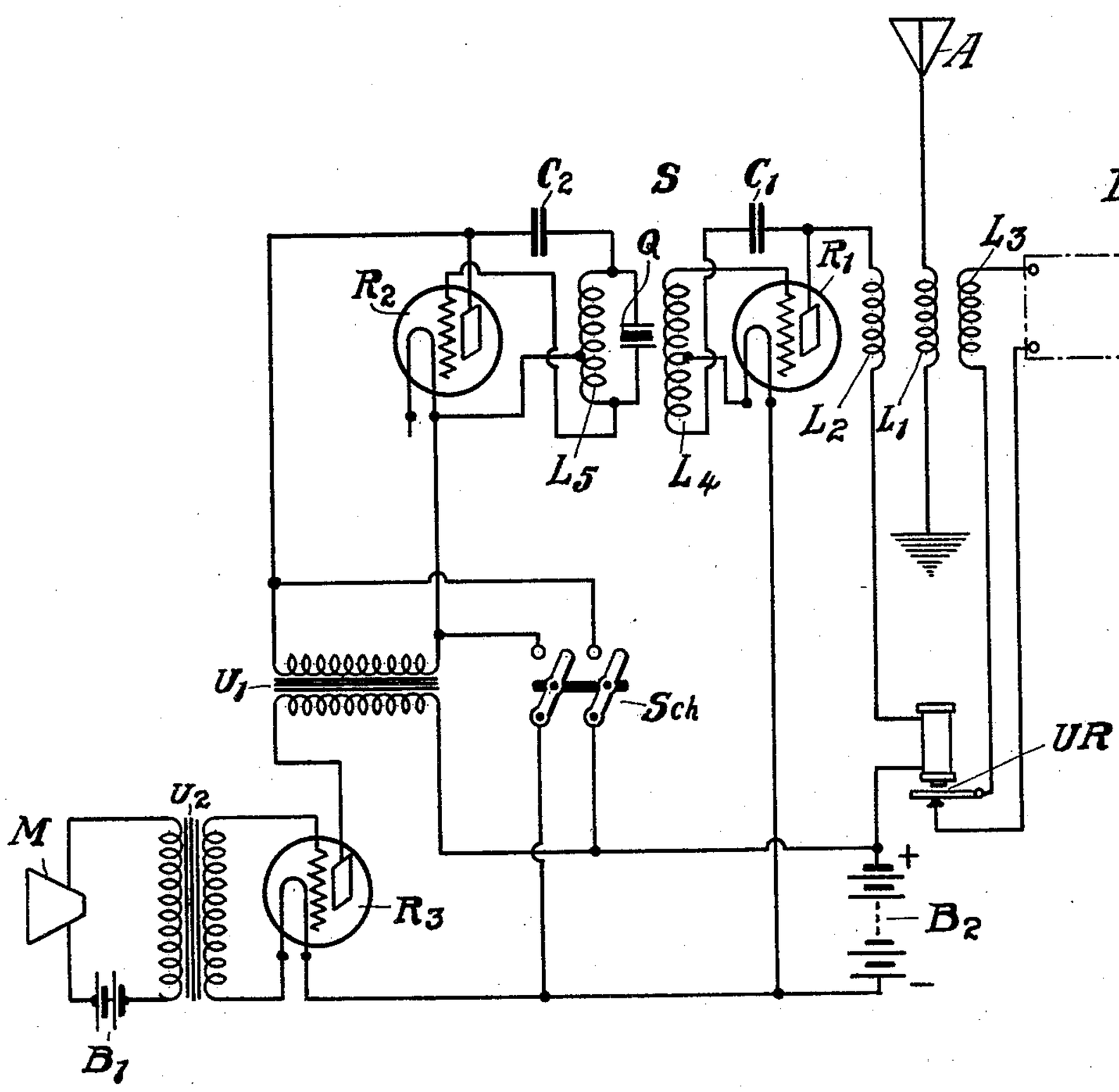

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WIRELESS SYSTEM

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This invention relates to wireless telegraphy and telephony systems and is more particularly concerned with vacuum tube oscillating apparatus.

One object of the invention is to provide a wireless apparatus, comprising a transmitter and a receiver, for use in duplex transmission, in which substantially identical sets may be used for transmitting a message between two chosen points.

Another object of the invention is to permit a wireless duplex transmitting and receiving apparatus to use one and the same channel for transmitting from both counter stations.

A further object of the invention consists in providing means in connection with a radio transmission system, whereby the transmitter is automatically stopped with the cessation of the signal or speech to be transmitted, without the use of relays or similar mechanical switching devices and whereby the oscillator tubes are carrying a large load only during the period when actual signals or speech is transmitted and, accordingly, the life of the tubes is considerably increased.

Still another object of my invention is to provide a radio transmitting station for duplex operation with means whereby the carrier wave generator is put out of action, upon cessation of a signal or of the speech to be transmitted.

Another object of the invention consists in providing a combined wireless transmitting and receiving set for duplex operation, which may be fixedly adjusted and which requires no subsequent tuning and, consequently, is simple and easy to operate.

