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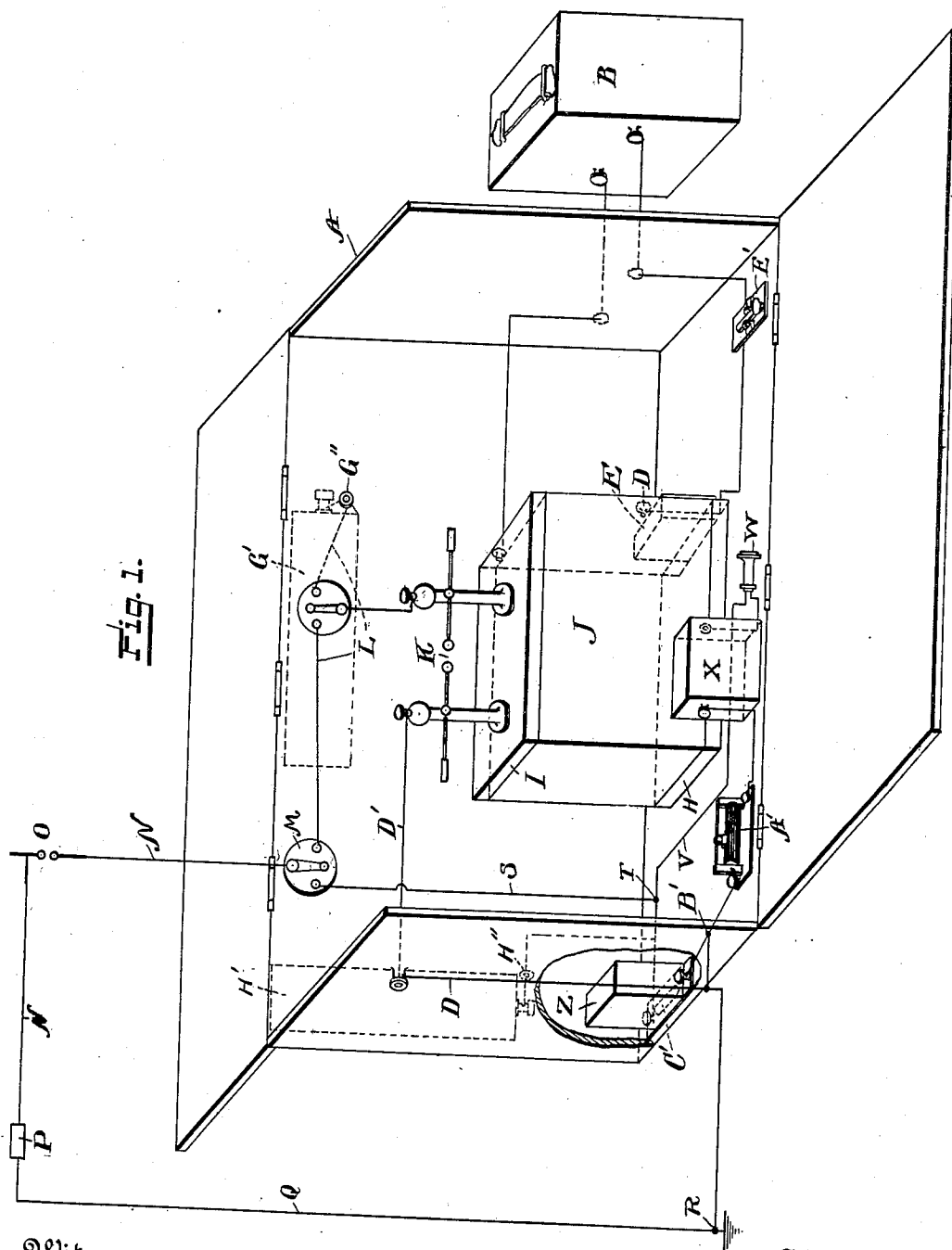
H. DUNWOODY.

PATENTED SEPT. 8, 1908.

WIRELESS TELEGRAPH APPARATUS.

APPLICATION FILED MAY 21, 1907.

