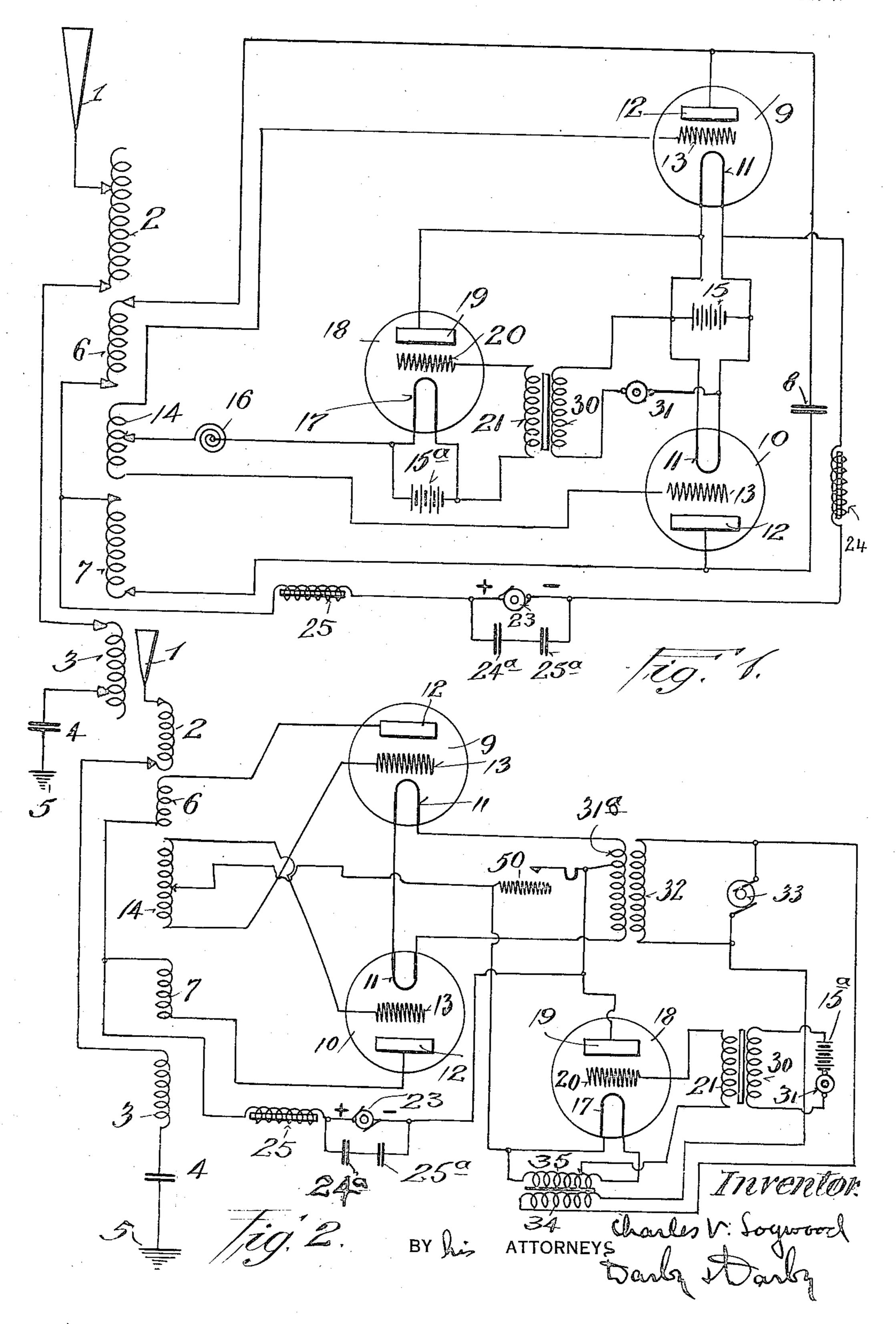
C. V. LOGWOOD.

RADIOCOMMUNICATION.

FILED JULY 2, 1921.

