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SIGNALING APPARATUS

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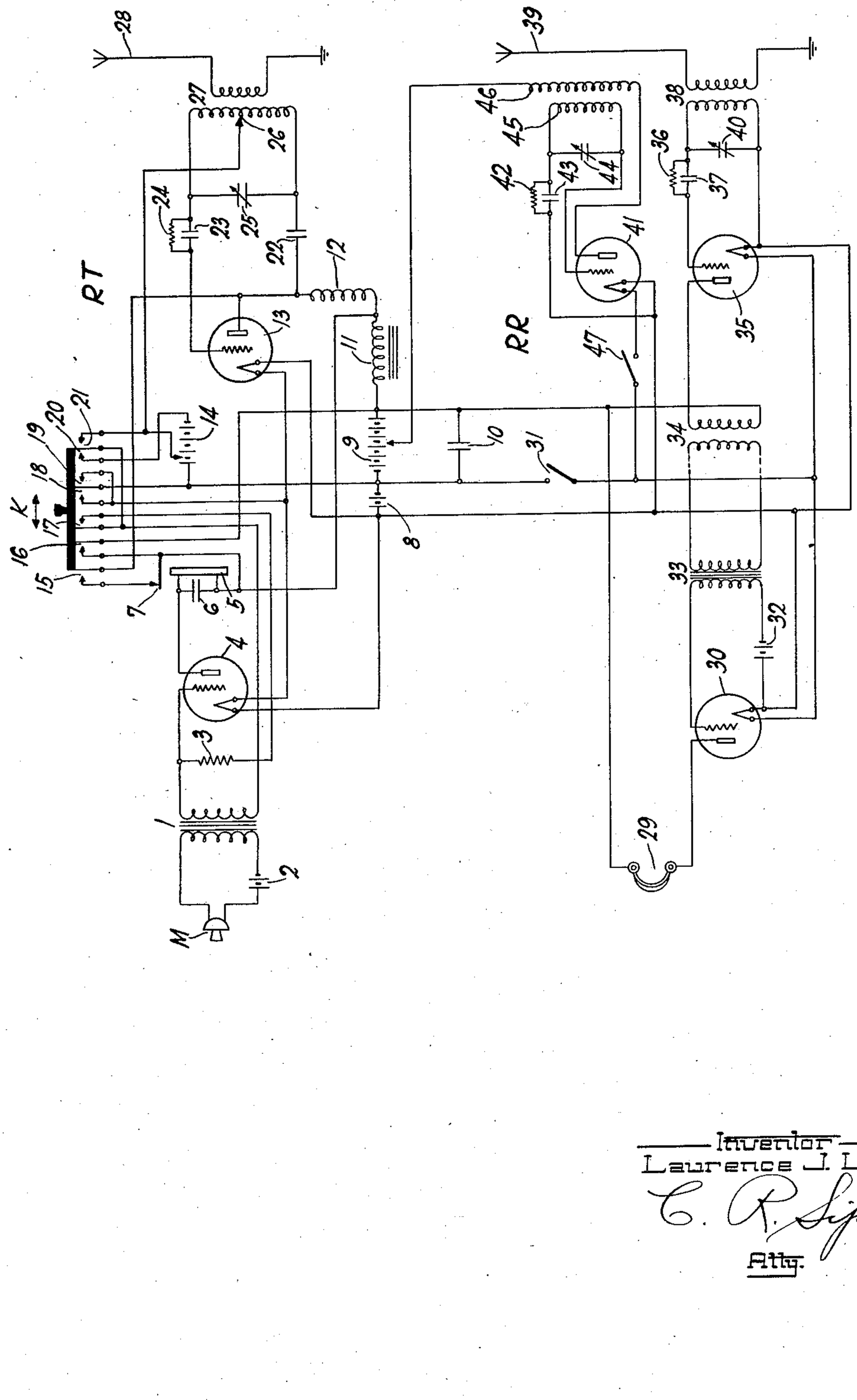

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SIGNALING APPARATUS

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8 Claims. (Cl. 250—17)

The present invention relates in general to signaling apparatus, but more particularly to radio apparatus designed especially for use in an airplane to enable the pilot to communicate with the ground stations. The main object of the invention is the provision of a simple and improved radio transmitter for airplanes which enables the pilot to either talk with or telegraph to the ground stations.