4 SHEETS—SHEET 1.



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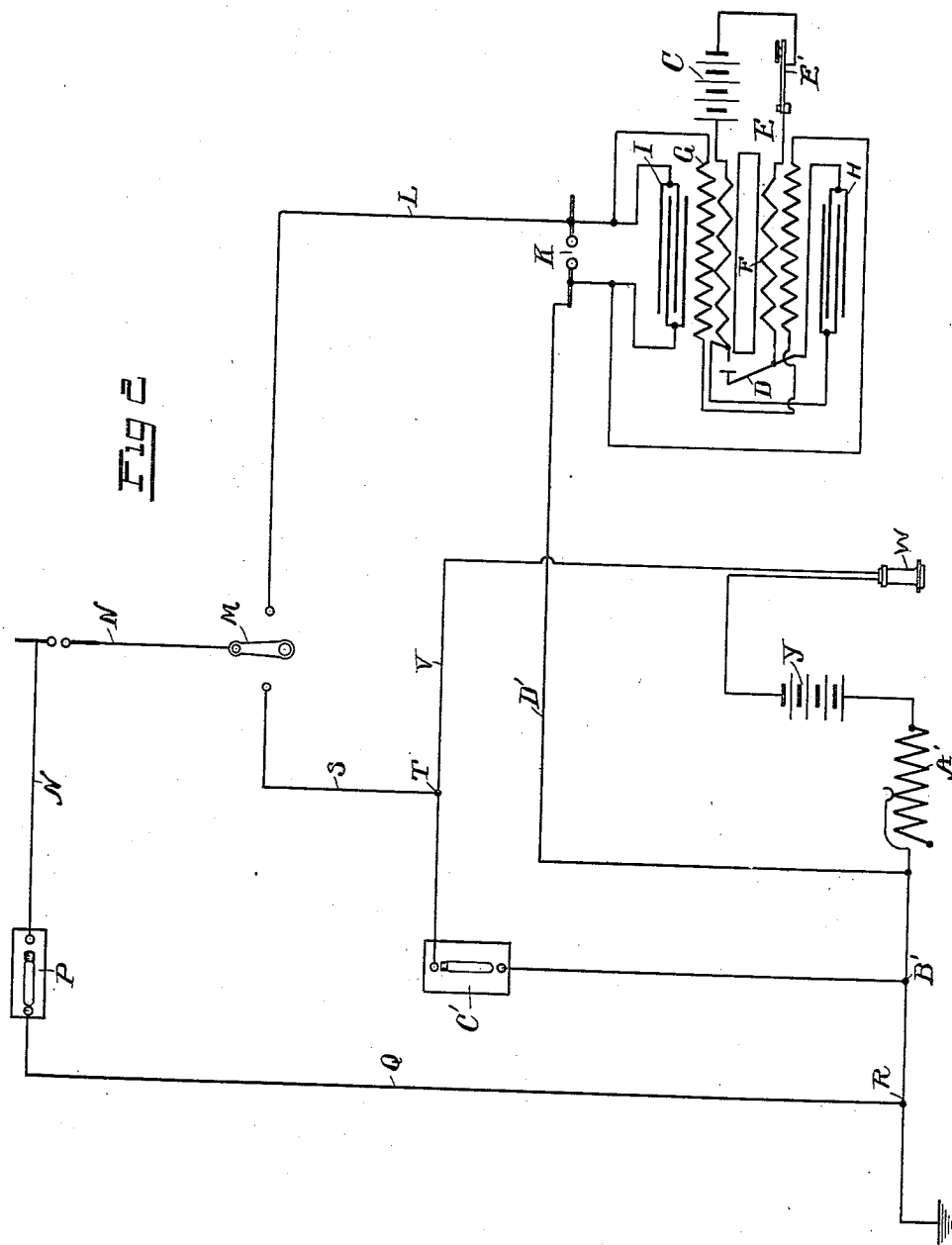
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4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.