2 SHEETS-SHEET 1.

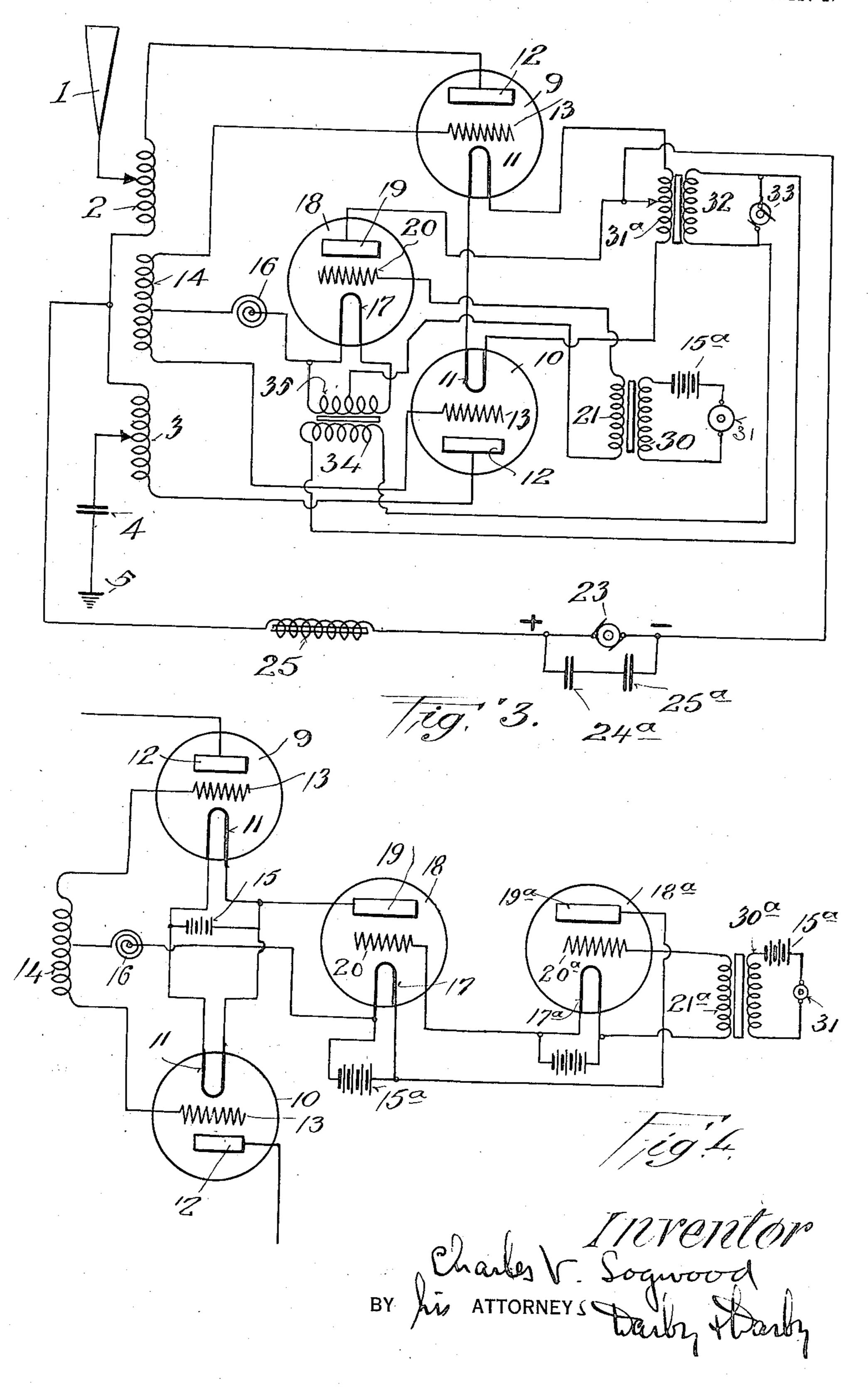


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2 SHEETS-SHEET 2.



## UNITED STATES PATENT OFFICE.

CHARLES VEYNE LOGWOOD, OF CHICAGO, ILLINOIS, ASSIGNOR TO DE FOREST RADIO TELEPHONE & TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

RADIOCOMMUNICATION.

Application filed July 2, 1921. Serial No. 482,035.

To all whom it may concern:

a citizen of the United States, residing at mary circuit includes inductances 6 and 7, Chicago, in the county of Cook, State of inductively associated with inductances 2, 5 Illinois, have made a certain new and useful 3, of the radiating circuit and condenser 8, 60 invention in Radiocommunication, of which and vacuum tubes 9 and 10. Each of the the following is a specification.

cation, and is particularly directed to sys- the filament electrode 11, and the plate elec-10 tems that are employed for the transmission trode 12 and the intermediate or grid elec- 65 of signals through the medium of high fre- trode 13. The grid electrodes of the two quency currents.

