July 16, 1929. W. WURST 1,721,492

METHOD OF AND ARRANGEMENT FOR MULTIPLEX TELEPHONY

Filed Nov. 23, 1923

Fig. 1

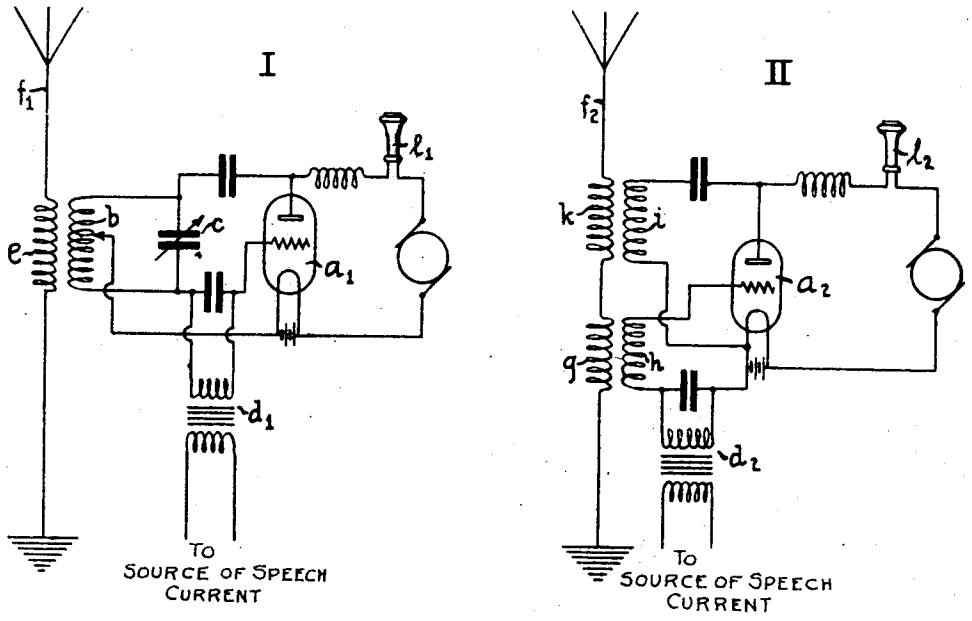
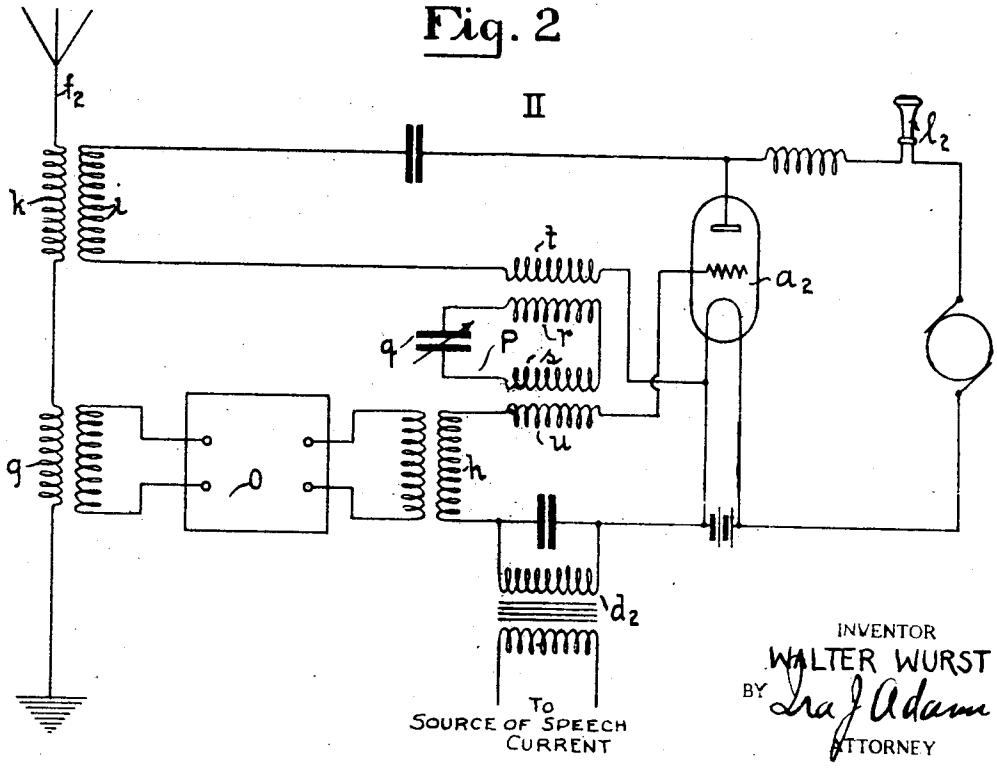


Fig. 2



INVENTOR
WALTER WURST
BY Ira J Adams
ATTORNEY

Patented July 16, 1929. 1,721,492

UNITED STATES PATENT OFFICE.

