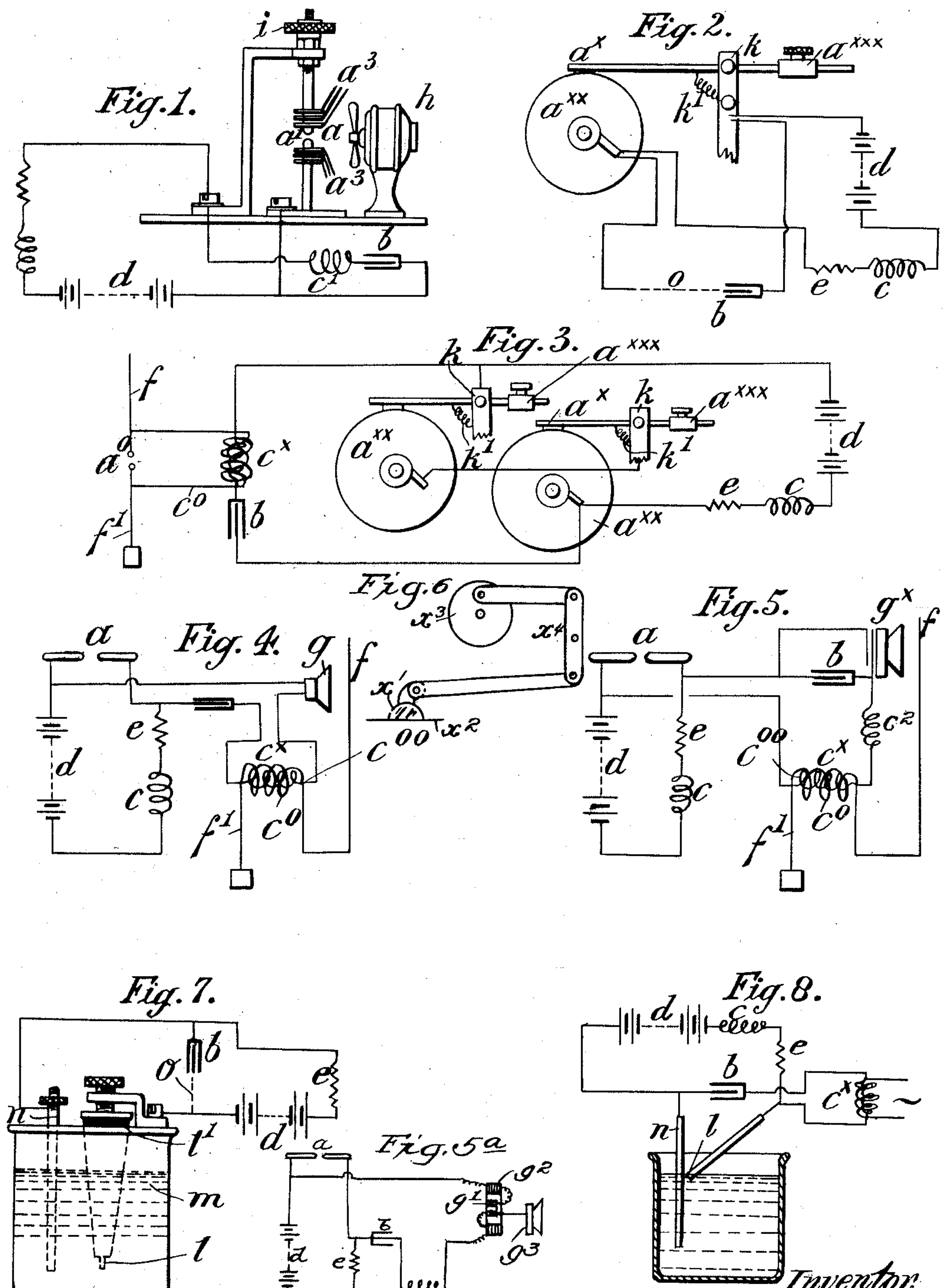
S. G. BROWN.

APPARATUS FOR PRODUCING AND UTILIZING ELECTRIC CURRENTS OF HIGH PERIODICITY.

APPLICATION FILED DEC. 17, 1906.

976,778. Patented Nov. 22, 1910.



Witnesses.

Robert Everett,

Inventor:
Sidney G. Brown,
By James L. Norris,
Atty.

UNITED STATES PATENT OFFICE.

SIDNEY GEORGE BROWN, OF LONDON, ENGLAND.

APPARATUS FOR PRODUCING AND UTILIZING ELECTRIC CURRENTS OF HIGH PERIODICITY.

976,778. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed December 17, 1906. Serial No. 348,309.