These and further objects of my invention will become more apparent as the following detailed description proceeds, which is taken in reference to the accompanying drawing, which shows, by way of example, one form of a circuit system, in which my invention may be embodied. However, I wish it to be understood that the specific circuit, chosen for the purpose of illustration and specifically referring to a wireless duplex system, is subject to many modifications and should not have the effect of limiting the interpretation of the invention, short of its broad scope, as expressed in the appended claims.

Thus, for instance, it will become obvious that the basic principle underlying the invention, for achieving the above object, may be applied to any kind of radio transmitter and is, by no means, confined in its application to the specific embodiment of a duplex station.

Referring more particularly to the drawing, this shows a circuit for wireless duplex operation, which enables it to carry out transmission from both the counter stations on one and the same wave length, or through one and the same channel. However, it is not an absolute requirement that transmission be carried out on a single wave. With the methods, as used hitherto in the art, traffic could be carried on only in the case that the difference of wave length between the transmission and receiving wave was chosen large enough so that the resulting intermediate or heterodyne frequencies were above the limit of audibility. This method presents the disadvantage that two different waves have to be used and the number of possible channels will, accordingly, be restricted. At the present time, the tendency is to create apparatus simple in construction and of light weight, which are readily transportable and may easily be operated. Such apparatus is particularly required for use in air craft, where a minimum of weight and easy operation plays a vital rôle. With the provision of a single channel for transmitting and receiving, this object is accomplished to a large extent.

According to this invention, the anode voltage necessary for the operation of the oscillating tubes is generated by the modulating system, whereby, at the same time, the anode voltage varies, in accordance with the rhythm of the speech currents and thus, simultaneously, produces the modulation of the transmitter. In duplex operation the counter station is receiving, whenever the transmitter operates. During this time, the transmitter at the receiving end, in accordance with the invention, ceases to operate,

on account of the fact that the transmitting tube is not able to oscillate, because of lack of the necessary anode operating voltage. With a traffic being carried on in the opposite direction, the transmitter of the station, which has been receiving previously, will commence to operate only at the instant when it is modulated, whereas now the transmitter of the counter station ceases. This enables it to operate both transmitters on one and the same wave length.

It is apparent that this scheme possesses great advantages over the known methods used in a duplex transmission system, in which a relay or similar switching device is used to cut off the transmitting antenna, after completion of a message.

A further advantage of the invention, as described, consists in that, during the transmitting intervals, no carrier current is radiated, which makes it difficult to take a bearing of the transmitting station. This difficulty is, furthermore, increased by the change of the direction of traffic between the two counter stations, which, necessarily, takes place frequently during a conversation. Under circumstances, it may even be favorable, for the purpose of securing secrecy, to use a single transmitter, in accordance with the present invention, without carrying on a duplex traffic. The cessation of the oscillation, during the intervals of signals and speech, has the further advantage that a heavy load is applied to the tube only during the period actual signals, or speech, are transmitted and the life of the tubes is, accordingly, increased to a very large extent, thus decreasing the operating cost of the transmitter considerably.

Referring more particularly to the circuit of the drawing, an antenna circuit, comprising an antenna A, is shown, which includes a coupling coil L_1, to which are coupled two further coils L_2 and L_3, for the connection of the transmitter S and the receiver E, respectively. The transmitter S, in the example shown, comprises a master oscillator R_2, controlled by a piezo electric device Q and a power amplifier R_1, supplying the antenna circuit. It is evident that the arrangement of the transmitter, in accordance with the invention, may be that of a single self-excited tube oscillator, or may be a simple quartz controlled oscillator, instead of a separately controlled transmitter, comprising a master oscillator and power amplifier. The oscillatory circuit of the master oscillator is comprised of the capacity C_2 and the induction coil L_5, to which the quartz crystal Q is placed in parallel. The master oscillator is coupled with a power amplifier tube R_1, by means of a coupling coil L_4. A suitable tap point of this coupling coil is connected to the cathode of the power amplifier, one of the remaining ends being connected to the grid and the other end being connected across a neutralizing capacity C_1 to the anode, the latter capacity serving the well-known purpose of neutralizing the inherent capacity grid to anode, for the purpose of suppressing self-oscillations of the power amplifier R_1. The output circuit of the power amplifier contains the coupling coil L_2, for connection to the antenna circuit. The anode voltage necessary for operation of the master oscillator is supplied across a repeater U_1, whose primary is inserted in the anode circuit of an amplifier tube for the microphonic control currents. A microphone M, in series with a battery B_1, is connected to a further repeater U_2, whose secondary is arranged to control the grid of the amplifying tube R_3 in a manner well-known in the art. The primary of the repeater U_1 is inserted in the anode circuit of the amplifying tube R_3. The anode voltage necessary for the operation of the tubes R_1 and R_3 is supplied from the battery B_2. The master oscillator tube R_2 receives its anode voltage from the repeater U_1.

