No. 615,652. Patented Dec. 6, 1898.

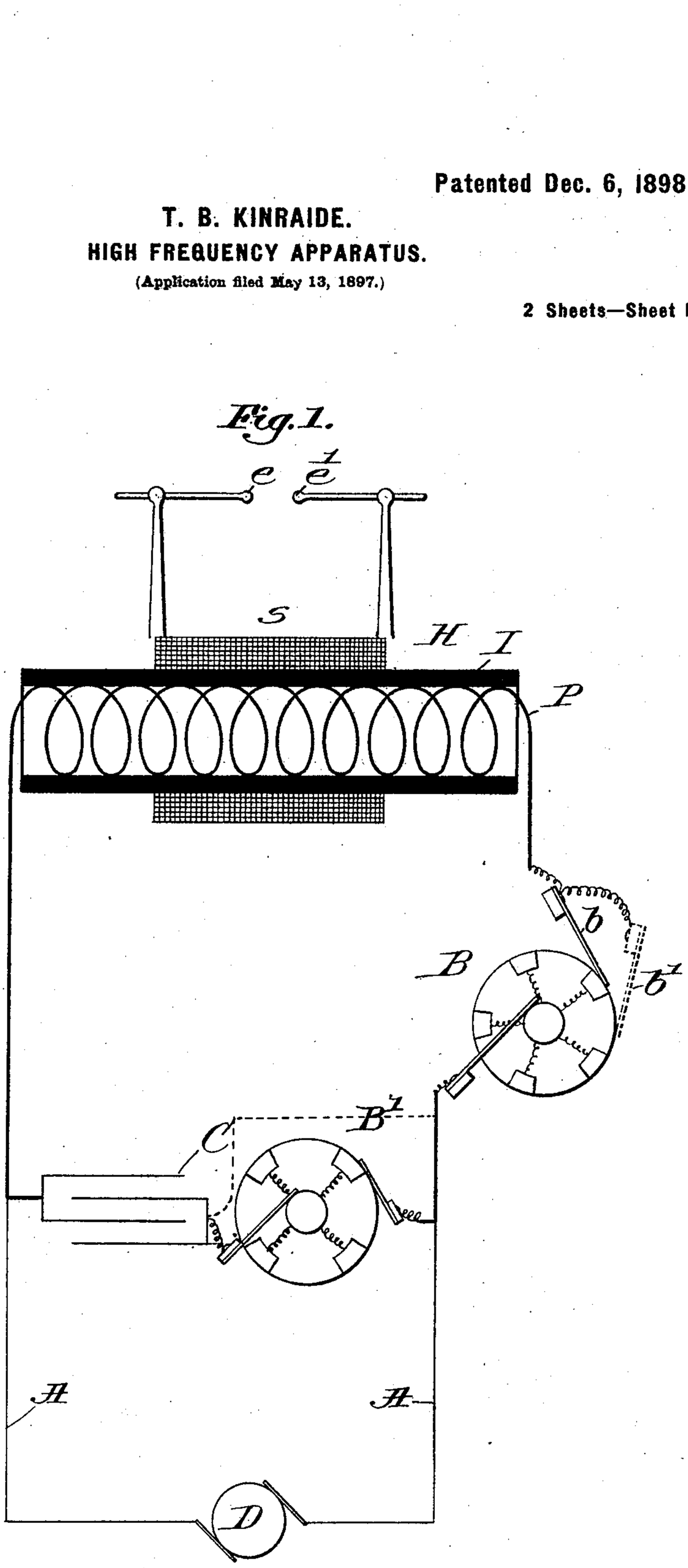
T. B. KINRAIDE.

HIGH FREQUENCY APPARATUS.

(Application filed May 13, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 2.