To all whom it may concern:

Be it known that I, Sidney George Brown, a subject of the King of Great Britain, residing at 4 Great Winchester street, in the city of London, England, electrical engineer, have invented certain new and useful Improvements in Apparatus for Producing and Utilizing Electric Currents of High Periodicity, of which the following is a specification.

This invention relates to an improved means for obtaining and working electric currents of high periodicity, applicable for use in connection with wireless telegraphy and for other uses where such currents—high periodicity currents—are employed.

It is known in the art to which the present invention pertains that, if an arc is struck between carbon poles, the arc being shunted by a suitable capacity and inductance, there occur electric oscillations which may attain a periodicity of several thousand per second.

I have found that oscillations of high periodicity may be caused to occur and the continuous flow thereof maintained by effecting a sparking between metal poles, if these poles be shunted by a suitable capacity, and a high self inductance be placed in series with the spark gap, so as to maintain the flow of direct current. Thus, the effect of the inductance is to maintain a continuous flow of direct current while the shunting capacity tends to extinguish it. The period of extinguishing is, however, momentary or infinitesimal so that the energy stored up by the inductance effects the restarting of the spark or re-asserts its superior power over the capacity.

To work the spark gap, the voltage of the battery may vary according to the particular arrangement of circuit, the constitution of the metal poles or other condition of the spark gap; the inductance being such as to maintain a steady flow of sparks and the resistance being adjusted so that no dangerous rush of current will result if short-circuiting of the spark gap occurs. If the capacity across the spark be of small degree, say, .01 or .005 microfarad or less, the oscillations may rise to many millions per second. By placing inductance in series with the capacity this system may be tuned.

The temperature of the metal poles should be kept below a certain degree, otherwise arcing may take place, with the result that the oscillations will cease. To this end, the poles may be constituted of large masses of metal or the cooling may be effected by water jacketing the poles. Suitable means, such as a screw device, may be employed for facilitating the adjustment of the distance between the poles to form the spark gap.

Instead of the sparking being effected between fixed metal poles it may take place between a fixed metal plate or pole adapted to rest with slight pressure upon, or assume a position in proximity to, a rotating metal disk or drum, or a metal rod or bar may be arranged to move to-and-fro on a metal strip, the arrangement permitting of continual sparking between the two metal poles in relative motion to one another. Another arrangement may consist of an electrode composed of platinum, nickel, or other metal, arranged to dip into an electrolyte consisting of dilute sulfuric acid or a solution of caustic potash; a small surface only of the aforesaid electrode being exposed to the action of the electrolyte, and an anode of large surface being placed in the electrolyte. Upon a strong current being passed through the combination, a capacity being placed across from anode to cathode, electrical oscillations will take place. By arranging the cathode quite close on the surface of the liquid, but not actually touching the anode, and introducing an inductance in series in the circuit supplying the current, an enhanced effect may be obtained.

In order that the said invention may be clearly understood and readily carried into effect, I will proceed to describe the same with reference to the accompanying exemplary diagrams whereof,

Figure 1 is a view illustrating an arrangement of spark gap device according to my invention. Fig. 2 illustrates another arrangement of spark gap device according to my invention. Fig. 3 is a view illustrating two spark gap devices similar to that shown in Fig. 2 arranged for being worked in series. Fig. 4 illustrates the application of the invention to a system of wireless telephony in which a carbon microphone is employed as a transmitter; Fig. 5 representing an arrangement in which a Dolbear electrostatic telephone is employed as a transmitter. Fig. 5ª diagrammatically shows a modification with respect to the organization illustrated by Fig. 5. Fig. 6 illustrates a modified construction. Figs. 7 and 8 illustrate arrangements of sparking devices in which electrodes are employed whereof one dips into or rests upon the surface of the electrolyte so as to expose only a small portion of its surface to the electrolyte while the other electrode is immersed in the electrolyte.