15 cient and economical in manufacture.

materially increased.

distance of transmission of signals, such as are adjustable, as indicated, and the induc-25 obtained with simple non-complicated cir- ment electrode 17 of a vacuum tube 18, 80 cuits.

Further objects of the invention will appear more fully hereinafter.

30 combination, construction, location and relative the tubes 9, 10. The grid electrode 20 of the 85

35 pointed out in the claims. Referring now to the drawings,—

Fig. 1 is a diagrammatic view illustrating a circuit arrangement embodying my invention, showing the same in connection with a 40 wireless telephone transmitter system;

Fig. 2 is a similar view for a slightly modified arrangement showing in addition to the telephone circuit a wireless telephone transmitter system;

further modified arrangement; and

Fig. 4 is a similar view showing a modiis employed in accordance with my inven-50 tion.

The same part is designated by the same reference character wherever it occurs throughout the several views.

55 circuit of the open radiating type, compris-

ing the antenna 1, the inductances 2, 3, con-Be it known that I, Charles V. Logwood, denser 4, and earth connection 5. The privacuum tubes contain or have associated This invention relates to radio communi- therewith the usual three electrodes, namely, tubes 9, 10, are connected to each other The object of the invention is to provide through the inductance 14, which is induca signaling system which is simple and effi-tively associated with the coils 2, 6, 7 and 3, as shown. The vacuum tubes 9 and 10 are 70 A further object of the invention is to connected in shunt to the coils 6, 7, and the provide a system of the character set forth condenser 8. The filament electrodes 11 of wherein the electrical power of radiation is the vacuum tubes 9 and 10 are connected in parallel, and are heated from a common A further object of the invention is to source, for example, the battery 15. All 75 provide a system which will lengthen the connections to the inductances 2, 6, 7 and 3 wireless telephone, without distortion, to a tance 14 has an adjustable tap connection distance greater than has heretofore been including a choke coil 16 leading to the filawhich filament electrode 17 is heated from a suitable source, for example, battery 15a. The plate electrode 19 of vacuum tube 18 is My invention consists substantially in the connected to one leg of the filaments 11 of tive arrangement of parts and circuits em- vacuum tube 18 is connected to its filament ployed in connection therewith, all as will 17 through the transformer coil 21. With be more fully hereinafter set forth, as shown this arrangement it will be apparent that in the accompanying drawings and finally there is no conductive connection between the grid electrodes 13 of vacuum tubes 9 and 90 10 and any other electrode or electrodes thereof, the only connections effected being the inductive relation between the grid and plate electrodes and the high resistance leakage path existing between the filament and 95 the plate electrodes of the vacuum tube 18 in the evacuated vessel thereof. Current is supplied to the plate electrodes 12 of the vacuum tubes 9, 10, from a suitable source Fig. 3 is a similar view showing a still of current, for example, generator 23, 100 shunted by condensers 24<sup>a</sup>, 25<sup>a</sup>. One terminal, usually the negative terminal of the fication of the type of resistance path that current source 23, is connected to one leg of the filaments 11 of the vacuum tubes 9 and 10, through the choke coil 24, and the 105 other terminal is connected through the choke coil 25 to the respective plate electrodes 12 of the vacuum tubes 9 and 10, there-Referring to Fig. 1, I show an insulating by constituting the usual B battery circuit of the oscillating audion circuit. The choke 110

coils 25 and 24 tend to filter out excessive vacuum tubes 9 and 10 through the plate 5 absorb changes of commutator ripples.