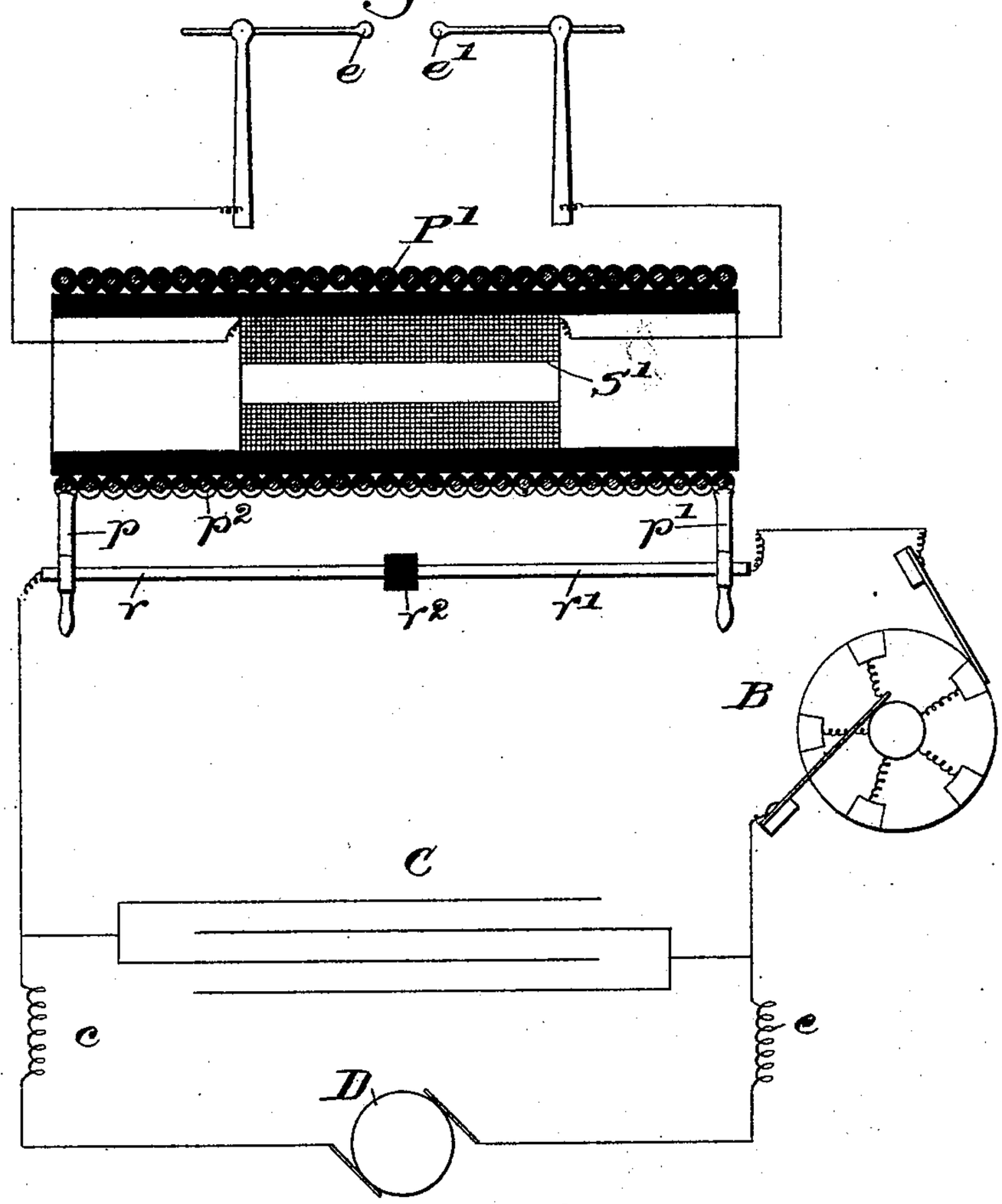
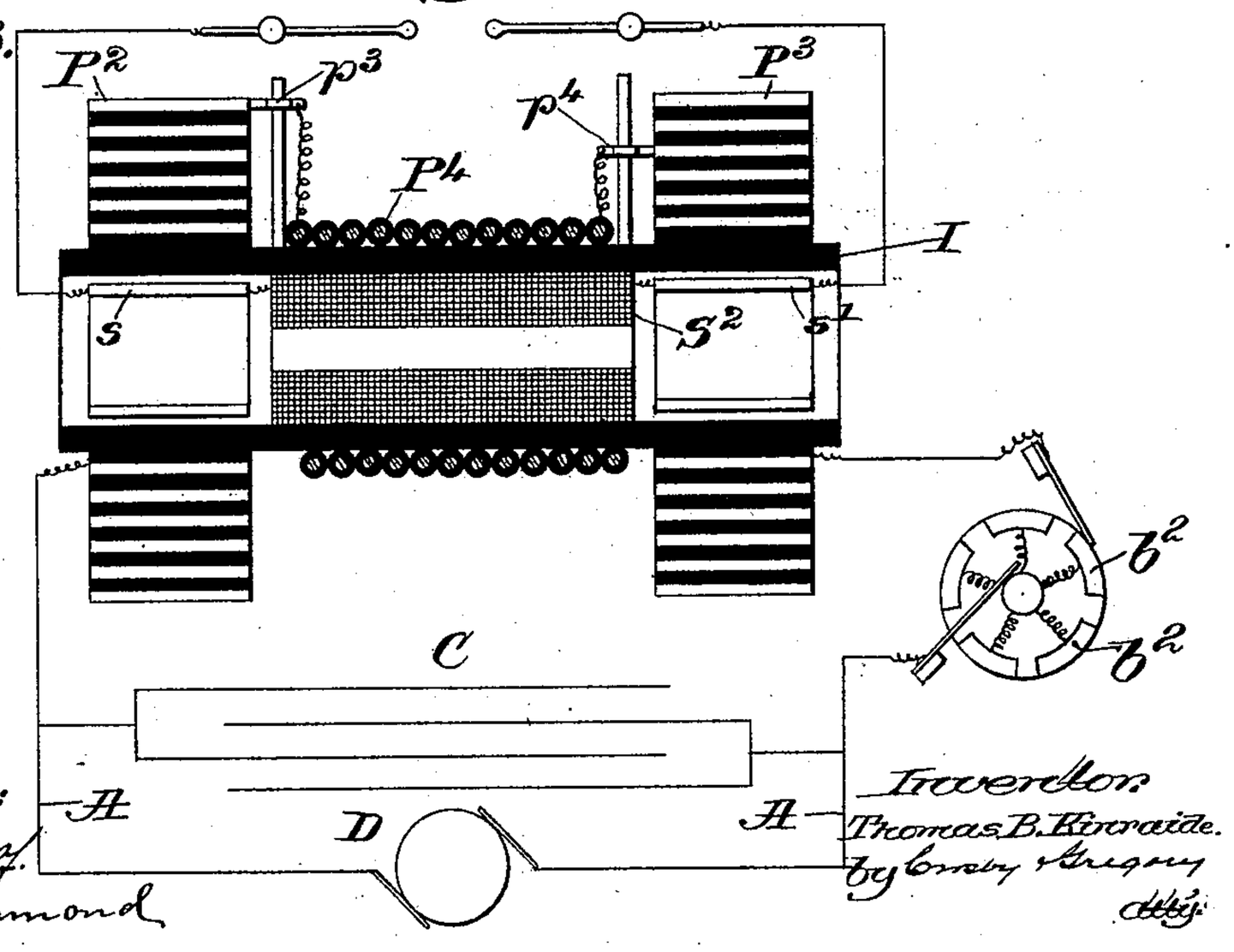


