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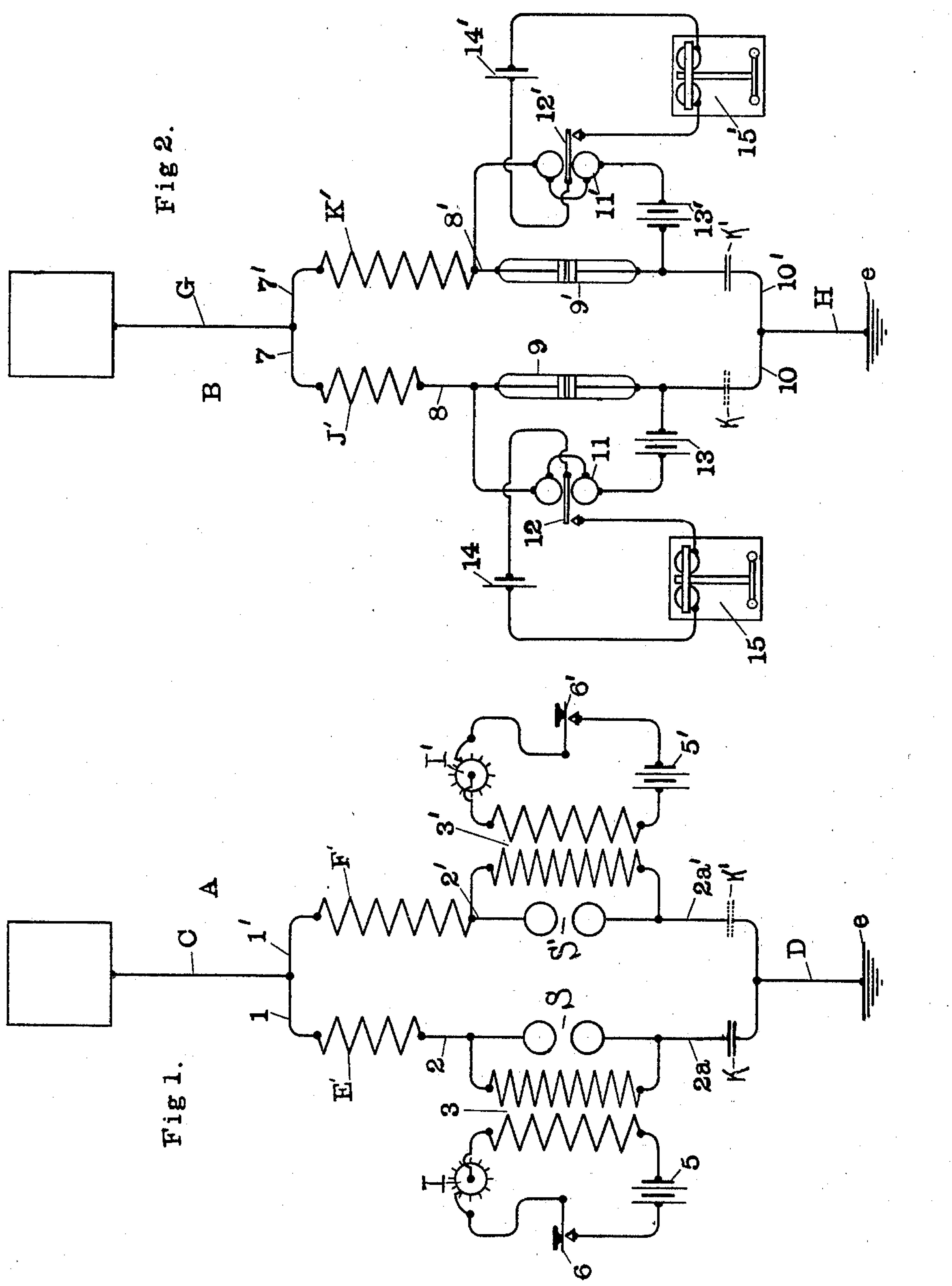
G. W. PICKARD.

WIRELESS SIGNALING SYSTEM.

(Application filed June 22, 1901.)

(No Model.)



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GREENLEAF W. PICKARD, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO GUSTAVE P. GEHRING, OF PHILADELPHIA, PENNSYLVANIA, AND THE AMERICAN WIRELESS TELEPHONE AND TELEGRAPH COMPANY, OF ARIZONA TERRITORY.

WIRELESS SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 711,174, dated October 14, 1902.

