No. 774,758. PATENTED NOV. 15, 1904.

T. B. KINRAIDE.

ELECTRIC SPARK GAP.

APPLICATION FILED MAY 25, 1904.

NO MODEL.

Fig. 1.

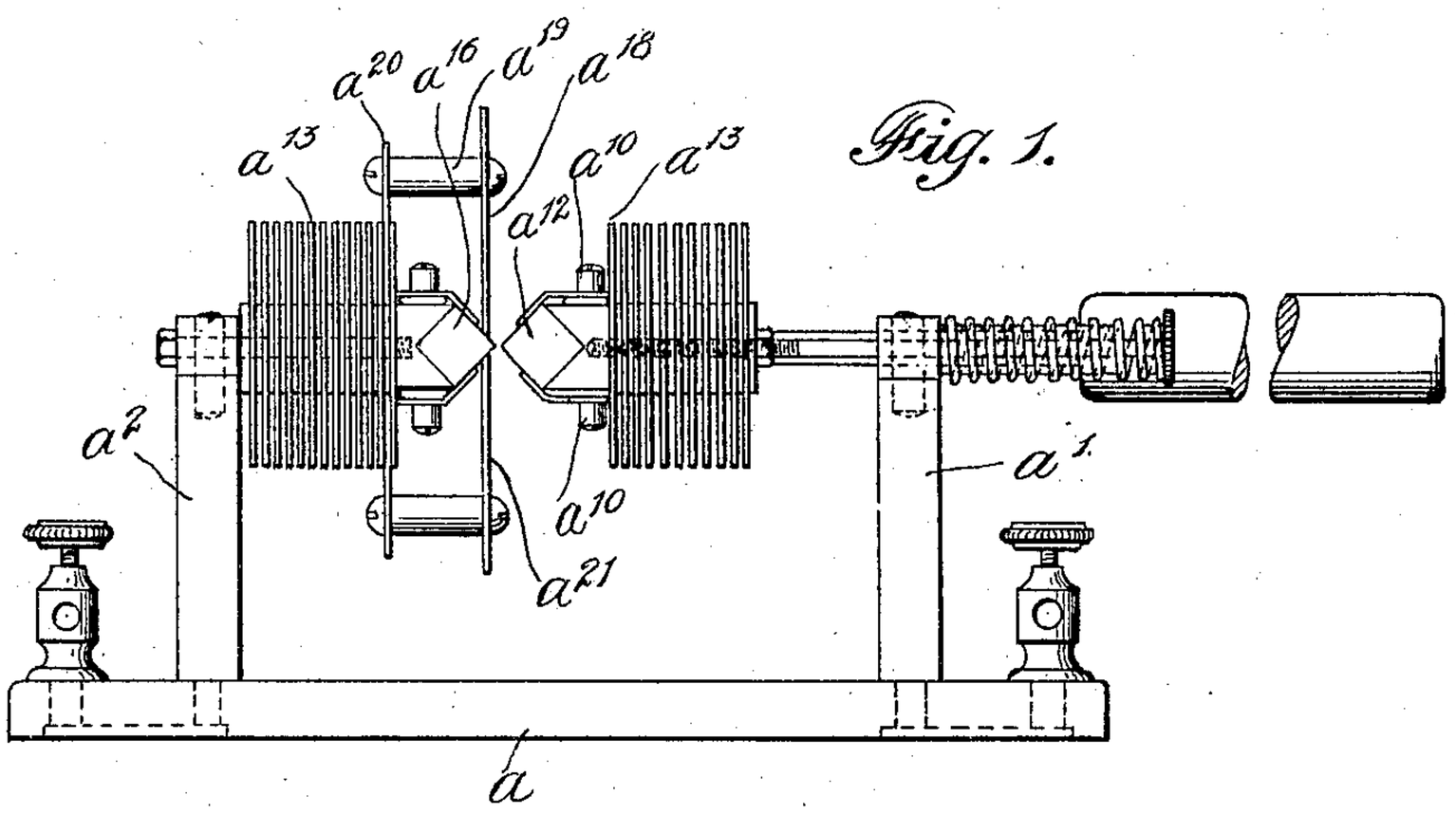


Fig 2.

