H. SHOEMAKER.

TRANSMITTING APPARATUS.

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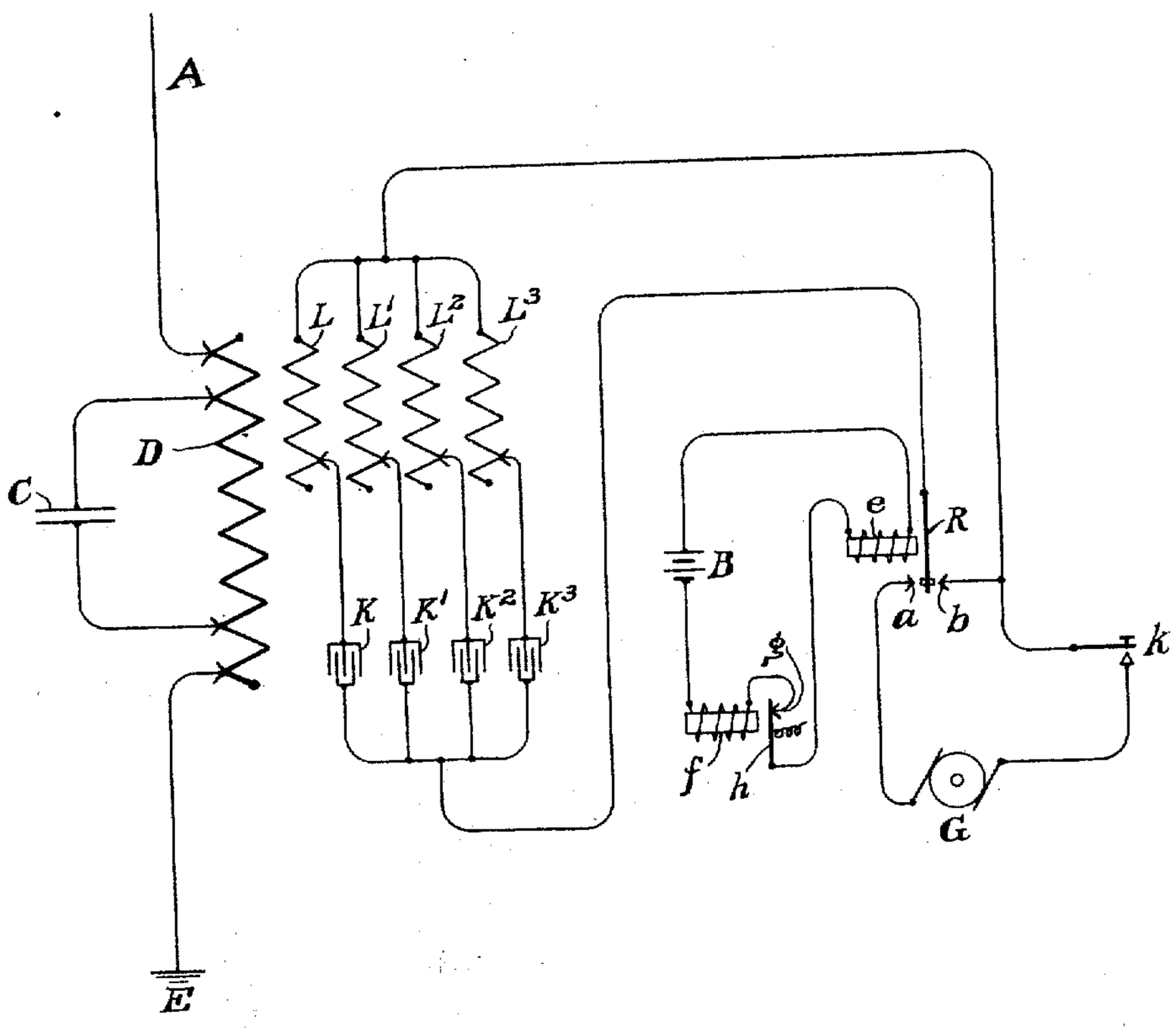
932,820. Patented Aug. 31, 1909.

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# UNITED STATES PATENT OFFICE.

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## TRANSMITTING APPARATUS.

932,820. Specification of Letters Patent. Patented Aug. 31, 1909.

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*To all whom it may concern:*

Be it known that I, HARRY SHOEMAKER, a citizen of the United States, residing at Jersey City, county of Hudson, State of New Jersey, have invented certain new and useful Improvements in Transmitting Apparatus, of which the following is a specification.

