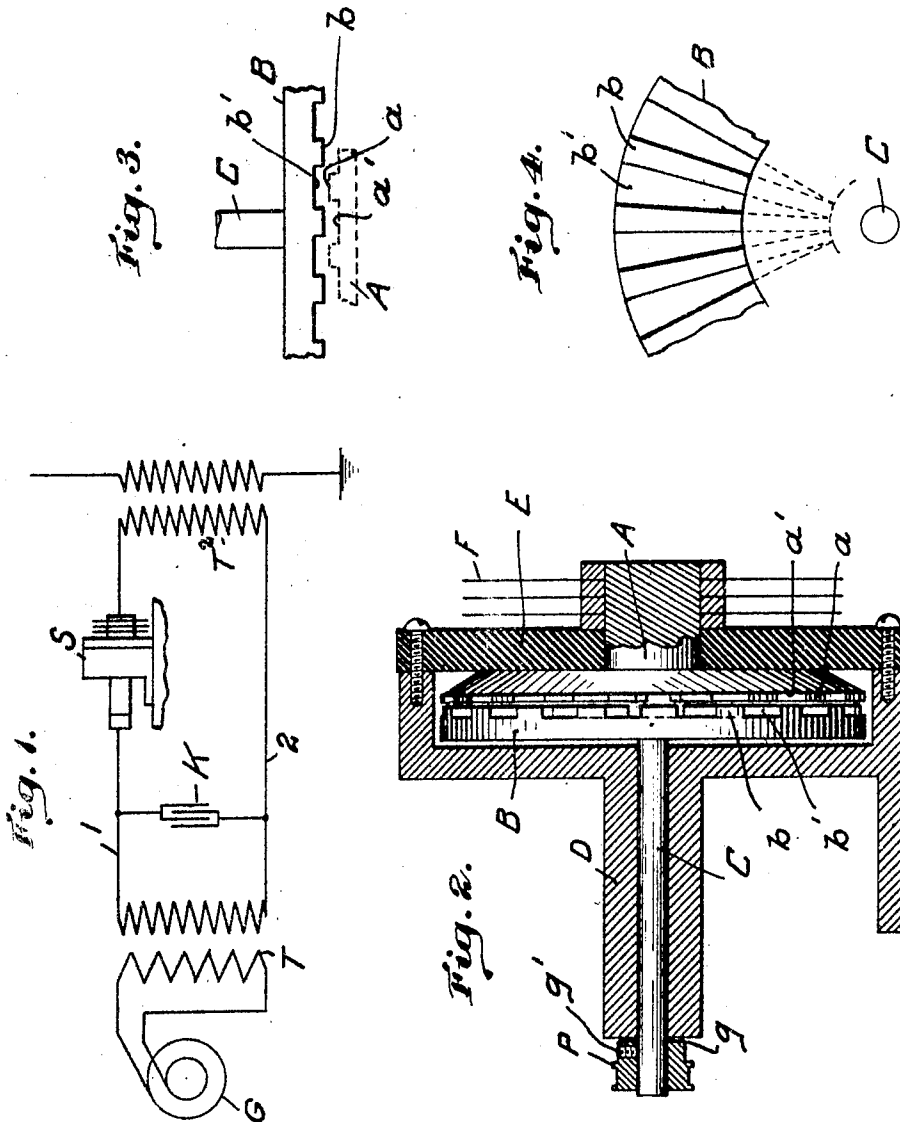


M. EASTHAM.
METHOD OF PRODUCING TONE EFFECTS IN WIRELESS TELEGRAPHY.
 APPLICATION FILED SEPT. 20, 1911.

1,056,893.

Patented Mar. 25, 1913.

2 SHEETS—SHEET 1.



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Fig. 5.

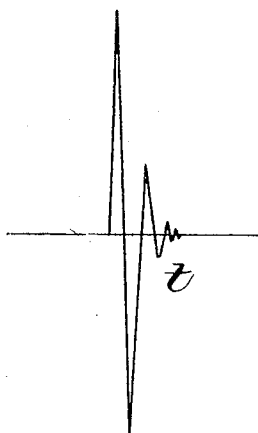


Fig. 6.