Fig. 3.



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UNITED STATES PATENT OFFICE.

THOMAS B. KINRAIDE, OF BOSTON, MASSACHUSETTS.

HIGH-FREQUENCY APPARATUS.

SPECIFICATION forming part of Letters Patent No. 615,652, dated December 6, 1898.

Application filed May 13, 1897. Serial No. 636,293. (No model.)

To all whom it may concern:

Be it known that I, THOMAS B. KINRAIDE, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in High-Frequency Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to oscillators or high-frequency coils, having for its object the provision of compact apparatus of enormous rapidity and comparatively light weight and bulk especially adapted for work with X-rays.

The details of my apparatus will be more fully apprehended in the course of the following description, taken in connection with the accompanying drawings, illustrative thereof, and the invention will be more fully defined in the appended claims, forming a part of this specification.

In the drawings, Figure 1 shows diagrammatically one embodiment of a simple form of apparatus for carrying out my invention. Figs. 2 and 3 are similar views showing further features of the invention.

A A designate a circuit from a suitable source of electricity, herein shown as a dynamo D, this circuit being any usual commercial circuit or branch from a usual street-main or any other source of energy and leads directly, without any intervening apparatus, to a condenser C of small capacity.

The condenser is connected at either end (the right-hand connection being indicated by dotted lines, Fig. 1) to a coarse primary P, preferably having a single winding of a high-frequency coil H, a break B being interposed in the circuit, this break being shown as a commutator, although any other high-speed interrupter may be employed.

From the above description it will be understood that the dynamo is in direct circuit with the condenser, giving the latter a continuous primary charge, which is constantly piled up in the condenser; but the relatively coarse wires of the coil-circuit, the circuit being completed with great rapidity by the high-speed break, tend constantly to discharge the condenser, and this is accomplished and without any excessive raising of the potential thereby, so that the potential of the coil depends almost altogether upon the fluctuations of the condenser for its intensity.