With no speech currents being produced by the microphone, no current will flow in the anode circuit of tube R_3 and, accordingly, no anode voltage will be impressed upon the master oscillator tube R_2, which cannot, therefore, operate and control the power oscillator R_1. Whenever the microphone is in operation, the current variations produced, in accordance with the sound waves impressed upon the microphone, will be applied to the grid circuit of tube R_3. An amplified microphonic current will flow in the anode circuit of the tube R_3 and, accordingly, through the primary of the repeater U_1. Thus, an anode voltage will be impressed upon the tube R_2 by the secondary of the repeater, with an amplitude varying in the rhythm of the speed current variations. This anode voltage, impressed upon tube R_2, will set the latter into operation, whereby the oscillations of the power tube will be controlled accordingly. The transformation ratio of the transformer U_1 is to be made such that the comparatively low voltage of the microphone modulating currents in the anode circuit of tube R_3 is stepped up to a value sufficient to serve as operating anode voltage of the master oscillator tube R_2. For practical purposes, it will be favorable to insert a suitable biasing battery in the anode circuit of the tube R_2, as, naturally, with the decrease of the anode battery below a certain value, the tube is no longer able to operate. Therefore, the oscillating currents flowing through the inductance L_2 will be modulated, in accordance with the speech currents delivered by the microphone.

The batteries for heating the filaments of the tubes, which are not illustrated in the drawing, for the sake of simplicity, are, naturally, connected at all times and also main-

tain the filament temperature during the intervals of transmission. The expenditure of anode current, on the other hand, is essentially less than is the case with a usual oscillator, on account of the fact that the anode supply voltage, during the non-oscillation condition of the transmitter, operates only on the inner resistance of the tubes and, accordingly, has to carry a smaller load. Thus, the strain on the tubes is decreased and their life, accordingly, increased, which results in a considerable reduction of operating costs.

In the example shown, a receiver E, indicated schematically, is also coupled with the antenna, the entire system constituting a duplex system for wireless telephony. T represents a receiving device, such as a telephone, connected to the output of the receiver. In this receiver, naturally, oscillations of the transmitter will be set up and, thus, the own message will be translated to the telephone T. In order to prevent a too strong action of the own speech on the receiver, it is favorable to have the transmitter control a device for switching off the receiver, whenever the transmitter is in operation. For this purpose, in the example shown by the drawing, a switch over relay UR is inserted in the anode circuit of the power oscillator tube R_1. This relay may serve, for instance, to interrupt the anode circuit of a receiving tube, or to apply an additional negative bias upon a receiving tube, thus making the receiver inoperative. This is schematically illustrated in the drawing, by carrying one of the input leads from the coupling coil L_3 to the receiver over the contacts of the switch over relay UR. This relay, which is of the type of marginal relays, will drop its armature during an intermission of the transmitter, as the anode current of the tube R_1 decreases, when the tube does not oscillate, on account of the anode battery working only on the inner resistance of the tube. On the other hand, whenever the microphone M is in operation, the anode current will increase and, accordingly, relay UR will respond.

However, it is not absolutely necessary to provide such a disconnecting arrangement, as, in many cases, the heavy voltages impressed upon the receiver, at the instant the transmitter starts to operate, will put such a bias upon the receiving audion, that it is rendered inoperative and is not able to operate as a rectifier any longer.

A system, as described, is primarily useful for sets operating with short electric waves. In this case, it is not necessary to have a common antenna for both transmitter and receiver, but two separate antennæ, a transmitting antenna and a receiving antenna, may easily be used, in view of the simplicity of antennæ of this kind. In this latter case, a reaction from the transmitting antenna on the receiver may be minimized by suitably arranging and spacing the transmitting and receiving antennæ.

With a circuit, as shown by the drawing, it is, furthermore, possible to carry out telegraphic traffic, for which purpose a switch *Sch* is provided, by means of which the modulating arrangement, together with the repeater U_1, may be put out of operation. At the same time, with the operation of this switch, the anode battery B_2 is connected directly to the master oscillator tube R_2 and the keying of the oscillator may now be carried out by any one of the well-known schemes, such as, for instance, by interrupting the output or anode circuit, or by applying a sufficiently negative bias on the grid, in accordance with the opening and closing periods of the telegraphic sending key, such as a normal Morse key.

While I have described my invention more or less specifically with reference to the showing herein, it is obvious that I would have it understood that my invention may be practiced in other ways, without departing from the spirit and scope thereof, in attaining the objects hereinbefore set forth.

What I claim to be secured by Letters Patent in the United States is:—

In combination with a radiophone station for duplex operation, an antenna circuit, a space discharge power amplifier supplying said antenna circuit, a crystal controlled three-electrode vacuum tube master oscillator controlling said power amplifier, a microphone device producing modulating currents in accordance with the speech variations to be transmitted by said transmitter, a vacuum tube amplifier for amplifying said modulating currents, a step up transformer having its primary inserted in the output circuit of said amplifier, the secondary of said transformer serving as the sole anode voltage source of said master oscillator, a receiver associated with said antenna circuit and a switch over relay having an operating winding included in the space current supply circuit of said power amplifier and being adapted to disconnect said receiver in response to a change of space current in said power amplifier when speech modulated waves are impressed thereon.

In testimony whereof I affix my signature.

WILHELM SCHEPPMANN.