WALTER WURST, OF BERLIN, GERMANY, ASSIGNOR TO GESELLSCHAFT FÜR DRAHTLOSE TELEGRAPHIE M. B. H. HALLESCHES, OF BERLIN, GERMANY, A CORPORATION OF GERMANY.

METHOD OF AND ARRANGEMENT FOR MULTIPLEX TELEPHONY.

Application filed November 23, 1923, Serial No. 676,490, and in Germany December 2, 1922.

In wireless telephony, it is known that two or more transmitters independent of one another can be operated at substantially the same wave length and can at the same time be used as receivers or be combined with special receiving arrangements. The wave lengths of these two transmitters must be kept exactly constant during their operation, or else heterodyne sounds occur which make reception impossible. The control by speech must be so effected that the wave-length is not altered. Modes of controlling which fulfill this condition are known, for instance, the direct current grid-controlling of a vacuum tube. On the other hand, the variations of the working plate-voltage and filament-voltage must be reduced in such a way that the wave lengths are not perceptibly altered, since an alteration of even less than ten oscillations per second produces a disturbing creaking, although the heterodyne sounds do not then lie within the range of audibility. However, such constancy of wave-length is extremely difficult of attainment in practice, that is, duplex telephony with two transmitters wholly independent of one another which have the same wave-length seems extremely difficult.

According to the present invention, multiplex, for example, duplex telephony is possible without keeping the wave length of the transmitters exactly constant by impressing the wave length of one of the transmitters which is chosen at will, upon the other transmitter which has a suitable arrangement.

In the drawing,

Fig. 1 is a diagrammatic representation of a circuit arrangement embodying the invention and comprising two transmitters, one of which is controlled as to its wave length by the other; and

Fig. 2 is a diagrammatic representation of a circuit arrangement which may be employed in the controlled transmitter.

In Fig. 1 I is the transmitter by which the wave length is determined. The transmitting vacuum tube a_1 acts upon an intermediate circuit containing, as shown, a coil b and a condenser c arranged, for instance, in three-point connection. This connection can, if desired, be replaced by a connection of any other suitable form. The manner of controlling the transmitter I has no influence on the operation of the arrangement. In the illustrated arrangement, the known method of control by speaking on to the grid of the tube a_1 across the speech-transformer d_1 is employed. The coil b of the intermediate circuit is normally coupled to the coil e of the aerial f_1, so that the radio frequency energy generated by the vacuum tube transmitter I is transferred to aerial f_1 and radiated by it. II is a separately controlled transmitter. The transmitting vacuum tube a_2 receives its grid-voltage across aerial f_2, which takes up part of the energy radiated by aerial f_1 and transfers it across the coupling coil g to the grid-coil h, so that the grid of the transmitting vacuum tube a_2 gets an alternating voltage of a frequency corresponding to the frequency of transmitter I. The plate of the transmitter II is coupled to aerial f_2 by means of the plate-circuit coupling coil i and the aerial coupling coil k, and in this way gives back radio-frequency energy across the aerial f_2 to the first transmitter. The grid coil h of transmitter II is closely coupled to the coil g of the aerial f_2, so that the radio frequency energy coming from transmitter I supplies the grid energy necessary for causing transmitter II to give off the same wave length as transmitter I. Transmitter II is controlled by speaking on to its grid across the speech-transformer d_2 or in any other suitable way. Both of the transmitters contain a receiving device, for example, the telephones l_1 and l_2 in the plate-filament direct-current circuit of the transmitting vacuum tubes. The speech of transmitter I can then be heard in telephone l_2 and that of transmitter II in telephone l_1.

When this arrangement is used for wireless telephony, a radio frequency amplifier o, Fig. 2, is preferably connected between the aerial coupling coil g and grid coil h so that the incoming radio frequency energy is amplified as necessary for the grid energy of transmitter II. The controlling and receiving arrangements may remain the same.

The operation of the arrangement whether it is or is not provided with a radio frequency amplifier can be improved by interposing a special coupling between the plate and grid circuits of the controlled transmitter II. Such coupling may comprise a circuit P, Fig. 2, tuned to the wave length being transmitted, so that the transmitter inclines to self-excitation. The coupling must, however, be made

so loose that the oscillations of transmitter II only commence when excited by transmitter I. It is clear that the grid energy necessary for the separate controlling of transmitter II is diminished by the circuit P which includes a condenser q and coils r and s. The coils r and s are coupled to the added plate circuit, coil t and grid-coil u respectively.