The fluctuations in the oscillator or coil are exceedingly high, for the reason that the break is run at a very high speed and the secondary is tuned thereto, being of relatively few turns, as already stated, the result being that there is a very powerful sparking from the electrodes e e', and yet the potential of the coil is not so high as in the oscillators at present employed, and therefore no oil insulation is required. This is a great desideratum in this apparatus, for the reason that the oil insulation has proved a very serious obstacle in practice.

In order to increase the efficiency of the apparatus still more, I prefer to construct the break or otherwise provide it with means whereby the intervals between the interruptions thereof may be proportioned to the time-constant of the circuit, and for this purpose I have indicated in dotted lines in Fig. 1 an adjustable brush b', movable relatively to what I may term the "main" brush b, (shown in full lines,) these brushes being adjusted so that the two brushes shall both rest together on an insulation before the contact is again completed, the periods of contact between said interruptions being readily proportioned, as stated, by this means, so as to correspond to the time-constant of the circuit, or instead of the adjustable means shown in Fig. 1 and just described I may build the commutator, if that kind of interrupter be used, so that it shall be definitely proportioned originally as desired, this construction being indicated in Fig. 3, where the contact-segments b^2 are shown as having considerable peripheral area, so as to increase the period of contact of the brush to correspond to the time period of the circuit. This feature of my invention produces greatly-improved results in the oscillatory discharge of the coil.

Another improvement resides in providing an additional break B′ at that end of the condenser which is adjacent the other break B, but not so as to cut off the circuit A from the latter break. I have indicated this break in Fig. 1. In this construction the breaks will be so constructed that certain of their interruptions will be substantially in unison and certain other of their interruptions will be

out of unison—that is to say, if the breaks are both rotated on and by the same shaft or otherwise caused to rotate in synchronism.

The break B may have, for instance, thirty contact-segments and the break B′ may have twenty contact-segments, so that as a result there will be in one revolution ten interruptions in unison and ten times when the two breaks will be half an interval apart and ten times when they will be a whole interval apart. Any other arrangement for producing this effect may be substituted. One break may have fifteen segments and the other twenty, &c.

The effect of the above-outlined construction is that the coil is given great frequency, and when the complete construction, as indicated, Fig. 1, is employed extraordinary results may be produced by causing the proportioning and arranging of the parts to be such that a spark-gap shall be maintained in the break B with an approximately continuous discharge, the break B operating in its revolutions to increase and decrease this spark-gap and the break B′ interrupting the same by intermittingly connecting the condenser into the circuit thereof, so that the operation of the oscillator is brought down from the usual singing sound to a sharp decisive snap and the sparking thereof is changed from the usual bluish sparking to a series of white sparks. Indeed, for certain laboratory purposes a copper disk may be substituted for the break B, which being rapidly rotated will cause by reason of the slight unevenness of its surface and of the frictional contact of the brush therewith a pulsation or interruptive tendency in its circuit, producing to some extent a similar effect to that of the break B.

The primary P may be either inside or outside the secondary S, being insulated therefrom at I, and the coil may have a core, although I prefer to use it without a core.

In Fig. 2 I have shown the primary P′ outside of the secondary S′ and have shown means for adjusting the coil so as to perfectly balance the fluctuations thereof and produce the precise harmonic effect desired for the purposes of any particular use thereof—as, for instance, the study of striæ, &c.—this means consisting of two brushes p p', sliding back and forth by any suitable means, being shown as mounted on conductor-rods r r', insulated from each other at r^2, the insulation of the primary being grooved to form a contact-path p^2, along which the brushes may move in contact with the successive turns of the coil.

From the above description it will be evident that the sparking between the electrodes e e' may be varied, so as to get any kind of discharge desired, it being possible to move the brushes p p' together toward each other, so as to decrease the area of the primary evenly relatively to each end of the secondary, or to move one brush independently of the other, and thereby increase or decrease the relative area of the primary at one or the other end of the secondary, it being worthy of observation also that the portion of the primary which is cut out, or that is left remote from the secondary beyond the brush, is not cut out entirely, so as to be of no effect; but it has an appreciable effect in influencing the action of the coil, the latter being, however, more readily seen in connection with the apparatus shown in Fig. 3, to which reference will now be made.