Application filed June 22, 1901. Serial No. 65,619. (No model.)

To all whom it may concern:

Be it known that I, GREENLEAF W. PICKARD, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Wireless Signaling Systems, of which the following is a specification.

My invention relates to wireless signaling systems in which the energy representing the signal is of the electromagnetic type, of extremely high frequency, and is impressed upon the natural media at the transmitting-station and received upon circuits at the receiving-station, in which are generated electrical potentials and currents which are employed to control recording apparatus.

My invention relates more particularly to a system in which electroradiant energy is impressed upon the natural media and received from the natural media by conductors extending vertically from the earth's surface and having an earth connection.

My invention comprises, further, means for determining the frequency of the electroradiant energy employed in such a system, and more particularly it comprises a system in which there are impressed upon the natural media from the same radiating-conductor, independently or simultaneously, energies of different frequencies, each energy or combination of energy representing a separate signal, and receiving at the receiving-station a plurality of messages in the form of electroradiant energy upon one and the same receiving-conductor and properly selecting out each message or signal to its proper recording device.

My invention comprises, further, a system for simultaneously transmitting from the same radiating-conductor radiant energies of different frequencies, each energy of a definite frequency being under control of a separate transmitter, and at the receiver receiving energies of different frequencies upon a single receiving-conductor or combination of conductors and selecting the energy of a predetermined frequency to its proper local circuit, whereby several messages are received simultaneously or independently and properly selected to their respective recording devices.

My invention comprises a system in which the radiating or receiving conductor or combination of conductors is common to several transmitters and receivers and having associated with such conductors branch circuits, including frequency-determining elements of different magnitudes, whereby the conductor and a branch circuit of the transmitter has the product of its capacity and inductance equal to that of the conductor and a branch circuit of the receiver.

Heretofore in wireless signaling systems it has been common to tune the transmitting and receiving stations to each other, so that the receiving-circuit would respond only to the energy of the particular frequency emitted at the transmitter. By my system, however, I am enabled to use the same radiating-conductor for transmitting several energies of different frequencies and for receiving several energies and selecting them into their proper branch circuits. In other words, instead of using a plurality of conductors at both the transmitter and receiving stations correspondingly tuned I employ only a single radiating-conductor and employ in connection therewith a plurality of branch circuits, each branch including a frequency-determining element, generally an inductance, whereby the necessity for a plurality of radiating-conductors is avoided.

Reference is to be had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of the circuits at a transmitting-station. Fig. 2 is a diagrammatic view of the circuits at an associated receiving-station.

In Fig. 1, C represents the usual aerial conductor of a wireless signaling system at the transmitting-station A. This radiating-conductor may be a single wire extending vertically from the surface of the earth and, if desired, supplied with a capacity area at the top, or it may be a combination of wires, a cylinder, or the like.

At the bottom of the conductor C are shown branch circuits, beginning with the conductors 1 1'. The branch circuit to the left comprises the conductor C, the conductor 1, the inductance E', the conductor 2, the spark-gap S, the conductor 2^a, conductor D, and earth-plate *e*. In shunt to the spark-gap S is the secondary of a transformer 3, in whose primary circuit is the source of energy 5, operator's key 6, and the usual interrupter I. Upon depressing the key 6 an interrupted or pulsatory current flows through the primary of the transformer 3 and there appears at the spark-gap S trains of sparks as long as such key 6 is held depressed. The circuit of the aerial conductor just traced possesses a certain capacity and a certain inductance (and resistance) which determines the frequency of the radiations of the electromagnetic energy emanating from the radiating-conductor. The inductance E' is the controlling inductance of the circuit and is therefore a frequency-determining element. The frequency of the energy transmitted from such circuit depends upon the product of the capacity and inductance of such circuit. In the other branch is comprised the conductor C, conductor 1', inductance F', conductor 2', spark-gap S', conductor $2^{a'}$, conductor D, and earth-plate *e*. This circuit is identical with the circuit previously traced, except that the inductance F' is different in amount than the inductance E' and as shown is of greater amount. In consequence the frequency of the radiation of the last-named circuit will be different from that of the first-named circuit, F' being the frequency-determining element of the last-named circuit, which is different from that of the former. In shunt to the spark-gap S' is the secondary of the transformer 3', in whose primary is the source of energy 5', operator's key 6', and interrupter I', as described in connection with the circuit including E'. When both keys 6 6' are depressed, there are emitted from the conductor C electroradiant energies of different frequencies, one depending upon the constants of the circuit including E', the other upon the constants of the circuit including F'. The keys 6 6' may be used alternately or simultaneously. In other words, two different messages may be sent at the same time from the transmitting-station, as shown in Fig. 1.