For the purpose of causing oscillations of high periodicity to occur and the continuous flow thereof to be maintained according to my invention by effecting a sparking between metal poles, an arrangement is illustrated in Fig. 1, whereby the desired effect may be obtained. The poles *a a* are shunted by a suitable capacity, indicated by a condenser *b*, a high self inductance *c* being placed in series with the spark gap *a′* for the purpose of maintaining the flow of direct current, whereof the source is indicated by a battery *d*. The voltage of the direct current or, as in the present example, of the battery *d*, necessary to work the spark between the aforesaid metal poles *a*, may range from 50 to 500 volts or even a higher or a lower voltage may be found suitable. Preferably, the voltage may be about 200 but it will be understood that in some instances it may be desirable or suitable to employ a higher or a lower voltage. This latter will, however, depend on the arrangement of the circuit and the materials constituting the metal poles or the condition of the spark gap. The self inductance *c*, in series, may be from 20 or even from 10 to 40 henries, with a resistance, together with the resistance *e*, in the present example, of 100 ohms; it being assumed that the battery *d* has a voltage of about 200 volts and the shunting capacity *b* is of the order of say .01 microfarad. The higher the value of a self-inductance the steadier the flow of sparks will be maintained; consequently it is advantageous to have the self-inductance as high in value as possible. The self-inductance may, however, be subject to variation, but it must be borne in mind that the lower the self-inductance the more easily will the steady flow of sparks be interrupted while the contrary effect will result if the inductance be high, that is to say, the less easily will the sparks be interrupted. The resistance of the circuit is to be so adjusted that if the spark gap be short circuited no dangerous rush of current will result.

If the shunting capacity *b* across the spark be of small degree, say .01 or .005 microfarad or less, the oscillations may rise to many millions per second. By placing inductance, *c′*, in series with the aforesaid capacity *b*, the system may be tuned. It is, however, unnecessary for successful working to have inductance in series with the capacity (condenser *b*) in order to produce high oscillations because if the inductance be so far reduced as to only amount to the connecting wires and if, further, these wires were twisted together, the oscillations would continue in full strength and, in this case, the said oscillations would be mainly determined by the resistance in series with the capacity. The inductance may, in some cases, take the form of a transformer, as shown at c^{x} in Fig. 3, the secondary c^{o} being wound so as to step up in voltage to any amount and a spark gap a^{o} may be introduced into the secondary, if necessary, say, as in the example illustrated, for use in connection with wireless telegraphy or telephony; *f* being the aerial wire and *f′* the earth connection. A microphone *g*, Fig. 4, may be introduced into the primary circuit c^{oo} to vary the value of the current through the primary of the aforesaid transformer c^{x} by altering the resistance. Or the tuning of the circuit to a given oscillation may be varied for a similar purpose, say, by the introduction of an electrostatic Dolbear telephone g^{x}, Fig. 5, placed across the tuning capacity *b*, so that by speaking into g^{x} the altered capacity due to the vibration of the disk pertaining to the aforesaid telephone will vary slightly the rate of oscillation of the waves and thus a distant wireless telephone receiver tuned to receive waves of a given standard rate of vibration will receive varying amount of current. Thus, the current will vary, through the receiver, according as the tune approximates more or less to that of the transmitter which, as before stated, varies in accordance with the voice. The transmitter by these means is enabled to make a telephone reproduce the sound.

Instead of altering the tuning by varying the capacity *b* as just described, the capacity may remain unaltered and the value of the inductance c^{2} in series with the microphone *g* or electrostatic telephone g^{x} may be varied in a more or less similar manner. As an example, this variation may be accomplished as shown in Fig. 5ª by varying the distance between two small coils of wire g', g^{2}, which coils may be arranged in series with each other, see Fig. 5ª the relative distance of the coils being regulated by a disk g^{3}. Thus it will be apparent that, in speaking into the microphone *g*, or into the electrostatic telephone g^{x}, a corresponding variation in the energy radiated may result so that a distant wireless tuned receiver in combination with a telephone may reproduce the speech or the words spoken at, or other sound emanating from, the transmitting station.

The spark may be worked between any kind of metal poles, such as copper, zinc, iron, aluminium, or the like or even very hard carbon may be used, and, sometimes, mercury.

As hereinbefore indicated, the temperature of the metal poles should be kept below a certain degree otherwise arcing will take place with the result that the oscillations will cease. A low temperature may be maintained by means of poles constituted of large masses of metal as shown in Fig. 1 in which large plates a^3 constitute the poles a. A fan indicated at h may, moreover, be employed to aid the cooling effect if and when found necessary.

It will be understood that if the voltage of the current is to be raised considerably two or more spark gap devices may be arranged to work in series. The distance between the metal poles to form the spark gap may be adjusted by any suitable means such as a screw device i (Fig. 1). When this screw is used it may be suitably operated in accordance with known methods.