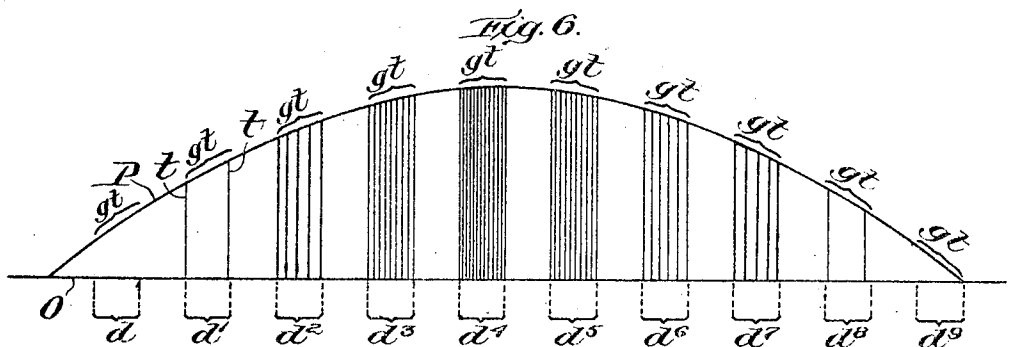
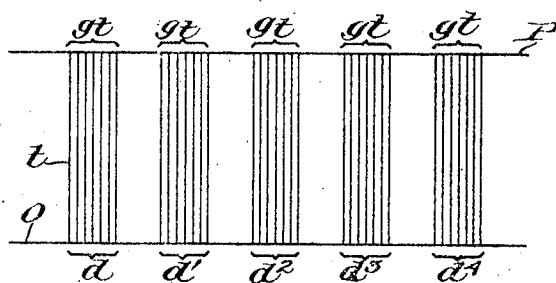


Fig. 7.



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UNITED STATES PATENT OFFICE.

MELVILLE EASTHAM, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO CLAPP-EASTHAM COMPANY, OF CAMBRIDGE, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

METHOD OF PRODUCING TONE EFFECTS IN WIRELESS TELEGRAPHY.

1,056,893.

Specification of Letters Patent.

Patented Mar. 25, 1913.

Application filed September 20, 1911. Serial No. 650,452.

To all whom it may concern:

Be it known that I, MELVILLE EASTHAM, a citizen of the United States, and resident of Cambridge, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Methods of Producing Tone Effects in Wireless Telegraphy, of which the following is a specification.

My invention relates to wireless telegraphy, and consists of a method of producing regulable tone-effects in the operation of wireless telegraphic apparatus.

The objects of my invention are as follows: To produce tone-effects, similar in musical regularity to those obtainable by the use of high-frequency generators and synchronized spark-interrupters, while employing generating apparatus of ordinary commercial frequency and securing the economy, advantage and efficiency due to the use of such generators. To eliminate the necessity for accurate tuning by effective damping of spark-oscillations. To adjust the tone to any pitch desired within the practicable acoustic limits, particularly to regulate the tone-pitch to suit the peculiarities and limitations of telephonic receivers. To employ low potentials (as contrasted with those which have prevailed in the operation of wireless telegraphic circuits) by utilizing the acoustic efficiency of comparatively faint regular musical tones, as contrasted with unmusical irregular crepitations, and thus to facilitate the insulation of condensers and antennae. To render the operation of wireless apparatus practically noiseless.

My invention is characterized by the production of a train-discharge, and by breaking the normal continuity of the train into recurrent train-groups, separated by intervals of no discharge, and determining the frequency of recurrence of these train-groups; then producing a tone effect in correspondence to the train-group frequency, and therefore independent of the generator frequency. The tone produced is the simple tone which corresponds to the frequency of recurrence of the group of trains and is not sensibly—or perceptibly at least—affected or modified by the generator cycle undulations, or by any superpositions of disturbing overtones or crepitations (by the trains themselves).

My invention may advantageously be practised with an apparatus such as illustrated in the drawings hereto annexed, in which,—

Figure 1 diagrammatically represents parts of a wireless telegraphic circuit and shows a form of my novel spark gap device, in side elevation; Fig. 2 shows in diagram details of the spark gap devices; Fig. 3 shows in diagram certain details of the said devices; Fig. 4 shows a portion of a spark gap disk; Fig. 5 illustrates diagrammatically a single train-discharge; Fig. 6 illustrates diagrammatically the separation of groups of train discharges, the groups occurring at acoustic frequency, independent of generator-frequency, and Fig. 7 illustrates diagrammatically the division of discharge into groups of trains, the groups occurring as units at acoustically satisfactory frequency.

