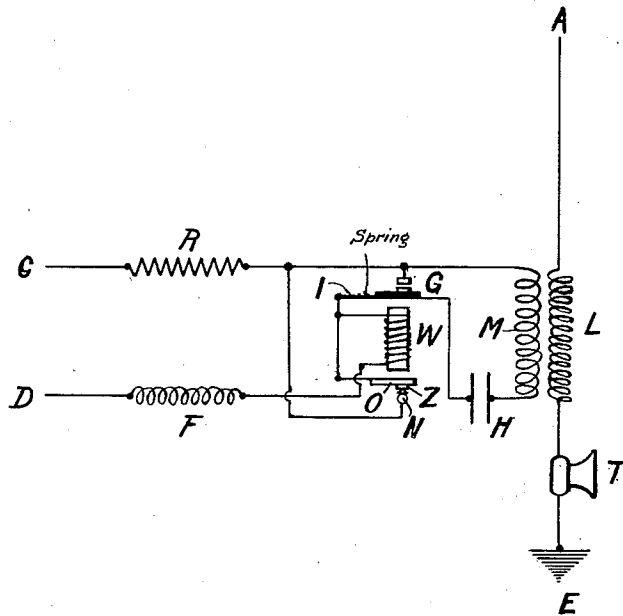


W. TORIKATA, E. YOKOYAMA & M. KITAMURA.
 RADIOTELEPHONY, RADIOTELEGRAPHY, AND THE LIKE.
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Witnesses: *H.T.P. Lee*
Voltas W. Ward.

Inventors:
Wichi Torikata
Eitaro Yokoyama,
Masajiro Kitamura.

By: *Spears, Huddleston, Dumas & Spears*
Attys

UNITED STATES PATENT OFFICE.

WICHI TORIKATA, OF AKITA, EITARO YOKOYAMA, OF SAKAI, AND MASAJIRO KITAMURA, OF TOKYO, JAPAN.

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To all whom it may concern:

Be it known that we, WICHI TORIKATA, residing at No. 224 Hanaoka-mura, Kita-Akita-gun, Akita-ken, Japan, EITARO YOKOYAMA, residing at No. 1 Matsugashita, Mikunimachi, Sakai-gun, Fukui-ken, Japan, and MASAJIRO KITAMURA, residing at No. 59 Suidocho, Koishi-kawa-ku, Tokyo-shi, Tokyo-fu, Japan, each a subject of the Emperor of Japan, have invented certain new and useful Improvements in Radiotelephony, Radiotelegraphy, and the like, of which the following is a specification.

This invention relates to high frequency generators, for use in radio telephony, radiotelegraphy and like purposes.

The special feature of our invention is the adoption of an equilibrator and a self-starting device to a spark-gap for producing high frequency currents for use in radiotelephony and also radio-telegraphy and like purposes.

It is known that in ordinary spark-gaps connected to an oscillation circuit, the high frequency current generated undergoes changes in its intensity, caused by the deformation of the electrodes or by changes in the dielectrics or by fluctuations in the feeding current or similar causes.

For the practical production of high frequency currents, we have found such spark gaps that work after the method known as the Wien's spark-gap highly efficient in energy, but owing to the small clearance between electrodes of such spark-gaps, small deformations of the electrode material and other causes produce large fluctuations in the energy of the high frequency current. Such spark-gaps are not well adapted to wireless telephony or telegraphy unless provided with some special means to eliminate such fluctuations.

We have been able to produce by means of a spark-gap to which we had applied an equilibrator and a self-starting device, a high frequency current which practically showed no fluctuations.

The functions of the equilibrator and self-starting device used by us, we shall explain in one example below, but state that each device has also been found to fulfil its special duty when used alone in connection with a spark-gap.

The figure gives an example of an equilibrator and self-starting device adapted to a

spark-gap, as we have found it specially adapted to use in wireless telephony and telegraphy.

In the figure "C" and "D" are the terminals of a direct current source, "R" is a resistance, "F" an inductance, "H" a condenser, "LM" an oscillation transformer, "A" an aerial wire, "E" ground, "T" a telephone transmitter, "W" an electro-magnet, both "O" and "I" armatures to "W," the former acting as self-starter and the latter as equilibrator, "Z" a metallic contact point on the armature "O", "N" a fixed metallic contact point against "Z" and "G" the oscillation-gap with electrodes.

In rest we adjust the equilibrator, so that the two electrodes are in mechanical touch or have a very small clearance and the self-starting device so that the contacts are closed.

On connecting "C" and "D" with an electric current source, a current will flow in the circuit "D F W O Z N R C", but not through the circuit "D F W I G R C" as the initial resistance of this circuit is very high when using electrodes of high surface resistance or adjusting a small clearance between them. (In our experiments we found special advantages attached to electrode materials which have a high surface resistance. We experience difficulties in breaking down the initial resistance of such electrodes, which we have perfectly overcome by the devices of our invention.) Now we dimension the electro-magnetic device "W" with the armature "O", so that at the moment a current flows in the circuit "D F W O Z N R C" the armature with the contact "Z" is attracted. At the moment the flow of current is interrupted by the separation of the contacts, a super-tension is produced in this circuit owing to the inductance of the electro-magnetic device "W" and in cases also to a separate inductance such as in this case "F" which we use to augment the effect. Now the super-tension produces discharges between the electrodes *g*, which discharges, either pierce any high resistance coating that may have formed on the opposing surfaces of the electrodes (hitherto herein termed "surface resistance" of the electrodes) or jump the space between; or, again they may both pierce such coatings and jump the space, if any, between the electrodes at the same time. The gap, after such a spark has

passed through, will be ionized and a strong current, which was at the beginning cut off by the high resistance in the electrode circuit, will be able to flow through the circuit "D F W I G R C".