tionally good oscillating circuit, giving a accordingly. very high efficiency in power supply to the 10 the vacuum tubes 9 and 10 being fed by a circuit with only 8 micro-henries of induct- 75 15 ing the current to increase or decrease in helix 8 inches in diameter, thus a frequency 80 9 and 10. An increase of positive potential on one grid electrode 13 increases the plate current, while in the other tube a negative 20 charge is impressed on the grid, which further deflects the current to the other tube until the oscillation completes the cycle and reverses the process causing a shift of the polarity which in turn reacts throughout the 25 circuit. Thus it will be seen that the grid electrode 13 of one tube is always influenced by the opposite tube. It will be apparent that through the operation of oscillation there is a necessity for equalizing the nega-30 tive charge on the grid electrodes 13, and to accomplish this I employ a resistance. It is obvious that a high resistance is necessary, and, for that reason, I employ the resistance represented by the evacuated space between 35 the filament 17 and the plate 19 of the vacuum tube 18. The current source 15<sup>a</sup> which heats the filament 17 of the vacuum tube 18 is isolated from the ground and is connected through the choke coil 16 to the grid elec-40 trodes 13 of the vacuum tubes 9 and 10, as as described in connection with Fig. 1, with 105 hereinbefore described. Thus a positive the vacuum tube 18 connected between the 19 of the tube 18 from a current source 15 tubes 9 and 10, as hereinbefore described. employed for heating the filaments 11 of the In this instance, however, the filaments 11 45 tubes 9 and 10, so that the internal resistance include in the circuit thereof one coil, 31a, of 110 of the tube is sufficient to prevent short cir- a transformer, the second coil, 32, of which cuiting the filaments 11 to grids 13, as in is connected in shunt around the terminals power transmission sets this must be of an alternating current generator 33,. avoided, and excessive grid currents must whereby alternating current is supplied necessarily be checked. Where the system through a transformer 32, 31a, to the fila-115 is to be employed for telephone transmission, ments 11, to light the same. Alternating the primary coil 30 which is inductively as- current 33 is also connected in shunt to the sociated with the coil 21 connected between primary coil 34 of the transformer, the secthe grid 20 and filament 17 of vacuum tube ondary coil, 35, of which is connected in 55 18, is connected through microphone 31, series with the filament electrodes 17 of 120 which derives its current as illustrated, the vacuum tube 18 whereby the filament though to these variations I do not desire 17 is supplied with heating current, as to be limited or restricted, from the current will be obvious. In this arrangement the source 15, which is employed to heat the fila- microphone 31 is connected in a microphone 60 ment 11 of the vacuum tubes 9 and 10. circuit supplied with current from a suitable 125 When words are spoken in the microphone source such as the battery 15<sup>a</sup>. When it is 31, currents are induced through the trans- desired to use this circuit and system for former 30, 21, to the grid 20 of vacuum tube radio telegraph transmission I have found it

currents. Choke coil 16 prevents high fre- electrode 19 of tube 18 to the grid electrodes. quency currents from passing through the 13 of vacuum tubes 9 and 10. Thus the valeakage path and the condensers 24° and 25° riations of wave forms cause speech to be transmitted through the radiating system 1 70 I have found this circuit to be an except to 5, and, of course, at the receiving end

With this circuit I have found it possible radiating circuit. The plate electrodes of to transfer through the primary oscillating supply of current from a generator 23, ance with an efficiency of 60 per cent output causes a change of potential in the grid elector to input, using a capacity of .008 microtrodes 13 of the vacuum tubes 9 and 10, by farads across the plates. This inductance inducing an opposite potential, thereby caus- corresponds to one and a half turns of a the plate electrodes 12 of the respective tubes of two million is easily obtained without any damage to the power tubes employed for generating the high frequency currents.

I have found that it is advisable that the tubes 9 and 10 be so associated to the in-85 ductances employed that the plate of one tube is always influenced by the grid of the other tube with a capacity of .01 microfarads. I have obtained a wave length from 200 to 5,000 meters without changing any of 90 the constants of the circuit other than the inductance in each plate circuit, and employing an inductive grid circuit as shown

with a period of only 200 meters.

In Fig. 2 I show a substantially identical 95 arrangement as shown in Fig. 1, varying therefrom only in diagrammatic illustration, illustrating the application of the system to wireless telegraphy, and also to show a modification as to the means employed for light- 100 ing the filaments of the respective vacuum tubes 9, 10 and 18. It will be observed that the circuit arrangements of the vacuum tubes 9 and 10 are the same in this figure potential is impressed on the plate electrode grids and filaments of the respective vacuum 18, thus stopping or increasing the leak cur-efficient to connect the telegraph key as 65 rent which passes from the filaments 11 of shown between the grids 13 and the filaments 130

11, i. e., in the leak path of the vacuum tubes cold electrodes with said antenna earth sys-9 and 10. In Fig. 3 an effort has been made tem, a circuit connecting one set of said cold that of Fig. 2, omitting the telegraph key a high resistance, and means for varying 5 50, in the same diagrammatic scheme em- said resistance by and in accordance with 70 ployed for the illustration of Fig. 1, whereby signals. the similarity thereof will be readily appar- 3. A radio signaling system comprising an ent. I have also incorporated in this view antenna earth system, a plurality of audions the modification wherein the inductive cou- having plate, grid and filament electrodes 10 pling between the antenna earth circuit and associated therewith, a circuit connecting 75 the plate circuit of the vacuum tubes 9 and said plate electrodes to each other and to therebetween, thereby enabling the elimina- said grid electrodes to each other, a circuit tion of inductance coils 6 and 7.