The inventions embodied in this apparatus, so illustrated, form the subject matter of an application for patent filed by me concurrently herewith, Serial Number 650,398.

Referring to Fig. 1: G represents an alternating current generator set, which includes the step up transformer T. The cycle-frequency of the generator is preferably that of the usual commercial type and practice, say, 60. The circuit which is excited by the transformer T also, as usual, comprises the wires 1 and 2, capacity K, inductance T' and a spark gap device, comprehensively designated by S. The frequency of the generator G is immaterial, except that for economy and convenience it should be low. Indeed the circuit which comprises the spark gap S may be excited by a constant-potential generator. The spark gap device S is herein represented by two disks A and B; being mounted on the shaft C to rotate in the bearing D, driven by the pulley P from any suitable source of power; the disk A being mounted in the insulating plate E. Adjustment of the two disks A and B is provided for by securing the pulley P to the shaft C by means of a set screw g', so that the face g of the pulley may be adjusted to bear on the end of the housing D and secure any desired spacing of the disk B from the disk A. The face g may be held against the housing by some simple means, as by leading the driving belt (not shown) from the pulley P at

a slight angle. The housing D is extended to form a box to inclose the disks A and B, the core E, of insulating material, being secured as shown. The plate A, mounted in the core plate E, may be provided with external fins or plates F, for heat-radiating purposes. The two disks provide the spark gap in the circuit. The opposed faces of the disks A and B are circular. Each is milled to form salient sectors *a* on the disk A, and *b* on the disk B (see Figs. 3 and 4). The sides of these sectors are not truly radial, but are inclined to the radius by such an angle that when in the rotation of the disk B a sector *b* is symmetrically opposite the interval between two sectors *a* on the disk A, that is to say, is just midway between the two sectors *a*, the edges of the sector *b* shall be parallel to the edges of the respectively adjacent sectors *a*, and distant therefrom by slightly more than the extreme sparking distance. The relation between the disks and their sectors is shown in diagram in Fig. 3, where the outline of the developed edge of disk A is shown in dotted lines. The opposed parallel faces of the sectors *a* and *b* are brought close together by adjustment of the disk B so that the distance between them, measured parallel to the axis of the disks, shall be very small, say from four to eight thousandths of an inch. The two members A and B of the spark gap devices, or train interrupter, are composed of highly heat-conductive material, such as silver or copper, and are connected in circuit as indicated in Fig. 1. The circumferential arc subtended by a sector *a* or *b* is less than that subtended by an interval (*a'* or *b'*) between two salient sectors, preferably about three fifths thereof. By making the two members A and B alike, an ample extent of surface is provided and arc-formation effectively restrained. By adjusting the surfaces of the opposed salient sectors *a* and *b* so that they are but slightly separated, a spark may be established between them at relatively low potentials.

The operation of the apparatus is as follows: Assuming that a 60 cycle generator is employed the rotary sector-disk B is rotated at such speed that each salient sector *b* passes an opposite sector *a* with high frequency as contrasted with the generator-frequency, say 600 times a second. The establishment and interruption of spark communication thus will produce, say, 600 isolated train-groups per second. If the circuit is, for instance, adapted to charge the condenser about 18000 times per second the operation of the train interrupting devices will produce 600 train groups per second, with 15 discharges per group on the average assuming the discharge to take place about half the time. The number of discharges will vary from group to group, depending

on the amount of power consumed in the circuit and on the stage in the generator cycle undulation at which a discharge occurs. The abundance of highly heat conductive material in the spark-members causes effective damping of oscillations, so that the excitation of the coupled circuit represented at T^2 is by impact, and tuning is unnecessary. The rate at which the train groups occur can be regulated simply by regulating the speed of rotation of the disk B. The telephonic auditory receiver at the receiving station responds by emitting a clear musical tone of high acoustic efficiency, determined as to pitch by the train group frequency at the sending station; above described. The shape of the salient sectors *a* and *b*, above described, insures such separation along the entire length of each sector-edge, as will produce spark discharge interruptions without fail.