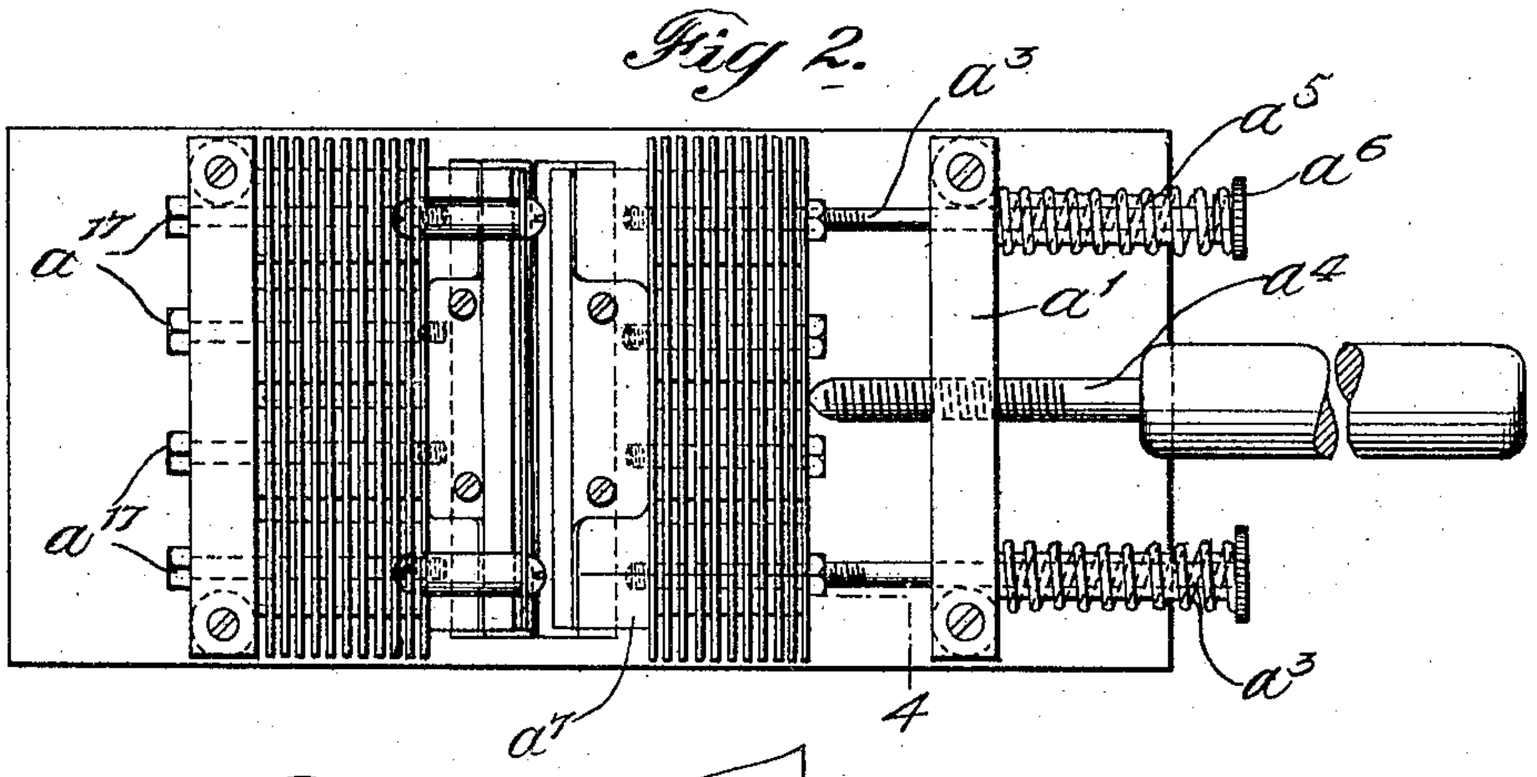


Fig. 3.