At the receiving-station shown at B in Fig. 2 G is the usual aerial conductor, having two branch circuits as follows: One of these circuits comprises conductor G, the conductor 7, the inductance J', conductor 8, wave-responsive device 9, conductor 10, conductor H, and earth-plate *e*. This circuit is adjusted by means of the inductance J', so that the product of its capacity and inductance shall be the same as that of the branch circuit at the transmitter including the inductance E'. In consequence, whenever the circuit including the inductance E' at the transmitter is emitting radiant energy the circuit at the receiver including the inductance J' will respond to and select such energy, which will then effect the wave-responsive device 9 in circuit with J', which then controls, by means of a local circuit embracing relay 11 and source of energy 13, the recording device 15, controlled by the tongue 12 of said relay 11 and the source of energy 14. The other branch circuit at the receiver includes conductor G, conductor 7', inductance K', conductor 8', wave-responsive device 9', conductor 10', conductor H, and earth-plate *e*. The product of the capacity and inductance of this last-named circuit is adjusted by means of the inductance K' to be equal to that of the circuit at the transmitter including the inductance F'. In consequence, when the circuit of the transmitter including such inductance F' is emitting radiant energy the circuit at the receiver including the inductance K' will respond to and select such energy, which then controls the wave-responsive device 9' in circuit with K'. In shunt to this wave-responsive device 9' is the local circuit including the relay 11' and source of energy 13'. The tongue 12' of the relay 11' controls a local circuit including the source of energy 14' and the recording device 15'.

The conductors C and G possess considerable electrostatic capacity, as is well understood in this art, and are the principal capacity elements operating in conjunction with the inductances to determine the natural periods of the branch circuits. The remaining portions of the transmitter and receiving circuits also possess electrostatic capacity; but, as previously stated, C and G form the greater portion and, in fact, the controlling part of the capacity at each station. Similarly in the circuits of both the receiver and transmitter there is inductance in addition to the inductances E', F', J', and K'; but these inductances are by far the principal ones and in consequence the controlling ones. If the dimensions of the circuits at both transmitter and receiver are made identical, then the inductance E' and the inductance J' will be the same in magnitude, and likewise the inductances F' and K' will be of the same magnitude. It is not necessary, however, that the conductors and connections at each station should be of the same dimensions, for it is possible by the inductances K' and J' to adjust the branch circuits until they become selective. In such case J' and E' may be unequal, and likewise K' and F' may be unequal.

It is thus seen that depressing key 6 will affect recorder 15 and depressing key 6' will affect the recorder 15' and that these keys may be depressed simultaneously or independently or alternately and the proper messages will be selected out to the proper recorder means.

Though I have shown but two transmitters and two receivers in conjunction with a single radiating or single receiving conductor, it is to be understood that my system is not limited to such number. It is to be understood, furthermore, that the number of stations may be increased and that any receiving-station may have a branch circuit which is selective of the energy transmitted from any transmitting-station. For example, a third branch circuit might be used in Fig. 2, which should be selective of energy transmitted from a station other than that shown in Fig. 1.

From the foregoing description it is seen that the circuit of the receiver including J′ selects the messages emitted by the circuit at the transmitter including the inductance E′ to the exclusion of any other messages—such, for example, as emitted by the circuit including the inductance F′. Likewise the circuit at the receiver including the inductance K′ selects messages emitted by the circuit at the receiver including the inductance F′ to the exclusion of all other messages—as, for example, those emitted by the circuit at the transmitter including the inductance E′.

In practice it is desirable that in the conductor 2^a or $2^{a'}$ at the transmitting-station there be inserted a condenser of small capacity. Such condenser will not interfere with the high-frequency oscillations in the circuit in which it may be included and will serve to prevent an interchange of energy between the secondaries of the transformers 3 and 3′. Such condenser being small, it will operate as a great restraining device for the very low frequency currents in such secondaries. In Fig. 1 there are shown two such condensers at *k* and *k*′, respectively, one being in dotted lines.