My invention relates to transmitting apparatus, and particularly transmitting apparatus for employment in a system of signaling, telegraphing, telephoning, or for other purposes, wherein electro-radiant energy is transmitted through the natural media.

It is the object of my invention to provide transmitting apparatus, for systems as above mentioned, which will impress upon the natural media electro-radiant energy derived from electrical oscillations produced without the usual spark gap heretofore so comm nly employed.

More particularly, it is the object of my invention to produce electro-radiant energy derived from an oscillating circuit which, in turn, derives its energy from a relatively low potential source as compared with the potentials heretofore employed, the oscillating circuit having relatively great capacity and relatively low self-induction. The arrangement for securing such great capacity and low self-induction is a feature of my invention and comprises a plurality of pairs of inductance and capacity connected in parallel with each other, the total capacity being then the sum of the individual capacities, while the inductances connected in parallel, an inductance for each capacity, gives an effect of very low self-induction. With a great capacity thus secured a great charge can be stored in the condensers at relatively low potential. And upon discharge the oscillations lack persistency due to the low self-induction. The capacity or capacities of the oscillation circuit quickly take up in this relation a large charge, and when permitted to discharge, the discharge is very powerful and not persistent, the frequency of oscillation being low as compared with the frequency of the electro-radiant energy. In inductive or other relation with the oscillation circuit as described, is another circuit whose natural frequency is very high, equal to that of the electro radiant energy, and this circuit consists preferably of a condenser and a self-induction, no spark gap being employed. The properties of the oscillation circuits heretofore described having very great capacity, in discharging are able to quickly and powerfully charge the last circuit mentioned, which then discharges at a natural frequency which is very high and produces the electro-radiant energy.

For an illustration of one of the forms my invention may take and when employed in a telegraph system, reference is to be had to the accompanying drawing.

Between the aerial conductor A and the earth connection E is connected a variable portion of the inductance D. A variable portion of the inductance D is also connected in circuit with the condenser C, thus forming an oscillating circuit of very high frequency which has no spark gap and whose resistance is maintained as low as possible. In inductive relation with the inductance D are the four inductances L, $L^1$, $L^2$, and $L^3$, and in series with each of these inductances is a condenser K, $K^1$, $K^2$, and $K^3$. The inductances L, $L^1$, $L^2$ and $L^3$ have very low inductance, while the condensers K, $K^1$, $K^2$ and $K^3$ have relatively very great capacity. The four series of condensers and inductances are connected in parallel with each other, and each condenser and its inductance is so adjusted that the product of the inductance and capacity shall be equal to or very closely equal to the product of the inductance and capacity of each of the other three branches. The terminal common to the condensers K, $K^1$, $K^2$ and $K^3$ is connected to the vibratory reed or armature R, while the terminal common to the four inductances L, $L^1$, $L^2$ and $L^3$ is connected to the contact *b*. The contact *b* is connected through the operator's key *k* with one terminal of the generator G whose other terminal connects with the contact *a*. The generator G is any suitable source of current, preferably a direct current generator or battery delivering current at say 500 volts pressure. The reed R is vibrated,

either at its natural period or at some other period, so as to contact alternately with the contacts *a* and *b*. As a means for accomplishing this vibration, there may be provided an electro-magnet *e* connected in series with the battery B and the electro-magnet *f* whose spring retracted armature *h* is normally in engagement with the contact *g* connected to one terminal of the winding *f*; when the armature *h* is so in engagement with the contact *g* it is attracted by the electro-magnet *f* breaking the circuit of the electro-magnet *e*, such circuit being immediately reëstablished again and again broken in rapid succession. The reed R is then vibrated at corresponding rate by the electro-magnet *e*.