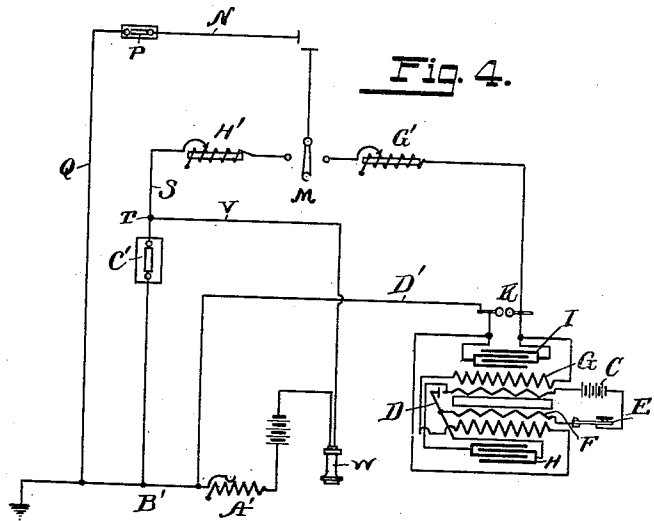
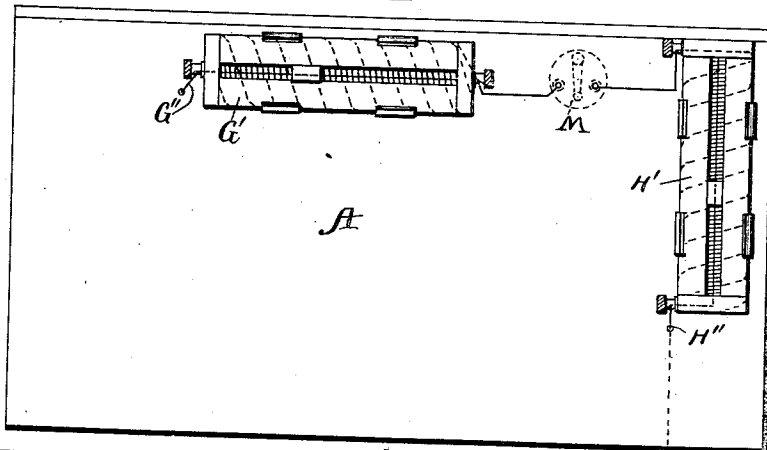
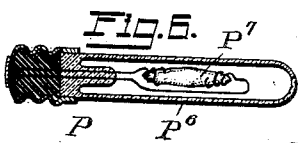
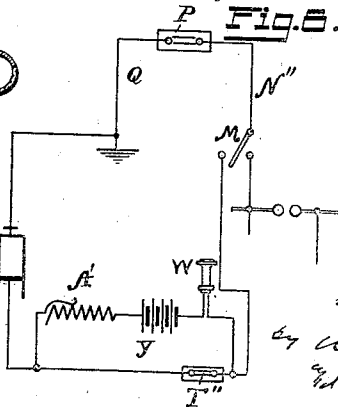
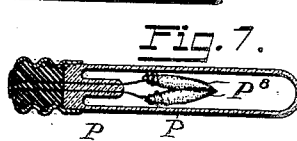


Fig. 5.



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4 SHEETS—SHEET 4.

Fig. 5.

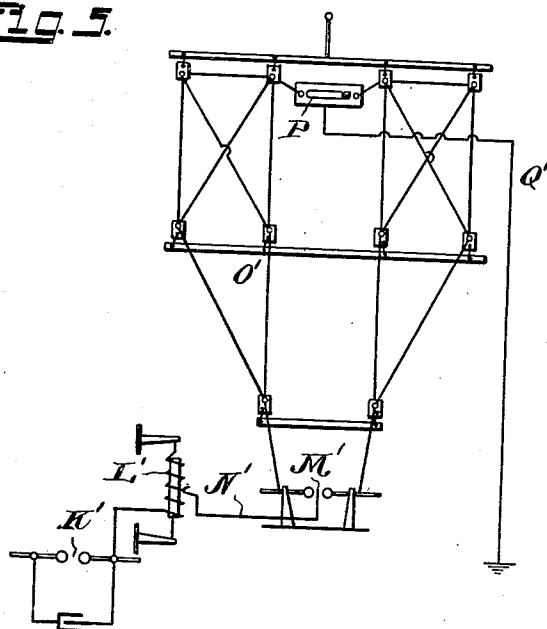
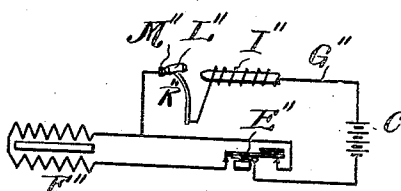


Fig. 6.