Two means of communication are in general use for communicating between airplanes and ground stations, namely, radio telephone and radio telegraph. A radio transmitter having sufficient power to transmit voice or telephone communications the required distances for airplane to ground communication is heavy, cumbersome, and quite expensive. Also, radio telephone is not as reliable as radio telegraph since telegraph signals may be intelligibly received under such adverse conditions as would render radio telephone communication practically impossible. Thus, planes which are equipped with radio telephone transmitters are usually also equipped with a telegraph transmitter for use in case of emergency.

The main objection to the use of telegraph communication from airplanes is that the pilot must use one hand for keying the transmitter while sending his messages. This is undesirable at any time, since the pilot should have both hands available for use in controlling the plane, but especially so when the pilot is attempting to land his plane in a fog and desires to keep in communication with the ground station continually in order to locate the landing field, obtain directions and instructions for landing, etc. This and other objections are overcome by the improved transmitter of the present invention.

According to one feature of the invention, the improved radio transmitter is arranged so that it may be used either for telephone or telegraph communication, the change from one method of operation to the other being accomplished by the operation of a key located on the instrument panel in the cockpit of the plane. Thus, telegraph communication is ordinarily used, thereby eliminating the necessity of an expensive radio-telephone transmitter. However, when the pilot is over a landing field, he simply operates the key and may then talk with the ground station. The transmitter has sufficient power for voice communication when the plane is relatively close to the ground station.

According to another feature of the invention, the transmitter is arranged to be "keyed" for telegraph signals by voice instead of by a telegraph key. The pilot uses the same microphone for talking and for keying the transmitter, thereby leaving both hands available at all times for use in controlling the plane.

Other features of the invention and a complete understanding of the same may best be had from the following description of the operation when read in connection with the accompanying drawing, comprising one figure only, which shows by means of the usual schematic diagram sufficient of the apparatus to enable the invention to be understood.

The drawing discloses the improved radio transmitter in the upper portion thereof, and in the lower portion discloses a suitable receiver which may be used in connection therewith.

Referring to the drawing, the improved radio transmitter RT consists essentially of a microphone M, an amplifying tube 4, an oscillating tube 13, a switching key K, and the various transformers, condensers, coils, and batteries which are necessary to interconnect the various circuits. The oscillating tube 13 is included in an oscillating circuit of the shunt-feed type, the plate circuit including the radio frequency choke coil 12 and the modulating choke coil 11 and the plate battery 9. The oscillating circuit comprising the condenser 25 and the primary of the coupling transformer 27, which couples the transmitter to the antenna 28, is connected to the plate circuit of the tube 13 by means of condenser 22, and to the grid of the tube by means of the condenser 23 and grid leak 24. The oscillator is designed to oscillate at the particular frequency which is used for communication between the airplane and the ground stations. The grid-return circuit includes the left-hand portion of the biasing battery 14, the connection being made to a point along the primary winding of transformer 27.

The microphone M is coupled by means of transformer 1 to the grid circuit of the amplifying tube 4. A battery 2 is provided to supply transmitter current. The output circuit of the amplifying tube 4 includes the winding of a relay 5 and a condenser 6 in multiple, the modulating choke coil 11, and the plate battery 9. A key K is provided to arrange the circuits of the transmitter for either voice or telegraphic communication. When the key K is in its right-hand position, the transmitter is arranged for voice communication. In this position, the filament battery circuit for the tube is completed at the contact 19, the resistance 3 and the sec-

ondary winding of transformer 1, which are connected in parallel in the grid circuit of the amplifying tube 4, are connected through contacts 17 and 21 to a point along the biasing battery 14 to provide approximately six to eight volts bias on the grid of amplifying tube 4. With the key in this position, the transmitter is ready to transmit voice current to the repeating station.