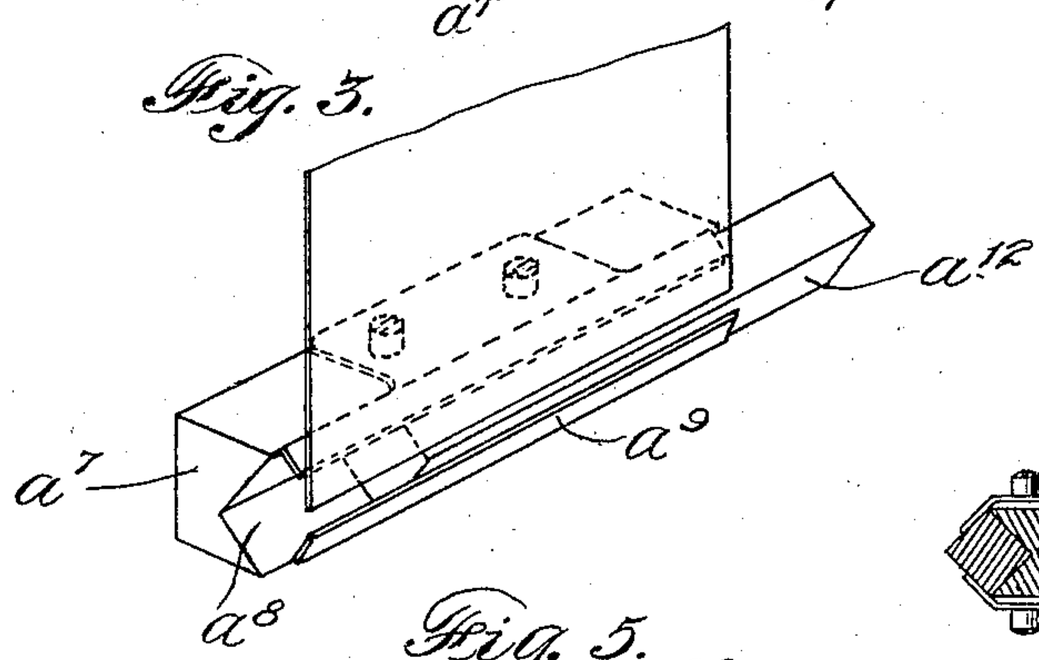


Fig. 4.

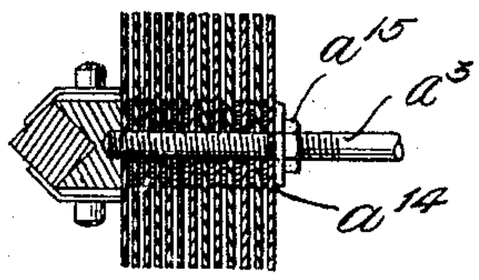
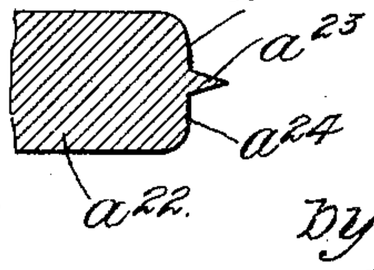


Fig. 5.



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No. 774,758. Patented November 15, 1904.

UNITED STATES PATENT OFFICE.

THOMAS B. KINRAIDE, OF BOSTON, MASSACHUSETTS.

ELECTRIC SPARK-GAP.

SPECIFICATION forming part of Letters Patent No. 774,758, dated November 15, 1904.

Application filed May 25, 1904. Serial No. 209,686. (No model.)

To all whom it may concern:

Be it known that I, THOMAS B. KINRAIDE, a citizen of the United States, and a resident of Boston, in the Commonwealth of Massachusetts, have invented an Improvement in Electric Spark-Gaps, 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 spark-gaps intended particularly for high-frequency apparatus where great strain and constant action with a high-voltage current is required, my object being to provide a spark-gap capable of continuous service with uniform and economical action. One of the main difficulties encountered in this class of apparatus is that the heating effects are apt to cause a short circuit, thereby destroying the sparking effects and rendering them irregular in their action by tending to produce a continuous arc, due partly to the heated condition of the metal and partly to the heated air, which forms a good conductor between the two electrodes, and also the intense heating of the electrodes, especially at their points, tends rapidly to destroy them. Moreover, when used with an alternating current a point spark-gap is apt to be quite irregular and unsteady in its operation. Also the oxidizing of the metal causes serious interference with the continuous and proper operation of the usual spark-gap. My invention is to obviate all these disadvantages, as will be more fully pointed out in the course of the following description, where I have set forth in detail a preferred mechanical embodiment of my invention, and the latter will be more particularly defined in the appended claims, forming a part of this specification.