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UNITED STATES PATENT OFFICE.

HALSEY DUNWOODY, OF THE UNITED STATES ARMY.

WIRELESS-TELEGRAPH APPARATUS.

No. 898,197.

Specification of Letters Patent.

Patented Sept. 8, 1908.

Application filed May 21, 1907. Serial No. 374,944.

To all whom it may concern:

Be it known that I, HALSEY DUNWOODY, lieutenant, United States Army, at present residing at Fortress Monroe, in the State of Virginia, county of Elizabeth City, have invented certain new and useful Improvements in Wireless Telegraphic Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to wireless signaling apparatus and especially to a wireless telegraphic or radio electric apparatus of a portable character.

The object of my invention is to improve the art in general and also to produce a practical portable wireless telegraphic apparatus which shall be capable of sending and receiving messages with unerring certainty for distances of from twenty to one hundred miles and over and, yet, shall be so light as to be capable of being carried by two or even one man, and which requires so little space that the whole may be packed in a box not larger than an ordinary valise.

Portable wireless outfits, heretofore produced, capable of sending and receiving messages with certainty, over the distance my invention covers, have been of a much heavier character, requiring the use of pack animals, automobiles, or other equivalent means of transportation, while on the other hand these outfits of a light character capable of being carried by one or two men, have been of the character of models, and small demonstration apparatus, and in every instance, they have been incapable of operating in actual practice over the distances readily covered by my device.

The advantages of a practical portable wireless apparatus capable of covering from twenty to one hundred miles and over and capable of being carried by two or even one man, in the field of battle, in campaigns, or maneuvers, in surveying and other similar operations, and adapted for use on gun boats, torpedo boats, yachts and crafts of similar nature, are apparent; especially, when it is remembered that at the supreme moment, in a battle for instance, it might be imperative that the wireless equipment be capable of being readily moved about by one or two men; and occasions could arise when the same would be true, or at least very highly desir-

able, in maneuvers, or campaigns, or in surveying parties exploring a rough country and far from base. Then, again, it is of no small importance to have such a light apparatus when moving the same off and on yachts, torpedo boats, and small craft, especially when it is desired to carry such apparatus to and from said craft at any time, and in a row boat without danger of losing it overboard during the act of lifting it from the boat to the vessel.

I attain my object of improving the art generally by introducing into existing systems certain new features, described more particularly hereinafter, and I produce my light portable apparatus by omitting certain parts of existing apparatus therefrom and in introducing therein these said new features combined with others, all as more fully described below.

To these ends, my invention consists in a wireless telegraphic apparatus of any kind whatsoever, having an aerial from one side of a spark gap to an electrical current separator or rectifier, and thence to ground, and constituting an efficient sending and receiving antenna.

My invention, also, consists in providing a wireless apparatus of any kind with a receiver normally in direct or shunt circuit with the transmitter, thereby lessening the weight and causing the wiring to be very much more simple, and doing away with much that is now used in the ordinary systems.

My invention further consists in producing an efficient current separator or rectifier useful in this art generally, but especially useful in any portable set.

My invention further consists in providing a portable set with certain of the above features, and in eliminating other well known features heretofore considered essential for a practical field apparatus, and in thereby producing a practical field apparatus which I believe is very much lighter than any heretofore produced, all as will be more fully herein described and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification:—Figure 1 is a perspective view of the box with my portable set ready for operation. Fig. 2 is a diagram of the circuits of said set. Fig. 3 is a view of sending and receiving inductance coils that are found useful to the apparatus shown in Figs. 1 and 2, when the operating

distances are to reach one hundred miles or over. Fig. 4 is a diagram of the circuits when the inductance coils, shown in Fig. 3, are employed. Fig. 5 is a diagram of my new antenna and modified spark gap. Figs. 6 and 7 are details of my current separator or rectifier. Fig. 8 is a diagram of another modified receiving circuit. Fig. 9 is a diagram of a modified sending circuit showing my new interrupter.