for effectively increasing sensitiveness of in a resistance, and means for varying said modulation effected by the microphones 31, resistance by and in accordance with signals. where exceedingly high power is being gen- 4. A radio signaling system comprising erated by the oscillion system. In this ar- an antenna earth system, a plurality of 20 rangement the vacuum tubes 9 and 10 are audions having plate, grid and filament elec- 85 connected through the resistance formed by trodes associated therewith, a circuit connectthe vacuum tube 18, to their respective fila- ing said plate electrodes to each other and to ments, but instead of the grid filament cir- said filament electrodes, a circuit connectcuit of the vacuum tube 18 being directly ing said grid electrodes to each other, a cir-25 controlled by the microphone, the grid electrodes cuited connected between said grid electrodes 90 trode 20 is insulated from its filament by the and said filament electrodes and including vacuum of tube 18a, the grid filament circuit therein a resistance, and means for varying 20a, 17a, thereof being directly controlled said resistance by and in accordance with by the microphone circuit 15a, 30, through signals, and means for associating said 30 the transformer 21<sup>a</sup>, 30<sup>a</sup>, the plate electrode audions with said antenna earth system. 19<sup>a</sup> being connected to the filament electrode 5. A radio signaling system comprising 17 of vacuum tube 18.

details will readily occur to those skilled in trodes associated therewith, a circuit con-35 the art without departing from the spirit necting said plate electrodes to each other 100 and scope of my invention as defined in the and to said filament electrodes, a circuit conclaims and shown in the accompanying necting said grid electrodes to each other, drawings, and I, therefore, desire to have the a circuit connected between said grid elecforegoing description and the drawings used trodes and said filament electrodes and in-40 in connection therewith regarded in an illus- cluding therein a resistance, and means for 105 trative rather than in a limiting sense; but varying said resistance by and in accordance having now set forth the objects and nature with signals, and means included in said of my invention, and having shown and de- plate and grid circuits for associating said scribed circuits showing the embodiment audions with said antenna earth system. theroef, what I claim as new and useful and 6. A radio signaling system comprising 110 desire to secure by Letters Patent is:

an antenna earth system, a plurality of trodes associated therewith, a circuit convacuum tubes having hot and two or more necting said plate electrodes to each other cold electrodes, means for associating said and to said filament electrodes, a circuit con- 115 cold electrodes with said antenna earth sys- necting said grid electrodes to each other, a tem, and with said hot electrodes, and a circuit connected between said grid elecvacuum tube interposed between one set of trodes and said filament electrodes and includcold electrodes and the filament electrodes ing therein a resistance, and means for varyso whereby the space between the electrodes of ing said resistance by and in accordance with 120 said last mentioned vacuum tube constitutes signals, and means included in said plate and a resistance in the circuit between said set of grid circuits for associating said audions cold electrodes and the filament electrodes, with said antenna earth system and with and means for varying the conductivity of each other. 60 the space of the vacuum tube by and in ac- 7. A radio signaling system comprising 125

to lay out the same circuit arrangement as electrodes with said hot electrodes including

10, is modified to a conductive coupling said filament electrodes, a circuit connecting connected between said grid electrodes and In Fig. 4 I have shown an arrangement said filament electrodes and including there-80

an antenna earth system, a plurality of Many other modifications and changes in audions having plate, grid and filament elec-

an antenna earth system, a plurality of 1. A radio signaling system, comprising audions having plate, grid and filament elec-

cordance with signals.

an antenna earth system, a plurality of 2. A radio signaling system, comprising audions having a plate, grid and filament an antenna earth system, a plurality of electrodes associated therewith, a circuit convacuum tubes having hot and two or more necting said plate electrodes to each other 65 cold electrodes, means for associating said and to said filament electrodes, a circuit con- 130

trodes and said filament electrodes and including therein a vacuum space, and means 5 for varying the conductivity of said vacuum space by and in accordance with signals.