Voice currents which are present in the microphone circuit are induced into transformer 1 and impressed on the grid of the amplifying tube 4. these currents are amplified by tube 4 and pass through the by-pass condenser 6 and through the modulating choke coil 11 to the plate battery 9. This modulating choke coil is also included in the plate circuit of the oscillating tube 13 which is oscillating at the broadcast frequency, and the variations in potential across this coil produced by the voice currents passing therethrough modulate the output of the oscillator in accordance with the speech currents. The modulated currents in the primary winding of transformer 27 are induced in the secondary winding of this transformer and radiated by means of the antenna 28. The ground-receiving station is provided with a radio receiver suitable for receiving and detecting the modulated radio waves.

A suitable radio receiver RR for use in the plane in connection with the transmitter RT is shown in the lower portion of the drawing. The receiver consists of an antenna 39, a coupling transformer 38 coupling the antenna to the grid circuit of the detector tube 35, transformer 34 coupling the plate of the detector tube to succeeding stages of the receiving set in case more stages are provided, the transformer 33 which couples the output of the intermediate stages to the grid of the amplifying tube 30, a pair of headphones 29, and an oscillator comprising tube 41 and its associated apparatus. A switch 31 located in the cockpit of the plane completes the filament circuit to tubes 30, 35, and the tubes of the intermediate stages. A separate switch 47 is provided to complete the filament circuit to the tube 41. This switch is also located in the cockpit of the plane and is operated only when telegraph communication is being used.

In the assumed case, with the key K in its right-hand position and the pilot using voice communication to the ground station, key 31 is closed but key 47 is left open. The ground station with whom the pilot is communicating will also use radio telephone, the incoming modulated waves being received over antenna 39 and induced in the secondary of transformer 38 which is located in the gird circuit of the detecting tube 35. The usual grid leak and condenser, 36 and 37, are provided in the grid circuit of tube 35 and a variable condenser 40 is shunted across the secondary winding of transformer 38 to tune the detector stage to the proper frequency. The output of the detector tube 35 is taken through the intermediate stages and finally to the amplifying tube 30. The grid circuit of the amplifying tube 30 includes a biasing battery 32 and the secondary winding of the audio frequency transformer 33. The output of the amplifying tube 30 is taken through the headphones 29 which the pilot keeps on his ears at all times while in the air. The pilot can now communicate with the ground station by telephone in the regular manner.

Ordinarily, telegraph communication is used between the airplane and the ground stations instead of radio telephone communication as described above. To arrange the transmitter for telegraph communication, the pilot throws the key K to its left-hand position. In this position, the resistance 3 is disconnected and the secondary winding of transformer 1 is connected through contact 20 of the key to the right-hand terminal of the biasing battery 14. The full voltage of battery 14 is sufficient to bias the tube 4 to cut-off, that is, the battery 14 impresses a sufficiently negative potential on the grid of tube 4 so that normally no plate current flows. The filament circuits of tubes 4 and 13 are completed at contacts 18, the modulating choke coil 11 is short-circuited at contacts 16, and the radio frequency choke 12 is short-circuited at contacts 15 by way of contacts 7 of relay 5. Since the radio frequency choke 12 and coil 11 are normally short-circuited, the feed back from tube 13 is no longer effective, and the tube 13 therefore stops oscillating and does not transmit the carrier wave. The short circuiting of the impedance coils 11 and 12 shunts the alternating current plate circuit including condenser 22, lower half of the primary of transformer 27, contact 26, left-hand part of battery 14, and contact 18 to the filament of tube 13. The alternating current in the plate circuit of tube 13 may now pass from the anode through contacts 15, springs 7 of relay 5, springs 16 and battery 9 to condenser 10 in multiple to the cathode of tube 13. As the oscillations of tube 13 depend upon the variations in the feed back circuit through the upper part of coil 27 and the grid leak and condenser to the grid of tube 13, and as such variations depend upon the current flow in the plate circuit through the lower half of coil 27, it will be apparent that when coil 27 is shunted by a path of practically no impedance, as just described, that practically no alternating current will flow in the coil 27 to vary the potential of the grid. It will also be apparent that whenever the short circuit is removed from the high impedance choke coil 12 that this shunt circuit is no longer effective due to its increased impedance and that current will flow in the plate circuit to start the oscillations of the tube 13.