Like letters of reference refer to like parts in all the views:—

A indicates the box containing my portable wireless telegraphic outfit, which, when complete for operating over distances from 20 to 100 miles, need not be larger than an ordinary valise, nor weigh more than, say, 150 pounds.

B indicates the casing carrying the transmitting battery C, and which may be storage cells or other source of power and need not be more than six or eight dry cells, and D the magneto spring interrupter of the ordinary commercial spark induction coil E, such as is now used in automobiles and small boats.

F represents the primary, and G the secondary, of this coil. Across the terminals of the primary F, is joined the small light condenser H, and across the terminals of the secondary G is joined the similar small and light condenser I.

J represents a casing placed in the box A for containing these parts, and K the adjustable sending spark gap, or other wave generator or transmitter.

L represents the direct wire connection through the double throw switch M between the spark gap K and the aerial N. This aerial or antenna N, may be formed of a very fine thread-like wire capable of being suspended by any ordinary stationary means, or even by a small gas balloon, or kite, or it may be composed of an uninsulated heavier wire, and it leads to the current separator P, through the auxiliary spark gap O, although in some cases this gap may be omitted. The current separator or rectifier P, may be of any well known construction, but I prefer one of my own which in practice has proved itself far superior to any others. It is composed of one or more crystals of carborundum, P⁷, P⁸, as shown in detail in Figs. 6 and 7, preferably one, sealed in a vacuum tube P⁹, which in turn screws in and out a socket like an electric lamp bulb. The carborundum in the tube is connected to earth at R by wire Q. By the use of this separator P, I am enabled to entirely dispense with the usual inductance coils for distances of twenty miles and over, and for distances up to one hundred miles and over, I need use only very light inductances of one of the forms more fully described below. This construction for twenty mile distances, permits the wiring to run directly from the spark gap to the

double throw switch, the aerial, the separator P, and through the same to ground, and by means of this simplified wiring, together with the light aerial above mentioned, the weight of the apparatus is greatly reduced. Even when the light inductances G', H', to be described below, are employed, the weight of the apparatus is not materially increased, and the efficiency of said apparatus is not at all destroyed by such lightening, when used over the distances stated.

The receiving circuit for this apparatus consists of the wire S running from the double throw switch M as shown, to the point T, where it connects with the wire V, which from the point T runs through the telephone receiver W to the local battery Y inclosed in the case X, thence to the adjustable resistance A', which may be a bar of carbon with a sliding contact, as shown in Fig. 1, to the point B', and to ground. The point B' is connected with the responder C', inclosed in the casing Z, as well as the point T. This responder C' may be of any suitable type, but I prefer to employ a very simple and efficient one, composed of one or more crystals of carborundum, substantially as disclosed in Patent, No. 837,616, Dec. 4, 1906, to H. C. Dunwoody, but in this instance, sealed in a vacuum tube, which may be readily screwed in and out of a socket, like an incandescent lamp bulb.

That side of the spark gap not connected to the aerial, is grounded through the wire D', as shown.

E' represents an ordinary telegraph key not specially insulated for controlling the primary circuit as shown.

The operation of the device so far described is as follows:—In order to send, the operator throws switch M to the right and makes and breaks circuit with the key E', in the primary circuit of the spark coil E, which causes corresponding sparks to pass at the gap K, and ether waves to traverse, and be thrown off, the wire L and aerial N, all as is well known. The alternating current passing through the current separator P to ground and back is, I believe, rectified. That is to say, one wave, suppose, for instance, the plus, probably, gets through the separator P, and the negative does not, then the ether vibrations or radio electric oscillations or waves are probably caused, and augmented, by that portion of the current that is dammed up, so to speak, between the current separator or rectifier and spark gap, while the ether wave of the current passes through the rectifier and is pumped, as it were, into the ground at every throb. It is also highly probable that this action lowers the resistance of the intervening spark gap O between the transmitting and receiving antenna and makes use of the earth as well as of the ether as a transmitting medium. I do not bind myself,