8. A radio signaling system comprising and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid elec-15 trodes and said filament electrodes and including therein a vacuum space and means for varying the conductivity of said vacuum space by and in accordance with signals, and audions having plate, grid and filament elecmeans for associating said audions with said trodes associated therewith, a circuit con-20 antenna earth system.

an antenna earth system, a plurality of audions having plate, grid and filament elec- circuit connected between said grid electrodes associated therewith, a circuit con-25 necting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, ductivity of the space between the electrodes a circuit connected between said grid elec- of said vacuum tube by and in accordance 30 cluding therein a vacuum space, and means plate and grid circuits for associating said 95 for varying the conductivity of said vacuum space by and in accordance with signals, and means included in said plate and grid circuits for associating said audions with said 35 antenna earth system.

10. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit con-40 necting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and in-45° cluding therein a vacuum space, and means for varying the conductivity of said vacuum space by and in accordance with signals, and means included in said plate and grid circuits for associating said audions with said. 50 antenna earth system and with each other.

audions having plate, grid and filament elec- circuit connected between said grid elec-55 necting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and in-60 cluding therein the separated electrodes of a vacuum tube, and means for varying the conductivity of the space between the electrodes of said vacuum tube by and in accordance with signals.

necting said grid electrodes to each other, an antenna earth system, a plurality of a circuit connected between said grid elec- audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and to said filament electrodes, a circuit con-70 necting said grid electrodes to each other, a circuit connected between said grid elecan antenna earth system, a plurality of trodes and said filament electrodes and inaudions having plate, grid and filament elec- cluding therein the separated electrodes of 10 trodes associated therewith, a circuit con- a vacuum tube, and means for varying the 75 necting said plate electrodes to each other conductivity of the space between the electrodes of said vacuum tube by and in accordance with signals, and means for associating said audions with said antenna earth system.

13. A radio signaling system comprising an antenna earth system, a plurality of necting said plate electrodes to each other 85 9. A radio signaling system comprising and to said filament electrodes, a circuit connecting said grid electrodes to each other, a trodes and said filament electrodes and including therein the separated electrodes of a 90 vacuum tube, and means for varying the controdes and said filament electrodes and in- with signals, and means included in said audions with said antenna earth system.

14. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit connect- 100 ing said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and including 105 therein the separated electrodes of a vacuum tube, and means for varying the conductivity of the space between the electrodes of said vacuum tube by and in accordance with signals, and with each other.

15. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and 115 11. A radio signaling system comprising to said filament electrodes, a circuit conan antenna earth/system, a plurality of necting said grid electrodes to each other, a trodes associated therewith, a circuit con- trodes and said filament electrodes and including therein the filament and plate elec- 120 trodes of an auxiliary audion, and means for impressing a signal current upon the grid electrode of said auxiliary audion.

16. A radio signaling system comprising an antenna earth system, a plurality of 125 audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and to said filament electrodes, a cir-12. A radio signaling system comprising cuit connecting said grid electrodes to each 130

electrodes and said filament electrodes and conductivity of the space between the elecelectrodes of an auxiliary audion, and means ance with signals, and means for associatfor impressing a signal current upon the ing said audions with said antenna earth 70

antenna earth system.

10 an antenna earth system, a plurality of an antenna earth system, a plurality of au- 75 audions having plate, grid and filament dions having plate, grid and filament elecelectrodes associated therewith, a circuit con-trodes associated therewith, a circuit connecting said plate electrodes to each other necting said plate electrodes to each other and to said filament electrodes, a circuit and to said filament electrodes, a circuit 15 connecting said grid electrodes to each other, connecting said grid electrodes to each other, 80 a circuit connected between said grid elec- a circuit connected between said grid electrodes and said filament electrodes and in- trodes and said filament electrodes and including therein the filament and plate elec-cluding therein the separated electrodes of trodes of an auxiliary audion, and means for a vacuum tube, and means for varying the 20 impressing a signal current upon the grid conductivity of the space between the elec- 85 electrode of said auxiliary audion, and trodes of said vacuum tube by and in acmeans included in said plate and grid cir- cordance with signals, and means included cuits for associating said audions with said in said plate and grid circuits for associatantenná earth system.

an antenna earth system, a plurality of trodes of said audions and said vacuum tube audions having plate, grid and filament from the same source of current. electrodes associated therewith, a circuit con- 22. A radio signaling system comprising necting said plate electrodes to each other an antenna earth system, a plurality of auand to said filament electrodes, a circuit dions having plate, grid and filament elec- 95 connecting said grid electrodes to each other, trodes associated therewith, a circuit cona circuit connected between said grid elec- necting said plate electrodes to each other trodes and said filament electrodes and in- and to said filament electrodes, a circuit cluding therein the filament and plate elec- connecting said grid electrodes to each other, 35 trodes of an auxiliary audion, and means a circuit connected between said grid elec- 100 for impressing a signal current upon the trodes and said filament electrodes and in-

with each other.