The pilot also closes the switches 31 and 47 when he desires to communicate by radio telegraph. Switch 31 completes the filament circuit to tubes 30 and 35 while switch 47 completes the filament circuit to the oscillating tube 41. The oscillating tube 41 and its associated apparatus comprising grid leak 42 and condenser 43, tuning condenser 44, and the coupling transformer comprising windings 45 and 46 are arranged to oscillate at a frequency which is slightly above or slightly below the frequency to which the oscillator of the transmitter is tuned. The transformer comprising windings 45 and 46 furnishes the coupling between the grid and plate circuits of the oscillating tube 41, and this transformer is also located relatively close to the transformer 38 so that the output of the oscillator is also impressed on the radio receiving circuit to secure a heterodyne action.

With the key K in its left-hand position the pilot may now telegraph to the ground station. To do this, he pronounces the syllable "'dah" or a similar syllable for each dash impulse in the telegraph message and the syllable "dit" or a similar syllable for each dot impulse to be transmitted. The syllable "dah" is somewhat prolonged and the variations in current in the microphone circuit are induced in the secondary winding of the transformer 1 and impressed on the

grid of the tube 4. Since the tube 4 is in this case biased to cut-off, it operates as a rectifier. The plate current flows through the winding of relay 5, thereby operating this relay and at contacts 7 opening the shunt around the radio frequency choke 12. When the shunt is removed from the choke 12, the oscillator starts to oscillate, thereby sending an impulse of the carrier frequency to which it is tuned. Since the syllable "dah" was pronounced in this case, the relay 5 remains operated for a short interval, sufficiently long to cause the oscillator to transmit a prolonged signal indicative of a dash signal. In case the syllable "dit" is spoken into the microphone M, the voice currents will be of much shorter duration and the relay 5 will only be operated for a very brief instant. This causes the oscillator to transmit a much shorter impulse of radio frequency wave.

From the foregoing, it is seen that the pilot may in effect key the radio telegraph transmitter by means of voice. Each time he speaks into the microphone M, the relay 5 is operated to remove the shunt from the radio frequency choke coil thereby starting the oscillator which transmits the signals from antenna 28. When the syllable "dah" is spoken into the microphone, the relay 5 remains operated for a somewhat prolonged interval, thereby allowing a dash signal to be transmitted. When the syllable "dit" is spoken into the microphone, the relay 5 is operated for only a brief interval and a dot signal is transmitted.

The ground stations are equipped with a telegraph transmitter which is also arranged to transmit short and long impulses of the particular frequency assigned in accordance with the dots and dashes of the telegraph messages. The signals from the ground station are received by antenna 39 and induced in the secondary winding of transformer 38 which is included in the grid circuit of the detector tube 35. Since in this case the switch 47 is also closed, the oscillator including tube 41 is oscillating at a frequency slightly detuned from the assigned broadcast frequency. The output of the oscillator is coupled to transformer 38 and the heterodyne action between the two slightly detuned frequencies produces an audible beat note which is amplified by the amplifying tube 30 and may be heard in the receivers 29. Thus when a dash signal is received, the pilot hears a tone in the receivers 29 of relatively long duration, while when a dot signal is being received, the tone heard in the receivers 29 is of relatively short duration. Thus the telegraph message is received by the pilot in the form of short and long tones representing the dots and dashes of the telegraph message.