however, to any particular theory of operation of this part of my invention nor to any particular compound or substance for producing this most remarkable result. And while I have found the carbids of silicon aluminum or carborundum to be well adapted for this purpose, I reserve the right to employ any current rectifier, whatever, or other substances made up of, or containing silicon, or carbon, or any other materials that may be found suitable in the future. However the ether waves or radio electric oscillations may be actually produced by my apparatus, they are found in practice, when produced by the same, to be far stronger to send and clearer to receive, than those produced without the aid of my separator, and, therefore, I believe some disturbance is set up through the agency of my separator, which creates a greater and cleaner cut, so to speak, vibration of the ether, or transmitting medium, than has been attained heretofore, with the same transmitting power.

The receiving circuit is completed by throwing the switch M to the left, and ether waves striking the antenna will be directed down the wire S to the responder C', and the resistance of the same being changed thereby, signals will be heard in the telephone W, in the manner well known. But, in this instance, owing to the use of my rectifier, or separator P, I have discovered that the signals are far stronger and clearer, as above stated, than is attained by any other instruments with which I am acquainted. This greater clearness and distinctness in sending and receiving enables me to use a much lighter transmitter or sparking apparatus than any heretofore found practicable for the same distances covered, including a lighter source of power and other parts. The result is, my separator is not only a most important factor in lightening my portable apparatus, but the arrangement comprises a most efficient sending and receiving antenna for general use, whether in a portable set, or not, and one which constitutes a marked improvement over any other, with which I am acquainted. It moreover, furnishes a new connection between the spark gap aerial and ground, which, as above stated, is at all times through the separator P, and thereby keeps down the evil effects of static charges as will appear more fully hereinbelow.

Open air gaps are old in antennæ, and the theory of their operation has been explained somewhat along the lines above, but after the most ample practical experience and exhaustive experiments, I have become convinced that it is very questionable whether or not the air gap, as heretofore used, accomplishes any useful purposes; but there can be no doubt, whatever, about my system accomplishing its purpose. I do not think that the rectifier or separator P, can be considered

an insulator, nor that the antenna can be considered insulated, for that portion of the antenna from the rectifier to the ground is fully charged at every throb.

The above apparatus taken as a whole constitutes a portable set weighing about 150 pounds or less, and is capable of sending and receiving messages with clearness and certainty of about twenty miles or over. If the distance is to be increased say up to one hundred miles or over, as above stated, I find it convenient to add two small adjustable inductances, G', H' in the sending and receiving circuits respectively, as shown in Fig. 3 and in diagram in Fig. 4. These inductances may be conveniently carried on the back of the box as shown in dotted lines in Fig. 1, and connected to the spark gap by wire G''. The sending inductance G' is composed of a light coil of lightly insulated heavy wire, with a sliding contact. It can be made light owing to the fact that the transmitting voltage on this portable apparatus is not sufficient to pierce the light insulation employed. The receiving coil H', is made of fine insulated wire with a similar sliding single contact, in which particulars it differs from all other coils with which I am acquainted that have been heretofore used for this purpose. It is found convenient in regulating waves coming from great distances to employ this coil so that the receiving apparatus will readily respond to varying wave lengths. When desiring to use these coils, connection is made to wire G'' with one side of the spark gap, and at H'' with the responder as shown in Fig. 1, the apparatus is then operated as above described, and the inductances are adjusted until the best results are obtained.

In Fig. 5, I have diagrammatically illustrated an antenna for general use and which in practice I have found to give excellent results, when joined up with my rectifier, it being also well adapted for use with my portable apparatus. In this figure K', represents a suitable spark gap, L' a suitable inductance coil having two sliding connections as shown, M' an auxiliary spark gap, and N', a connecting wire supported by any suitable means, as for example, by the same supports on which the spark gap M' is mounted, as shown. O' represents the antenna, P my current separator, or rectifier, Q' the connection to ground, and R' the point at which the connection is made.