In the drawings, Figure 1 represents one embodiment of my invention in side elevation. Fig. 2 is a top plan view thereof. Fig. 3 is a fragmentary detail in perspective, showing one of the percussion-plates in place and illustrating the removable character of the electrodes. Fig. 4 is a transverse sectional view taken on the dotted line 4, Fig. 2. Fig. 5 is a transverse sectional view of a modified form of discharge-electrode.

Mounted on a suitable base a are opposite uprights or supporting-standards a' a^2 for supporting the electrodes which constitute the apparatus the standard a' supporting slide-rods a^3 and an adjusting-screw a^4, operating in opposition to springs a^5, held between the support a' and headed ends a^6, provided on the slide-rods a^3. The rods a^3 support at their forward ends an electrode-carrier a^7, herein shown (see more particularly Fig. 3) as having a slideway a^8 at its forward side and provided with overhanging retaining-clips a^9, removably secured to the carrier a^7 by set-screws a^{10}. Said clips a^9 and way a^8 constitute a receiving-passage and holder for a removable electrode a^{12}. At the rear of the electrode-carrier a^7 I mount a series of vertically-extending heat-separators a^{13}, spaced apart by any suitable means, herein shown as themselves threaded upon the slide-rods a^3 and held apart by intervening washers a^{14} and clamped in immovable relation by nuts a^{15}. Opposite the electrode a^{12} is a similar electrode a^{16}, removably retained in a similar holder, composed of clips and a carrier, the same as already described. The latter is supported on rods a^{17}, rigidly held in the rear standard or support a^2 and carrying separator-plates a^{13}, as in the case of the opposite electrode.

The electrodes proper or discharge-bars a^{12} are herein shown as square in cross-section, and the seats of the holders are correspondingly shaped, the purpose of this construction being to permit the parts a^{12} to be changed, one edge thereof being kept in use until worn away, and then the electrode is simply pulled out from its holder, given a quarter-turn, and inserted again with another corner or edge presented for active use. These removable parts a^{12} are preferably composed of hardened steel, so that the oxid whenever formed is at once burned off, whereas with copper and the baser metals a permanent film of non-conducting oxid is formed, which rapidly results in insulating the discharge-surface of the electrodes. A V-shaped edge gives the best results; but the bar may be varied from the triangular shape to cylindrical shape to suit different conditions.

Adjacent one of the electrodes herein shown

for convenience of illustration (and preferably so constructed for use) is a percussion-plate a^{18}, rigidly connected by bolts a^{19} to brackets or supporting-arms a^{20}, extending from the outer pair of rods a^{17}. Also, preferably, a similar percussion-plate a^{21} is mounted in vertical alinement with plate a^{18} to coöperate with the electrode a^{16}, on the under side thereof. These plates a^{18} a^{21} engage or are arranged close to the electrode a^{16}, slightly back from the point or edge thereof. If desired, similar percussion-plates may be employed on both electrodes, although for usual purposes the arrangement shown is sufficient and even one of the plates will ordinarily suffice.

The foregoing construction taken as a whole results in giving a uniform continuous action, the separators a^{13} serving to separate the heat effect from the electric effect, it being borne in mind that there is always present a heat effect which invariably accompanies the electric discharge, and the object of the separator-plates a^{13} is to separate these two effects, thereby confining the spark-gap discharge as nearly as possible to the electric effect solely and shunting the heat effect or separating it as developed from the electric effect as the discharge takes place between the points at the discharge-gap. This results in permitting a continuous disruptive discharge effect. Taken alone, however, it does not give uniformity of action with an alternating current, and to secure this result I provide the percussion-plate, as I have found that the main reason for unsteady and defective action in this particular is due to the fact that the alternations of the current interfere with each other and produce a bombardment at the spark-gap, resulting in a decidedly irregular sparking. I have also discovered that this irregularity of action can be entirely prevented simply by placing a plate slightly back from the discharge-point, the result being that it permits both alternations to spark across the gap. The plate simply destroys the arcing which is otherwise produced by the alternation of the current, and thereby enables the discharge to take place naturally and also make a much freer path for the discharge, permitting longer sparking.