Assuming the reed R in contact with *a*, and the operator's key *k* closed, the condensers K, $K^1$, $K^2$ and $K^3$ are all charged from the generator G through their respective inductances. The resistance of the circuit is made as low as possible so that the charging is very rapid, the condensers very promptly coming to the potential of the generator G. The reed R continues vibrating however, and swings over to contact *b*, thus isolating the condensers and inductances from the generator G. Since the condensers have been charged up to the potential or very nearly to the potential of the generator G, and the potential of that generator being relatively low, there is no substantial spark at *a*. Similarly, the potentials of the condensers being relatively low no spark leaps between the reed R and the contact *b*, as R comes into contact with *b*. When contact has been made between R and *b* the condensers K, $K^1$, $K^2$ and $K^3$ discharge through the inductances L, $L^1$, $L^2$ and $L^3$, the contact *b* and the reed, the frequency of the discharge being low as compared with the electro-radiant energy to be emitted from the conductor A. Since the capacity of this oscillating circuit is very high and the inductance very low, the discharge will not be persistent, but will die out relatively quickly. The condenser C being connected to the inductance D which is in inductive relation to all the inductances L, $L^1$, $L^2$ and $L^3$, is practically instantaneously fully charged, and since the discharge of the circuit of the condensers K, $K^1$, $K^2$ and $K^3$ dies out quickly, the condenser is left to discharge through the inductance D, the natural frequency being very high as determined by the capacity of the condenser C and the inductance D. In this circuit the inductance may be larger in comparison with the capacity of C than the relation between the inductances L, $L^1$, $L^2$ and $L^3$ and the capacities of the condensers K, $K^1$, $K^2$ and $K^3$. These high frequency oscillations produced in the circuit containing the condenser C are then radiated from the conductor A in the well known manner. The effect is, therefore, to very quickly charge the condensers K, $K^1$, $K^2$ and $K^3$, and they discharge very rapidly, thus, in effect, electrically striking a blow to the condenser C charging it practically instantaneously. The reed R may perform several cycles during the closure of the operator's key *k* to represent a telegraphic dot, and, of course, it performs more cycles during the times that the key is held depressed to represent a dash.

While the generator G is spoken of as having a pressure of 500 volts, it is to be understood that other pressures may be employed, even though a thousand or more volts; for even with a thousand or more volts the striking or sparking distance is extremely small. If the reed R oscillates or vibrates at a frequency corresponding with the natural frequency of the circuit containing the condensers K, $K^1$, $K^2$ and $K^3$ and inductances L, $L^1$, $L^2$ and $L^3$, the sparking at *a* and *b* will be a minimum and practically zero. In any event, the sparking at *a* and *b* is practically nothing as compared with the sparks heretofore used in wireless telegraphy and the like forming a bridge for the oscillations. But in the case of the circuit containing condenser C and inductance D, there is no gap at all and it is this circuit which produces the oscillations which are radiated.

While I have shown four pairs of condensers and inductances, it is to be understood that other numbers may be employed, even a single pair sufficing in some cases. In any case, the capacity is made very great and the inductance small so as to secure the quick charge and extremely quick discharge as heretofore described for the purposes of more efficiently affecting the circuit containing condenser C and inductance D to produce the high frequency oscillations. By connecting pairs of condensers and inductances in parallel as shown, however, the capacity may be caused to greatly predominate over the inductance.

By the apparatus shown, it is possible to generate high frequency electro-radiant energy, there being a group or train of high frequency waves for each cycle of the reed R. And the number of cycles of the reed R may be made great or small as desired. When this rate of the reed R or other switching means is made very high, as for example, higher than the limits of audition, these circuits may be advantageously employed for telephony.

When referring to a source of current of relatively low voltage or potential, I refer to a voltage or potential so low that disruptive sparking, as it has heretofore been understood in this art, does not take place or is impossible. For example, heretofore in the art a high potential current was derived

from a step-up transformer, very high potential being impressed upon a condenser, or other means, and sufficient to produce a spark across a very considerable gap, the sparking being disruptive and serving as a bridge for oscillations. In my arrangement herein described and claimed, there is no such disruptive sparking.

What I claim is:

1. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, the capacity greatly predominating, and the pairs connected in parallel, means for charging the capacities to low potential, and means for discharging said capacities.

2. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging the capacities, and means for discharging said capacities through a closed circuit containing only said capacities and inductances.

3. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, the product of capacity and inductance of each pair being substantially identical with that of every other pair, said pairs of inductance and capacity being connected in parallel, means for charging the capacities to low potential, and means for discharging said capacities through a closed circuit.

4. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, the pairs connected in parallel and the total capacity greatly predominating, the product of the inductance and capacity of each pair being substantially identical with that of every other pair, means for charging the capacities to low potential, and means for discharging said capacities through a closed circuit.

5. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, the pairs connected in parallel and the total capacity being relatively great, means for charging said capacities to low potential, and means for discharging said capacities.

6. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel and the total capacity being relatively great, a direct current source for charging said capacities, and means for discharging said capacities.

7. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging and discharging said capacities, and an associated oscillation circuit deriving energy from said first mentioned circuit and having a higher natural period.

8. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, the capacity greatly predominating, said pairs connected in parallel, means for charging and discharging said capacities, and an associated oscillating circuit of higher natural frequency deriving energy from said first mentioned oscillating circuit.

9. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging and discharging said capacities, and an associated oscillating circuit of higher natural frequency inductively related to said first mentioned oscillating circuit and deriving energy therefrom.

10. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, the pairs connected in parallel, means for charging and discharging said capacities, and an associated oscillation circuit of higher natural frequency closed directly through a capacity and inductance.

11. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging and discharging said capacities, said capacities greatly predominating whereby the oscillations in said circuit are not persistent, and an associated oscillation circuit deriving energy from said first mentioned oscillating circuit, the oscillations in said associated circuit being persistent.

12. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, means for discharging said capacities through a path including only said capacities and said inductances, and an associated oscillation circuit deriving energy from said first mentioned oscillation circuit, the oscillations in said oscillation circuit being more persistent than those in said first mentioned circuit.

13. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, and an associated oscillating circuit, the oscillations in said associated circuit being of higher frequency than the oscillations in said first mentioned circuit, and the persistency of the oscillations in said associated circuit being greater than the persistency of the oscillations in said first mentioned circuit.

14. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, and a vibrating member for alternately charging said capacities to low potential and for discharging said capacities.

15. In transmitting apparatus, an oscil-

lating circuit containing pairs of inductance and capacity, said pairs connected in parallel and the total capacity being relatively great, and means for periodically charging said capacities to low potential and for discharging said capacities.

16. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, the total capacity of said circuit being relatively great, means for charging said capacities to low potential, signaling means, and a radiator in operative relation with said oscillating circuit.

17. In transmitting apparatus, a radiator, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging and discharging said capacities, and an associated oscillating circuit intervening between said oscillating circuit and said radiator, said associated circuit having a higher natural frequency than said first mentioned oscillating circuit.

18. In transmitting apparatus, a radiator, an oscillating circuit containing pairs of inductance and capacity and disposed in inductive relation with said radiator, said pairs connected in parallel, means for charging and discharging said capacities, and an associated oscillating circuit of higher natural frequency and greater persistency than said first mentioned oscillating circuit.

19. In transmitting apparatus, a radiator, an inductance associated therewith, an oscillating circuit containing pairs of inductance and capacity in inductive relation with said inductance, said pairs connected in parallel, means for charging said capacities to low potential and for discharging said capacities, and a condenser forming with a portion of said inductance a closed oscillation circuit.

20. In transmitting apparatus, a radiator, an inductance associated therewith, an oscillating circuit containing pairs of inductance and capacity in inductive relation with said inductance, said pairs connected in parallel, means for charging and discharging said capacities, and a condenser forming with a portion of said inductance a closed oscillation circuit, said oscillation circuit having higher natural frequency and greater persistency than said first mentioned oscillating circuit.

21. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, and means for periodically charging said capacities and for periodically discharging said capacities through a circuit containing only said capacities and inductances.

22. In transmitting apparatus, an oscillator comprising pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, and means for discharging said capacities through a path containing only said capacities and inductances.

23. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, means for discharging said capacities through a closed circuit containing only said capacities and inductances, and an associated oscillation circuit including capacity and inductance only and deriving energy from said first mentioned oscillation circuit.

24. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, means for discharging said capacities through said inductances, and an associated oscillation circuit including capacity and inductance only deriving energy from said first mentioned oscillation circuit.

25. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, means for discharging said capacities through said inductances, and an associated oscillation circuit including capacity and inductance only deriving energy from said first mentioned oscillation circuit, said associated oscillation circuit having higher natural frequency than said first mentioned oscillation circuit.

26. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, means for discharging said capacities through said inductances, and an associated oscillation circuit including capacity and inductance only deriving energy from said first mentioned oscillation circuit, said associated oscillation circuit being more persistent than said first mentioned oscillation circuit.

27. In transmitting apparatus, an oscillation circuit containing pairs of inductance and capacity, said pairs connected in parallel, means for charging said capacities, means for discharging said capacities through said inductances, and an associated oscillation circuit including capacity and inductance only deriving energy from said first mentioned oscillation circuit, said associated oscillation circuit having a higher natural frequency and greater persistency than said first mentioned oscillation circuit.

28. In transmitting apparatus, an oscillating circuit containing pairs of inductance

and capacity, a source of direct current, means for subjecting said capacities to said source of direct current, and means for discharging said capacities through said inductances.

29. In transmitting apparatus, an oscillating circuit containing pairs of inductance and capacity, said pairs connected in parallel, a source of direct current, means for charging said capacities by current from said source, and means for discharging said capacities through said inductances.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

HARRY SHOEMAKER.

Witnesses:
ANNA E. STEINBOCK,
C. D. EIHET.