During the flow of current in the circuit "D F W I G R C" the armature "O" is attracted and the contacts "Z" and "N" do not touch each other. At the moment the current starts flowing through the generator circuit "D F W I G R C", the equilibrating device starts to act. In this case the equilibrator consists of an armature "I" to which one electrode of the spark-gap "G" has been affixed, whereas the other electrode is separately mechanically fixed. The element I is arranged under any suitable spring control so as to prevent variation in the width of the gap which would ensue from the passage of current therethrough if no regulating device were used. This armature we have arranged to move in the field of the electro-magnet "W" and the electrode, being fixed to the armature, follows all movements of the armature.

The movement of the aforesaid armature, we have restricted within certain limits by a device of springs or through gravity to perform, together with the electromagnetic device, the following desired effect: We make the movement of the armature in a certain proportion to the current flowing in the spark-gap, when an oscillation circuit "G M H G" is connected to the spark-gap. In this oscillation circuit "H" is a condenser, "M" an inductance and "G" a spark-gap. For utilizing oscillations produced in the circuit "G M H G" we connect to it by induction a secondary oscillation circuit such as "A L T E," in which "A" is an aerial device, "L" an inductance used to couple the inductances "M" and "L," and "T" a microphone and "E" an earth connection, an arrangement which is in use in wireless telephony and telegraphy.

We have adjusted our equilibrator, consisting of the device before-mentioned, to be influenced by the current flowing, so as to always keep the tension across the electrodes constant, the charging of the condenser and therefore the high frequency energy produced also showing then no fluctuations. By the use of an equilibrator we specially eliminate fluctuations of the energy which would be caused by deformation of the electrodes changing the clearance and the resistance of the gap or by fluctuations of the feeding current and by fluctuations in the energy drawn from the spark-gap by the oscillation circuit. These and other causes of disturbance in the even production of oscillations are by no means eliminated by our invention, but it is the essential feature of our invention that bad effects following such disturbances are successfully neutralized or

equilibrated by the devices of our invention. We are able to produce oscillations of very uniform strength over long periods of time, as by means of our invention the effects following disturbances can be successfully neutralized. We have found by our invention a device to produce a very even and constant train of oscillations which we have found specially desirable for purposes of wireless telephony.

In the above the arrangement of our device is explained by one example, as it is actually to be used in practical service, but we can also combine a whole number of the afore-mentioned devices in multiple pairs of electrodes producing the same favorable results. Also the afore-mentioned example of the electrical connections of the devices of our invention can be varied according to the condition to be fulfilled.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare what we claim is:—

1. Apparatus for generating high frequency oscillations comprising, in combination, a source of current, an oscillation circuit having capacity and inductance, means for producing a high frequency gap, means for breaking down the initial non-conducting condition of said gap, consisting of an electro-magnetic device for making and breaking current flow around said inductive circuit for the purpose of producing a transient supertension across the oscillation gap when said gap is non-conducting or highly resisting, thereby precipitating the discharge across the gap, and means for regulating said gap to equilibrate the discharge to produce very constant oscillations, substantially as described.

2. Apparatus for generating high frequency oscillation comprising in combination, a source of current, an oscillation circuit having capacity and inductance, self-acting means for producing a high frequency gap, means for breaking down the initial non-conducting condition of said gap consisting of an electro-magnetic device for making and breaking current flow around said inductive circuit, so connected and operated by the current from the source of supply that a transient supertension is automatically produced across the oscillation gap when said gap is non-conducting or highly resisting, thereby precipitating the discharge across the gap, and means for regulating said gap to equilibrate the discharge to produce very constant oscillations, substantially as described.

3. Apparatus for generating high frequency oscillations comprising, in combination, a source of current, an oscillation circuit having capacity and inductance, means for producing a high frequency oscillation

gap, means for regulating said gap to equilibrate the discharge and means for breaking down the initial non-conducting condition of said gap consisting of an electromagnetic device the construction being such that the dual function of precipitating the passage of current across the oscillation gap and the regulating of the gap is vested in one and the same electromagnet, substantially as described.

4. Apparatus for generating high frequency oscillations comprising, in combination, a source of current, an oscillation circuit having capacity and inductance, means for producing a high frequency oscillation gap, means for equilibrating the discharge across said gap and means for breaking down the initial non-conducting condition

of said gap consisting of an electromagnetic device the construction being such that the dual function of precipitating the passage of current across the oscillation gap and the equilibrating of the discharge is vested in one and the same electromagnet, either the one or the other of said means being capable of being used alone, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

WICHI TORIKATA.
EITARO YOKOYAMA.
MASAJIRO KITAMURA.

Witnesses:

UHACHI ISHIWARA,
ROKURO AOYAMA.