From the foregoing explanation, it will be apparent that applicant has invented an improved radio transmitter which is light and relatively cheap, and still has practically all of the advantages of a heavy, cumbersome, and expensive radio transmitter suitable for voice communication. By means of the improved transmitter of this invention, the pilot ordinarily communicates with the ground stations by means of radio telegraph, but when in a position relatively close to the ground station, which is the time when he requires specific and detailed instructions, the transmitter is sufficiently powerful to transmit voice communication. The transmitter has the additional advantage of leaving the pilot's hands free for use in controlling the plane at all times since both the radio telephone and the radio telegraph communication are accomplished with the voice of the pilot by speaking into the microphone.

What is claimed is:

1. In a radio transmitter for airplanes, the combination with a microphone of means controlled by the pilot by speaking into said microphone for transmitting modulated radio frequency waves for radio telephone communication, means for converting the transmitter for telegraph transmission means thereafter controlled by the pilot by speaking into said microphone for transmitting short and long pulses of radio frequency waves representing dots and dashes of a telegraph message for radio telegraph communication.

2. The combination in a radio transmitter of voice controlled means for transmitting modulated radio frequency waves for telephone communication, voice controlled means for transmitting short and long pulses of radio frequency waves for telegraph communication, and means for changing the circuit at will to render said two means effective.

3. In a radio transmitter, means for generating and transmitting radio frequency waves, a combination of circuits including means for modulating said waves in accordance with speech currents for telephone communication, a second combination of circuits including means responsive to voice currents to intermittently render said transmitter inoperative to thereby transmit short and long impulses of said radio frequency waves for telegraph communication, and means for rendering either one of said combinations of circuits effective at will.

4. In a radio transmitter, means for producing and transmitting radio frequency waves, a microphone, means including said microphone for modulating said waves in accordance with speech for telephone communication, means for changing the relation of said microphone to the transmitter and means including said microphone for thereafter controlling said first means to cause it to transmit short and long pulses of said waves for telegraph communication, the duration of each pulse dependent on the voice currents from the microphone.

5. In a radio transmitter, an oscillator for generating and transmitting radio frequency waves, a microphone, means including said microphone normally connected for modulating said waves in accordance with speech for telephone communication, an electromagnetic relay, means for changing the connections of said means and for causing said relay to be controlled by voice current produced by speaking into said microphone, and means controlled by said relay for starting and stopping said oscillator to transmit telegraph signals composed of pulses of said radio frequency waves, each pulse measured by voice current.

6. In a radio transmitter, an oscillator for producing and transmitting radio frequency waves, a microphone, a key having two operated positions, means effective when said key is in one position for modulating said waves in accordance with speech currents produced by speaking into said microphone, means effective when said key is in its other position for rendering said oscillator normally inoperative, and means for rendering said oscillator operative by speaking into said microphone.

7. In a radio transmitter, an oscillator for generating radio frequency currents, an amplifying tube, a microphone coupled to the grid circuit of said tube, means for modulating the output of said oscillator in accordance with amplified speech

currents in the plate circuit of said tube, a relay in the plate circuit of said tube, a condenser connected in multiple with said relay for by-passing speech currents, means for biasing said tube to cut-off, the currents produced by speaking into said microphone being then effective to operate said relay, and means controlled by said relay for controlling the operation of said oscillator.

8. In a radio transmitter, an oscillator tube for generating radio frequency currents, a radio frequency choke in the plate circuit of said tube, an amplifying tube, a microphone coupled to the grid circuit of said amplifying tube, a relay and a condenser connected in multiple in the plate circuit of said amplifying tube, a key, means responsive to the operation of said key in one direction for starting said oscillator and for preparing circuits for modulating the output of said oscillator in accordance with amplified voice currents in the plate circuit of said amplifying tube, said condenser by-passing the voice currents to prevent the operation of said relay, means responsive to the operation of said key in the other direction for short-circuiting said radio frequency choke to stop said oscillator and for biasing said amplifying tube to cut-off, said relay being then operable by speaking into said microphone, and contacts on said relay for opening the short-circuit of said radio frequency choke.

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