In operation the distance between the two connections on the coil L' is varied until a spark of the greatest length possible is obtained at gap M'. This will occur when the maximum energy is passing. Then this gap is closed until it just touches or fails to touch the connecting wire N', and the apparatus is ready for use. By this means with the gap adjusted as described, I know when using this antenna, that I am causing a maximum

of energy to flow into my antenna, and I find it a much more satisfactory and accurate means of ascertaining this fact than the hot wire ammeters heretofore employed. Furthermore, in my experiments with this apparatus I have discovered that it not only possesses marked advantages over the old style antenna in transmitting, but also in receiving, because the static effect in this case and in the others above mentioned is almost reduced to zero, for the reason that the antenna is directly grounded through the rectifier. The importance of this feature of my invention will be recognized, when it is remembered that static effects constitute one of the greatest obstacles at the present day to the efficiency of wireless telegraphy.

In Fig. 9 I have shown an improved interrupter for my spark coil. I have found that one of the secrets of portable wireless sets is to get a perfectly acting interrupter. In the ordinary spark coils the interrupter continually has to start and stop, and works only while the sending key is down. In my improved device the interrupter acts all the time the set is being used, so it does not have continually to start and stop, and the improved results follow at once. In a portable set this is of great importance, for since it causes the sending to be more certain, other parts can be made more lightly and still be relied on to do the work.

To one side of the primary F of my spark coil, shown in Fig. 1, I connect the sending key E' as shown in Fig. 9, and to the pivot of this key I connect one side of the battery C. To the other side of said battery is connected the wire G', which in turn is connected to the electromagnet I'. This electromagnet is connected to the fixed end K' of the spring controlled armature L', normally touching the contact M', which in turn is connected with the other side of the primary coil F', and through the same, to the key, as shown.

From the foregoing disclosures it will be seen that I have produced several distinct improvements applicable to the wireless telegraphic art in general, and that a plurality of these improvements are essential to a successful portable field apparatus capable of being carried by one or two men and capable of operating with certainty over distances of from twenty to one hundred miles or more. Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. In a radio electric circuit, the combination of an aerial, means to impress oscillations thereon, and a current rectifier or separator in said aerial, substantially as described.

2. In a radio electric circuit, the combination of an oscillating circuit having an aerial, means to impress oscillations thereon, a ground connection for the same, and a cur-

rent separator or rectifier connected with said aerial, substantially as described.

3. In a wireless telegraphic apparatus, the combination of a sending spark gap, an aerial, a ground connection for the same, and a current separator or rectifier in said aerial between said transmitter and said ground.

4. In a wireless telegraphic apparatus, the combination of a wave transmitter, an aerial connected with the same, a ground connection for said aerial, and a current separator or rectifier containing silicon, in said aerial between said transmitter and said ground, substantially as described.

5. In a wireless telegraphic apparatus, the combination of a wave transmitter, an aerial connected with the same, a ground connection for said aerial, and a current separator or rectifier containing silicon and carbon, in said aerial between said transmitter and said ground, substantially as described.

6. In a wireless telegraphic apparatus, the combination of a wave transmitter, an aerial connected with the same, a ground connection for said aerial, and a current separator or rectifier composed of carborundum or silicon carbide in said aerial between said transmitter and said ground, substantially as described.

7. In a wireless telegraphic apparatus, the combination of a suitable wave transmitter, an aerial, an air gap in the same, a ground connection for said aerial, and a current rectifier or separator in said aerial between said ground and said transmitter, substantially as described.

8. In a wireless telegraphic apparatus, the combination of a suitable wave transmitter, an aerial, an air gap in the same, a ground connection for said aerial; and a current rectifier or separator composed of carborundum in said aerial between said ground and said transmitter, substantially as described.

9. In a wireless telegraphic apparatus, the combination of a suitable wave transmitter, an aerial, a ground connection for said aerial, and a current rectifier or separator in said aerial between said ground and said transmitter, said separator constituting the sole path for the current from said aerial and to its ground, substantially as described.

10. In a wireless telegraphic apparatus, the combination of a wave transmitter, an aerial, a ground for the same, a current separator in the same composed essentially of carborundum and located between said transmitter and said ground, substantially as described.