Having described my invention, what I claim is:

1. An arrangement for multiplex communication comprising a plurality of transmitters, each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, and means for coupling the grid circuit and plate-filament circuit of the tube of a second transmitter to its aerial in such a manner as to cause the existence of oscillations in the second transmitter to be determined through excitation by the wave length of the first transmitter.

2. An arrangement for multiplex communication comprising a plurality of transmitters, each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, means for coupling the plate-filament circuit of the transmitting tube of a second transmitter to its aerial, and means for separately closely coupling the grid circuit of the tube of the second transmitter to the aerial so as to cause said grid circuit to supply radio frequency energy from the first transmitter to the grid of the tube of the second transmitter to an extent such as to cause the second transmitter to deliver energy with the same wave length as the first transmitter said second transmitter being excited into oscillation by said first transmitter.

3. An arrangement for multiplex communication comprising a plurality of transmitters, each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, means for coupling the plate-filament circuit of the transmitting tube of a second transmitter to its aerial, means for coupling the grid circuit of the tube of the second transmitter to the aerial, and an amplifier in said grid circuit for causing sufficient energy to be supplied to said circuit from the first transmitter to cause the second transmitter to deliver energy with the same wave length as the first transmitter.

4. An arrangement for multiplex communication comprising a plurality of transmitters, each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, means for coupling the plate-filament circuit of the transmitting tube of the second transmitter to its aerial, means for coupling the grid circuit of the tube of the second transmitter to the aerial, and a tuned circuit for loosely coupling together the plate-filament circuit and grid circuit of the tube of the second transmitter.

5. An arrangement for multiplex communication comprising a plurality of transmitters, each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, means for coupling the plate-filament circuit of the transmitting tube of a second transmitter to its aerial, means for closely coupling the grid circuit of the tube of the second transmitter to the aerial, and a closed circuit tuned to the wave length being transmitted and coupled to the plate-filament circuit and grid circuit of the tube of the second transmitter so as to cause the second transmitter to have a tendency to produce oscillations, thereby diminishing the energy necessary to be supplied to the grid circuit of the tube of the second transmitter from the first transmitter in order to cause the second transmitter to deliver energy with the same wave length as the first transmitter.

6. An arrangement for multiplex communication comprising a plurality of transmitters, each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, means for coupling the plate-filament circuit of the transmitting tube of a second transmitter to its aerial, means for coupling the grid circuit of the tube of the second transmitter to the aerial, and a closed circuit tuned to the wave length being transmitted and coupled to the plate-filament circuit and grid circuit of the tube of the second transmitter so loosely as normally not to cause the tube of the second transmitter to produce oscillations, said circuit, however, causing the second transmitter to have a tendency to produce oscillations.

7. An arrangement for multiplex communication comprising a plurality of transmitters each of which comprises an aerial and a transmitting tube, means for independently determining the wave length of one of the transmitters, means for coupling the plate-filament circuit of the transmitting tube of a second transmitter to its aerial, means for closely coupling the grid circuit of the tube of the second transmitter to the aerial, and means for diminishing the energy necessary to be supplied from the first transmitter to the grid circuit of the tube of the second transmitter in order to cause the second transmitter to deliver energy with the same wave length as the first transmitter, said means comprising an amplifier in the grid circuit of the tube of the second transmitter and a circuit tuned to the wave length being transmitted and coupled to the plate filament-circuit and the grid circuit of the tube of the second transmitter.

8. An arrangement for multiplex com-

munication comprising a first transmitter and a second transmitter, each transmitter comprising a three electrode electron discharge tube and a transmitting conductor, means whereby said first transmitter generates oscillations determining the frequency of the arrangement, means whereby the grid anode circuit of said second transmitter is coupled to its transmitting conductor and is excited by said first transmitter thereby to cause oscillations, and communication apparatus associated with said transmitters.

9. An arrangement for multiplex communication comprising, a first transmitter and a second transmitter, each transmitter comprising a three electrode electron discharge tube and a transmitting conductor, means whereby said first transmitter generates oscillations determining the frequency of the arrangement, means whereby said second transmitter has its tube regeneratively connected in such manner that said second transmitter will transmit oscillations only when excited by said first transmitter, and communication apparatus associated with said transmitters.

10. An arrangement for multiplex communication comprising two different transmitters, each of which includes an antenna and a regeneratively coupled electron discharge device, the regeneration in only one of the transmitters being sufficient to cause self sustained oscillations of a predetermined frequency, and means whereby the other transmitter is regeneratively connected in such a manner that it will transmit oscillations of said frequency only when excited by said first transmitter.

WALTER WURST.