The sparking instead of being effected between fixed metal poles as above described, may, as illustrated in Figs. 2 and 3 take place between a fixed metal plate or pole a^x adapted to rest with slight pressure upon or assume a position in proximity to a rotating metal disk or drum a^{xx}. The plate or pole a^x is pivoted in a support or carrier k, a light spring k' and an opposing adjustable weight a^{xxx} maintaining the aforesaid plate or pole a^x in proper relation to the disk or drum a^{xx}. A kind of floating contact is hereby obtained with the drum. The disk or drum may be constructed of any suitable metal or of hard carbon. Aluminium has been found to give good results. The material used may, however, be determined by the voltage of the direct current. The fixed metal plate may be composed of copper or other suitable metal or again this may be constructed of hard carbon, but copper is found to work well. If aluminium be employed for the disk or drum a^{xx} the latter, when arranged and in action as shown, is quickly covered on its periphery with a more or less insulating film. This film replaces the air gap pertaining to the previously described arrangements (Fig. 1 for example) and is, moreover, highly efficient; the rubbing between the plate or pole a^x and the disk or drum a^{xx} preventing the film from becoming unduly thick. The device will be found to run continuously and be self adjusting. The disk or drum is kept cool by the large exposure of metal and by its rotation; the latter varying say from 30 to 500 revolutions per minute and if the drum is stopped for a very short period of time the oscillations may still continue. It seems that it is more advantageous to keep the positive (+) pole cool rather than the negative (—). The disk or drum is therefore by preference made the positive as it is better adapted to cool itself more readily.

If it be desired to produce continuous waves of high periodicity currents with considerable power, say for the purpose of wireless telegraphy the operating direct current must be increased in voltage. It is known in practice how to produce direct current dynamos that can give currents at considerable voltage—5,000 or more volts—but it would be inadvisable to use too high a voltage on apparatus such as shown in Fig. 2. To overcome this difficulty two or more sparking devices may be worked in series as shown in Fig. 3.

According to an alternative construction, shown by Fig. 6 a metal rod or bar x' may be arranged to move to-and-fro upon a metal strip x^2, the movement of the rod or bar x' being obtainable by means of a crank disk x^3 connected with the rod or bar x' by means of levers and links x^4, this arrangement permitting of continual sparking between the two metal poles in relative motion to one another, and of a floating contact as hereinbefore described. The capacity (b) is placed across this spark gap (a) to produce the electrical oscillations, as hereinbefore explained.

According to another arrangement, illustrated in Fig. 7, an electrode l composed of platinum, nickel or other metal may be arranged to dip into an electrolyte m consisting of dilute sulfuric acid, or, preferably, of a solution of caustic potash so as to expose only a small surface thereof to the action of the electrolyte. For this purpose, the electrode l is inclosed in a sheath or tube l' of insulating material, an anode n of metal of large area or surface is also placed in the electrolyte. b is the capacity, d the battery and e the resistance as in the previously described arrangements. An inductance (c), not shown, may be added as in the previously described examples. If a strong current be passed through the combination, a capacity b being placed across from anode n to cathode l electrical oscillations will take place.

By arranging the cathode l, as shown in Fig. 8, quite close, on the surface of the liquid, but not actually touching the anode n, and introducing an inductance c in series in the circuit supplying the current an enhanced effect may be obtained. At o in Figs. 2 and 7, the transformer, wireless or any other apparatus which it is desired to operate by the alternating current, may be situated.

I am aware that the well known Wehnelt electrolytic break or interrupter consists of a platinum wire projecting a short distance in dilute sulfuric acid and that this platinum wire is made the anode or positive pole while a large lead plate immersed in the electrolyte is made the cathode or negative pole. If such a device be supplied with a current at a pressure of 40 to 50 volts, an inductance being in series with the break, intermittence of the current will take place, which may be as high as 2,000 periods per second. This arrangement of break or interrupter will not work well when the polarity is reversed.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In an apparatus for producing and utilizing electric currents of high periodicity, the combination of a spark gap formed between electrodes lying in contact with and adapted for movement relatively to each other, a source of continuous current in series with said spark gap, an oscillatory circuit shunting said spark gap, and means for varying the periodicity of the oscillating circuit consisting in introducing therein a microphone capable of varying the resistance of said circuit.

2. In an apparatus for producing and utilizing electric currents of high periodicity, the combination of a spark gap formed between a balanced metal pole and a revolving disk on which said metal pole lightly rests, a source of continuous current in series with said gap, an oscillatory circuit shunting said gap, and a microphone for varying the periodicity of said oscillatory circuit by varying the resistance.

3. In an apparatus for producing and utilizing electric currents of high periodicity, the combination of a spark gap formed between a balanced metal pole and a revolving disk on which said metal pole lightly rests, means for preventing arcing, a source of continuous current in series with said gap, an oscillatory circuit shunting said gap, and a microphone for varying the periodicity of said oscillatory circuit by varying the resistance.

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

SIDNEY GEORGE BROWN.

Witnesses:

T. Selby Wardle,

Walter J. Skerten.