At the receiving-station care must be taken to prevent the wave-responsive devices 9 and 9′ from short-circuiting each other, and thereby closing each other's relay-circuits. If this were permitted, the wave-responsive device 9 would control not only recorder 15, but also recorder 15′. Likewise wave-responsive device 9′ would control not only its recorder 15′, but also recorder 15. To prevent this, I insert in the conductors 10 and 10′ the small condensers *k* and *k*′, respectively. Only one condenser is necessary, but, as shown in dotted lines, I employ two for the purposes of symmetry.

What I claim is—

1. In a wireless signaling system, a conductor, parallel branch circuits connected therewith, and frequency-determining elements complementary with said conductor of different magnitudes in the respective branch circuits.

2. In a wireless signaling system, a conductor, a plurality of parallel branch circuits connected therewith, said branch circuits taken in conjunction with said conductor forming conductors of different natural periods.

3. In a wireless signaling system, a plurality of parallel branch circuits, a conductor common to said branches, and forming with the respective branch circuits conductors of different natural periods.

4. In a wireless signaling system, a conductor comprising a frequency-determining element, a plurality of parallel branch circuits connected therewith, and complementary frequency-determining elements of different magnitudes in said branch circuits.

5. In a wireless signaling system, a plurality of parallel branch circuits including frequency-determining elements of different magnitudes, a conductor common to all said circuits and comprising a complementary frequency-determining element.

6. In a wireless signaling system, a plurality of oscillating circuits of different periods, and a frequency-determining element common to all the circuits coöperating simultaneously therewith.

7. In a wireless signaling system, a plurality of selective circuits of different natural periods, and a frequency-determining element common to all the circuits coöperating simultaneously therewith.

8. In a wireless signaling system, a plurality of oscillating circuits of different natural periods, and a radiating-conductor common to all the circuits coöperating simultaneously therewith.

9. In a wireless signaling system, a plurality of circuits of different natural periods and a receiving-conductor common to all the circuits and coöperating simultaneously therewith as a frequency-determining element thereof.

10. In a wireless signaling system, a plurality of oscillating circuits of different natural periods and a radiating-conductor common to all the circuits and operating simultaneously as a frequency-determining element for each of the circuits.

11. In a wireless signaling system, a plurality of circuits of different natural periods, and a receiving-conductor common to all the circuits and operating simultaneously as a frequency-determining element for each of said circuits.

12. In a wireless signaling system, a radiating-conductor, an earth connection, and a plurality of frequency-determining branches in parallel with each other and in series between said conductor and earth connection, said radiating-conductor constituting a frequency-determining element for said branches.

13. In a wireless signaling system, a receiving-conductor, an earth connection, and a plurality of frequency-determining branches in parallel with each other and in series between said conductor and said earth connection, said receiving-conductor constituting a frequency-determining element for said branches.

14. In a wireless signaling system, a radiating-conductor, and a plurality of frequency-determining branches in parallel with each other and connected in series with said conductor, said radiating-conductor constituting a frequency-determining element for said branches.

15. In a wireless signaling system, a receiving-conductor and a plurality of frequency-determining branches in parallel with each other and in series with said conductor, said conductor constituting a frequency-determining element for said branches.

16. In a wireless signaling system, a radiating-conductor, a plurality of oscillating circuits including frequency-determining elements of different magnitudes, said radiating-conductor constituting a complementary frequency-determining element common to all the circuits, and a connection from all of said circuits to said conductor.

17. In a wireless signaling system, a receiving-conductor, a plurality of circuits including frequency-determining elements of different magnitudes, said receiving-conductor constituting a complementary frequency-determing element common to all the circuits, and a connection from all of said circuits to said receiving-conductor.

18. In a wireless signaling system, a plurality of parallel branch circuits including inductances of different magnitudes, a conductor common to all said circuits and constituting a complementary frequency-determining element.

19. In a wireless signaling system, a plurality of parallel oscillating circuits including inductances of different magnitudes, and a frequency-determining element common to all the circuits.

20. In a wireless signaling system, a plurality of parallel circuits including inductances of different magnitudes, and a frequency-determining element common to all the circuits.

21. In a wireless signaling system, a plurality of parallel oscillating circuits including inductances of different magnitudes, and a radiating-conductor constituting a frequency-determining element common to all the circuits.

22. In a wireless signaling system, a plurality of parallel circuits including inductances of different magnitudes and a receiving-conductor constituting a frequency-determining element common to all the circuits.

23. In a wireless signaling system, a plurality of parallel oscillating circuits including inductances of different magnitudes and a radiating-conductor common to all the circuits and constituting a frequency-determining element for each of the circuits.