The train-groups produced by the above described apparatus according to my method will be established at that point where the potential attains sparking intensity, and will be discontinued when in the decline of the electromotive force the potential falls below the sparking-intensity. Theoretically therefore there will be interruptions in the regular continuity of the train group series, and electrically speaking this discontinuity must exist. Acoustically, however, no such discontinuity is perceptible. It might be supposed that the recurrence of maxima in synchrony with the generator cycle would produce an undertone, but so far as I have observed this does not occur.

The high heat-conductivity and relatively large mass of the sector disks and the metal part of the housing will suffice, in apparatus of moderate capacity, to control temperatures. It is advantageous to have the housing of these disks closed, since constant circulation of fresh bodies of air tends to oxidize the metal-surfaces and thus deteriorate their efficiency. Complete closure of the housing also suppresses the noise of the sparking devices and quiets the operation of the apparatus.

The method may still further be explained by reference to Figs. 5, 6 and 7, in which the irregular line *t* represents a single discharge-train, which oscillates to a point of rest in an infinitesimal of time. These trains follow each other with greater or less rapidity according to the stage in the potential-cycle at which they occur, and, with a sparking apparatus as above described, the trains are produced only when segments of the spark-terminals are within spark-distance of each other. Thus, in Fig. 6, P denotes the current curve in the sparking circuit during one half a generator phase. The abscissæ laid upon the line of origin O, rep-

representing time elapsed, the times in which the positions of the spark-terminal segments *a*, *b*, (Figs. 3 and 4) will permit discharges are represented by the distances *d'*, *d*², *d*³, etc., to *d*². At the stage represented by *d*, suppose the potential too feeble to cause spark discharge, while at the stage *d'* the potential rise produces two discharge trains. The lines *t*, *t* each represent a discharge-train such as is more completely illustrated in Fig. 5. At station *d*² the discharge trains number five. The two discharge-trains which occurred during stage *d'* constitute a train-group; so also the five discharge-trains during stage *d*². Each train-group is designated as *gt*. For stage *d*³ the train group *gt* comprises nine trains *t*, at *d*⁴ twelve or more, while at *d*, *d*³, *d'* and *d*³, the falling current produces fewer and fewer train-discharges to each group, while *d*³, like *d*, is silent. If, as hereinabove suggested, a source of constant potential be employed, the frequency of the generator becomes zero; yet, with the provisions for producing regularly recurrent groups of train-discharges, the result may be the same, acoustically considered, as with, say a 60 cycle alternating generator. Thus, in Fig. 7, *P* indicates constant potential, and *O* the line of origin on which time-abscissæ are laid off. *d*, *d'*, *d*² etc., represent the regularly determined sparking stages, *t* the discharge trains, and *gt* the groups of trains, which, other conditions being supposed to be the same, will each comprise the average number of discharge trains *t* as represented by the cyclically increasing and decreasing group-densities represented in Fig. 6. The silent stages which occur when alternating current generators are employed, do not sensibly affect the acoustic results.

What I claim and desire to secure by Letters Patent is:

1. The method of regulating the emission of electrical waves which consists in generating frequency discharges in groups of

trains, recurring at regular frequency which is independent of the frequency of the generator employed.

2. The method of regulating the emission of electrical waves which consists in exciting a circuit with potential at relatively low frequency, generating high frequency discharges divided into groups of trains in said circuit, said groups recurring at regular intervals with frequency intermediate between the exciting potential frequency and that of the discharge trains which constitute the groups.

3. The method of regulating the emission of electrical waves which consists in exciting a circuit with potential alternations of relatively low frequency, generating high frequency discharges in groups of trains recurring at regular intervals with frequency intermediate between that of the potential alternations and that of the discharge trains which constitute the groups.

4. The method of producing electrical waves suitable for the production of audible tone effects which consists in generating high frequency discharges divided into groups of trains recurring at regular and acoustically satisfactory frequency independent of the frequency of the generator employed.

5. The method of producing electrical waves suitable for the production of audible tone effects which consists in exciting a circuit with potential at relatively low frequency, generating high frequency discharges divided into groups of trains in the circuit, said groups recurring at regular and acoustically satisfactory intervals with frequency intermediate between the exciting potential frequency and that of the discharge trains which constitute the groups.

Signed by me at Boston, Massachusetts, this eighth day of September, 1911.

MELVILLE EASTHAM.

Witnesses:

CHARLES D. WOODBERRY,
ODIN ROBERTS.