I have shown a primary in Fig. 3 external to the secondary S^2 and made up of two separated portions P^2 P^3 adjacent the respective ends of the oscillator, each of these portions being made up of a flat helix of flat conductor, such as a copper ribbon, properly insulating from itself, as indicated, brushes p^3 p^4 being preferably provided movable up and down to contact with the successive layers of each helix, as shown, for the same purpose as already described in connection with the movable brushes of Fig. 2, the primary having an intermediate portion P^4 to give direction to the fluctuation. The secondary has preferably end pieces s s', which may be of copper or other conductor, being preferably ribbons of tin-foil secured to the inner surface of the insulation I, these extended areas of the secondary being in the direct field of influence of the portions P^2 P^3 of the primary. The operation and advantage of this construction is that it adds capacity to the high-frequency coils, so that a bright spark and heavy discharge takes place instead of the more disruptive discharge heretofore. The end portions of large area of the secondary give a condenser action to the secondary, tending to store or accumulate potential and produce much heavier and more sudden discharges with greater drop than would take place if the secondary terminated in the fine wire itself merely.

While I have described above my new method of operating an oscillator or high-frequency coil, I may remark that particularly in connection with the form of apparatus shown in Figs. 2 and 3 one or more choke-coils c (see Fig. 2) may be used in order to raise the potential.

The apparatus already described is of peculiar advantage for use in the observation of vacuum-tube discharges and the study of striæ, it being necessary in such matters to be able instantly and delicately to change the conditions of observation, the operator judging thereof by the appearance of the phenomena. For instance, if the striæ are confused and indistinct it is necessary to bring the coil into tune or at least into different tune from its condition, whatever the latter may be, and it is not always feasible and it may be, in fact, impossible to get the desired results by changing the speed of the break or the charging of the condenser or the capacity of the latter, &c., so that these observations are rendered extremely difficult and unscientific.

By the adjustable feature of my invention shown in Figs. 2 and 3 the coil may be instantly and accurately adjusted, so as to bring out the striæ distinct and clear. Again, still taking the study of striæ as an illustration, it frequently happens that the latter will constantly rush toward one end of the tube or will separate at the opposite ends thereof and will waver, so that they may not be readily studied or so that they may not be photographed, for instance. My invention enables the operator at once to throw the coil into such perfect balance that he may cause the striæ to remain perfectly stationary as desired simply by moving the brush p or p' outwardly at the end of the coil which proves to be the weaker, thereby bringing the influence of a higher potential to bear upon that end of the coil or by oppositely moving the other brush to lower the potential at the stronger end of the coil.

While I have herein shown a preferred embodiment of my invention I wish it understood that I am not restricted thereto, but that various changes in details and rearrangements of the combinations of parts may be resorted to within the spirit and scope of my invention as defined by the claims.

Having fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an induction device provided with a primary having a plurality of turns, means to shift the circuit connection from one turn to another transversely of said turns, at either or both ends of the coil at will, substantially as described.

2. The combination with a relatively immovable primary and a secondary of an induction device, of means to vary the position of the field of said primary relatively to the secondary by increasing said field at one end of the secondary and decreasing it at the other end, or vice versa, substantially as described.

3. The combination with a primary and a secondary of an induction device, of means to bring a greater or less number of turns of the primary into direct inductive action on the secondary independently at either end thereof, substantially as described.

4. The combination with a primary, of a secondary having opposite end portions of large area, substantially as described.

5. The combination with a primary, of a secondary, said secondary having opposite end portions of large area, and said primary also having relatively large area opposite thereto, substantially as described.

6. In an induction device, a primary having end portions of low resistance and extended area, substantially as described.

7. In an induction device, a primary having end portions of low resistance and extended area, said portions consisting of ribbon-like flat coils, substantially as described.

8. In an electrical apparatus, a source of energy, a primary, and a break in series circuit, and a condenser and second break in parallel across said source of energy, said second break being interposed at that end of the condenser adjacent said other break, said two breaks being constructed to give certain interruptions substantially in unison, and certain other interruptions out of unison, substantially as described.

9. In an electrical apparatus, a source of energy, a primary, and a break in series circuit, and a condenser and second break in parallel across said source of energy, said second break being interposed at that end of the condenser adjacent said other break, said two breaks being constructed to give certain interruptions substantially in unison, and certain other interruptions out of unison, and said first-mentioned break having the intervals between its interruptions proportioned to the time-constant of the circuit, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS B. KINRAIDE.

Witnesses:
GEO. H. MAXWELL,
GEO. W. GREGORY.