19. A radio signaling system comprising conductivity of the space between the elec-40 an antenna earth system, a plurality of trodes of said vacuum tube by and in ac- 105 electrodes associated therewith, a circuit con- and means for heating the hot electrodes of necting said plate electrodes to each other said audions and said vacuum tube from the and to said filament electrodes, a circuit same source of current. 45 connecting said grid electrodes to each other, 23. A radio signaling system comprising 110 50 conductivity of the space between the elec- and to said filament electrodes, a circuit con- 115 55 current.

60 necting said plate electrodes to each other of current. 65 cluding therein the separated electrodes of necting said plate electrodes to each other 130

other, a circuit connected between said grid a vacuum tube, and means for varying the including therein the filament and plate trodes of said vacuum tube by and in accordgrid electrode of said auxiliary audion, and system, and means for heating the hot elecmeans for associating said audions with said trodes of said audions and said vacuum tube from the same source of current.

17. A radio signaling system comprising 21. A radio signaling system comprising ing said audions with said antenna earth 25 18. A radio signaling system comprising system, and means for heating the hot elec- 90

grid electrode of said auxiliary audion, and cluding therein the separated electrodes of a vacuum tube, and means for varying the

audions having plate, grid and filament cordance with signals, and with each other,

a circuit connected between said grid elec- an antenna earth system, a plurality of autrodes and said filament electrodes and in- dions having plate, grid and filament eleccluding therein the separated electrodes of a trodes associated therewith, a circuit convacuum tube, and means for varying the necting said plate electrodes to each other trodes of said vacuum tube by and in ac-necting said grid electrodes to each other, cordance with signals, and means for heat- a circuit connected between said grid elecing the hot electrodes of said audions and trodes and said filament electrodes and insaid vacuum tube from the same source of cluding therein the filament and plate electrodes of an auxiliary audion, and means 120 20. A radio signaling system comprising for impressing a signal current upon the an antenna earth system, a plurality of grid electrode of said auxiliary audion, and audions having plate, grid and filament elec-means for heating the filament electrodes trodes associated therewith, a circuit con- of all of said audions from the same source

and to said filament electrodes, a circuit con- 24. A radio signaling system comprising necting said grid electrodes to each other, a an antenna earth system, a plurality of aucircuit connected between said grid elec- dions having plate, grid and filament electrodes and said filament electrodes and in- trodes associated therewith, a circuit con-

connecting said grid electrodes to each other, cuits for associating said audions with said a circuit connected between said grid elec- antenna earth system, and means for heating trodes and said filament electrodes and in- the filament electrodes of all of said audions 5 cluding therein the filament and plate elec. from the same source of current. trodes of an auxiliary audion, and means for impressing a signal current upon the an antenna earth system, a plurality of augrid electrode of said auxiliary audion, and dions having plate, grid and filament elecmeans for associating said audions with said trodes associated therewith, a circuit con-10 antenna earth system, and means for heat- necting said plate electrodes to each other 35 ing the filament electrodes of all of said and to said filament electrodes, a circuit audions from the same source of current. connecting said grid electrodes to each other, 25. A radio signaling system comprising a circuit connected between said grid elec-15 dions having plate, grid and filament elec- cluding therein the filament and plate elec- 40 trodes associated therewith, a circuit con-trodes of an auxiliary audion, and means necting said plate electrodes to each other for impressing a signal current upon the and to said filament electrodes, a circuit con-grid electrode of said auxiliary audion, and necting said grid electrodes to each other, with each other, and means for heating the 20 a circuit connected between said grid elec- filament electrodes of all of said audions 45 trodes and said filament electrodes and in- from the same source of current. cluding therein the filament and plate elec- In testimony whereof I have hereunto set trodes of an auxiliary audion, and means for my hand on this 23rd day of June, A. D., impressing a signal current upon the grid 1921. 25 electrode of said auxiliary audion, and CHARLES VEYNE LOGWOOD.

and to said filament electrodes, a circuit means included in said plate and grid cir-

26. A radio signaling system comprising an antenna earth system, a plurality of au-trodes and said filament electrodes and in-