24. In a wireless signaling system, a plurality of parallel circuits including inductances of different magnitudes, a receiving-conductor common to all the circuits and constituting a frequency-determining element for each of said circuits.

25. In a wireless signaling system, a radiating-conductor constituting a frequency-determining element, an earth connection, and a plurality of frequency-determining branches including inductances of different magnitudes, in parallel with each other, and in series between said conductor and earth connection.

26. In a wireless signaling system, a receiving-conductor constituting a frequency-determining element, an earth connection, a plurality of frequency-determining branches in parallel with each other and in series between said conductor and said earth connection, and inductances of different magnitudes in the respective branches.

27. In a wireless signaling system, a radiating-conductor constituting a frequency-determining element, a plurality of frequency-determining branches in parallel with each other and connected in series with said conductor, and inductances of different magnitudes in the respective branches.

28. In a wireless signaling system, a receiving-conductor constituting a frequency-determining element, a plurality of branch circuits in parallel with each other and in series with said conductor, and inductances of different magnitudes in the respective branch circuits.

29. In a wireless signaling system, a plurality of branch circuits including inductances of different magnitudes, a complementary frequency-determining element, common to all the circuits, and a connection from all of said circuits to said conductor.

30. In a wireless signaling system, a receiving-conductor, a plurality of circuits including inductances of different magnitudes, said receiving-conductor being a complementary frequency-determining element common to all the circuits, and a connection from all of said circuits to said receiving-conductor.

31. In a wireless signaling system, a plurality of parallel branch circuits including inductances of different magnitudes, a conductor having considerable capacity common to all said circuits and comprising a complementary frequency-determining element.

32. In a wireless signaling system, a plurality of parallel oscillating circuits including inductances of different magnitudes, and a frequency-determining capacity element common to all the circuits.

33. In a wireless signaling system, a plurality of parallel circuits including inductances of different magnitudes, and a frequency-determining capacity element common to all the circuits.

34. In a wireless signaling system, a plurality of parallel oscillating circuits including inductances of different magnitudes, and a radiating-conductor common to all the circuits and operating as a frequency-determining capacity element.

35. In a wireless signaling system, a plurality of parallel oscillating circuits including inductances of different magnitudes, and a radiating-conductor common to all the circuits and operating as a capacity element in determining the period of each of the oscillating circuits.

36. In a wireless signaling system a plurality of parallel circuits including induct-

ances of different magnitudes and a receiving-conductor common to all the circuits and operating as a capacity element in determining the period of each of the circuits.

37. In a wireless signaling system, a plurality of parallel circuits including inductances of different magnitudes, a radiating or absorbing conductor common to all the circuits and comprising the principal capacity element for determining the natural period of each of the circuits.

38. In a wireless signaling system, a conductor, a plurality of circuits in parallel with each other and in series with said conductor, inductances of different magnitudes in the respective circuits, said conductor operating as the principal capacity element in determining the natural period of each of said circuits.

39. In a wireless signaling system, a conductor, a plurality of circuits including inductances of different magnitudes, a capacity element common to all the circuits and determining in conjunction with said inductances the natural period of each circuit, and a connection from all of said circuits to said conductor.

40. In a wireless signaling system, a plurality of transmitters each emitting characteristic energy, a common radiator for all the transmitters, a plurality of parallel receiving-circuits, each selective of the energy emitted by a certain transmitter, and a receiving-conductor common to all the receiving-circuits and operating as a frequency-determining element.

41. In a wireless signaling system, a radiator and a plurality of parallel branches for impressing upon the natural media by said radiator energies of different frequencies, said radiator assisting in determining the frequency of each of said energies.

42. In a wireless signaling system, a receiving-conductor operating as a frequency-determining element common to a plurality of parallel selective circuits, and a plurality of means associated with said conductor, whereby a plurality of independent messages represented by electroradiant energies of different frequencies may be simultaneously or independently recorded.

43. In a wireless signaling system, a transmitting-conductor operating as a frequency-determining element common to a plurality of transmitting-circuits, and a plurality of parallel branches associated with said conductor, whereby a plurality of electroradiant energies of different frequencies representing a plurality of independent messages may be impressed upon the natural media.

In testimony whereof I affix my signature in presence of two witnesses.

GREENLEAF W. PICKARD.

Witnesses:

M. WIEGAND,

R. LEAMAN.