11. In a wireless telegraphic apparatus, the combination of a wave transmitter, an aerial, a ground for the same, a current separator in the same composed essentially of carborundum sealed in a vacuum tube, and located between said transmitter and said ground, substantially as described.

12. In a wireless telegraphic apparatus, a sending aerial provided with a current separator composed essentially of carborundum, substantially as described.

5 13. In a wireless telegraphic apparatus, a sending and receiving aerial provided with a current separator composed essentially of carborundum and at all times grounded through the same, substantially as described.

10 14. In a portable wireless telegraphic apparatus, the combination of a spark gap, a sending and receiving aerial connected directly to the same, a ground for said aerial, and a current separator connected to said
15 aerial and between said gap and ground, thereby causing said aerial to have a distinctive tone in sending, and therefore rendering the use of a tuner unnecessary, and thereby
20 lightening and simplifying the wiring of the apparatus, substantially as described.

15 15. In a portable wireless telegraphic apparatus, the combination of a spark gap, a sending and receiving aerial connected directly to the same, a ground for said aerial, and a current separator connected to said
25 aerial and directly connected to said ground, thereby causing said aerial to have a distinctive tone in sending and receiving, and therefore rendering the use of inductance
30 coils for tuning and for regulating the wave lengths unnecessary, and thereby lightening the apparatus, substantially as described.

16. In a portable wireless telegraphic apparatus capable of sending and receiving
35 messages for distances of twenty miles and over, the combination of a spark gap, a battery not exceeding six or eight dry cells, and an induction coil for the same, an aerial consisting of a fine thread-like wire con-
40 nected directly to one side of said gap, a ground for said aerial, a current separator in series with said aerial and connected directly with said ground, and a suitable receiving
45 apparatus, substantially as described.

17. In a wireless telegraphic apparatus, the combination of a wave transmitter, a receiving and sending aerial circuit connected thereto, a ground for the same, and a current separator and an adjustable capacity in
50 said circuit, substantially as described.

18. In a portable wireless telegraphic apparatus, the combination of a suitable wave transmitter, a receiving and sending aerial circuit directly connected thereto, a ground
55 for the same, a current separator consisting essentially of carborundum, and an adjustable capacity in said circuit, substantially as described.

19. In a portable wireless telegraphic apparatus, the combination of a suitable wave
60 transmitter, a receiving and sending aerial circuit directly connected thereto, a ground for the same, a current separator consisting essentially of carborundum, and an adjustable capacity in said circuit connected to
65 said ground, substantially as described.

20. In a portable wireless telegraphic apparatus the combination of a wave transmitter a sending and receiving aerial or ground
70 for the same, a current separator composed of carborundum in said aerial; and a receiver at all times in circuit with said transmitter and connected to said ground substantially as described.

21. In a portable wireless telegraphic apparatus the combination of a suitable wave
75 transmitter, a sending and receiving aerial directly connected to the same; a ground for said aerial; an air gap in said aerial; a current separator in said aerial between said trans-
80 mitter and said ground and a receiver at all times in circuit with said transmitter and connected to said ground, whereby the wiring is simplified and the apparatus lightened as substantially described.

22. In an interrupter for spark coils especially adapted for portable wireless telegraphic apparatus, the combination of a
85 spring controlled armature, two electric contacts a primary circuit, or controlling key, for the same, and a short circuit connected to said primary and including said contacts substantially as described.

23. In a wireless telegraphic apparatus the combination of a wave transmitter, an ad-
95 justable inductance connected to the same, an aerial, a rectifier in said aerial, and a plurality of spark gaps in a shunt with said aerial substantially as described.

24. In a portable wireless telegraphic ap-
100 paratus capable of sending 20 miles and more, the combination of one or more spark gaps, a battery and induction coil for the same, a magneto interrupter in shunt circuit with the primary of said induction coil, an
105 aerial consisting of small wire suspended as described, a current rectifier in series with said aerial and connected to ground and a suitable receiving apparatus containing a light tuner, substantially as described.

110 In testimony whereof, I have affixed my signature, in presence of two witnesses.

HALSEY DUNWOODY.

Witnesses:

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A. G. PENDLETON.