I prefer to make the percussion-plates of copper, although other materials may be used. In Fig. 5 I have shown a construction in which the percussion-plate is embodied with the electrode as nearly as possible, (although the result is inferior to that secured by the construction above explained,) said figure showing an electrode a^{22}, having a discharge edge or point a^{23}, and adjacent thereto a plane surface a^{24}, serving very much the same purpose as the plates a^{18} a^{21}. The discharge-point a^{23} maintains a positive condition and the plane surface a^{24} a negative condition, the former constituting a discharge element and the latter a receptive area and coöperating with the point a^{23} to receive the bombardment or percussion and counteract the arcing, as above explained.

In use the alternating current passes from one electrode to the other across the gap with the utmost freedom under all conditions of stress, and the construction above explained in detail results in a steady and uniform discharge, removing all strain on the condenser by making a perfectly free and easy path for the discharge.

Besides the features of construction to which I have already directed special attention I wish to direct attention to the fact that the preferred embodiment of my invention herein disclosed provides an edge discharge of considerable length, thereby securing to a large extent the advantages more fully explained in my Patent No. 623,318, dated April 18, 1899.

It will be understood that while I have endeavored herein to comply with the law requiring a complete description of the best embodiment of my invention I do not intend to limit all my claims thereto and wish it understood that various features of my invention are applicable to other relations and that many changes in form, arrangement, and combination of parts may be resorted to without departing from the spirit and scope of my invention. For example, the main features of my invention are applicable to a point discharge-gap, and so likewise various features herein shown may be omitted and yet leave a construction capable of producing superior results over the ordinary spark-gap. I consider the removable feature of the electrodes as of considerable importance, the holder being slightly yielding for maintaining perfect contact and yet permitting the instant removal of the electrodes for the purpose of rotating them so as to bring a new edge into active position or for the purpose of replacing them with entirely new electrodes. Also the copper separator-plates or means of separating the heat effect from the electric effect of the discharge is of importance, as it prevents the overheating of the discharge electrodes. In other words, this part of the invention provides what might be termed a "cool" discharge instead of a hot discharge rapidly tending to produce an arc and also the "percussion-plates," as I term them, for taking the bombardment and preventing the colliding or interference of the alternating current, thereby giving a smooth uniform discharge. All these novel features conspire together to produce a continuously even and steady discharge. Besides these leading features I have in some of my claims claimed various specific constructional details.

Having described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an electric spark-gap, having opposite

discharge-electrodes, heat-separating means consisting of a series of thin members of heat-conductive material extending laterally outward and located contiguous to the discharge-gap for diverting and separating from the electric current the heat effects and providing a cool discharge between said electrodes.

2. In an electric spark-gap, having opposite discharge-electrodes, heat-separating means located contiguous to the discharge-gap for diverting and separating from the electric current the heat effects and providing a cool discharge between said electrodes, said means comprising a series of separated conductor-plates in heat-conductive circuit therewith.

3. In an electric spark-gap, having opposite discharge-electrodes, heat-separating means located contiguous to the discharge-gap for diverting and separating from the electric current the heat effects and providing a cool discharge between said electrodes, said means comprising separated parallel plates mounted rigidly in conductive contact with the apparatus.

4. An electric spark-gap, having heat-separators in the form of thin conductor-plates mounted rigidly thereon.

5. An electric spark-gap, comprising opposite electrodes having a series of thin conductor-plates held rigidly adjacent but out of contact with each other, and extending outwardly from the electrodes.

6. In an electric spark-gap, an electrode having a rigid carrier provided with yielding holding means, and a discharge-bar removably held thereby, said holding means springing firmly in circuit-closing contact flat against the sides of said bar for giving a large conducting area for transmission of current.

7. In an electric spark-gap, an electrode having a rigid carrier provided with yielding holding means, and a discharge-bar removably held thereby, said bar having its forward sides converging to form a discharge edge, and said holding means conforming in shape thereto.

8. An electric spark-gap, having adjustable electrodes provided with two opposite equidistant, continuous discharge edges extending parallel to each other longitudinally across the apparatus.

9. An electric spark-gap, having electrodes provided with discharge edges extending lengthwise, parallel to each other, one of said electrodes being slidingly mounted in a support at a plurality of points, and means for adjusting said electrode toward and from the other electrode.

10. An electric spark-gap, comprising opposite electrodes of conductive material, said material being disposed in mass adjacent the discharge-gap and having the conductive material at the rear thereof distributed in thin radially-extending plates, the whole electrode being secured rigidly together for giving intimate conductive contact to all parts thereof.

11. In an electric spark-gap, comprising opposite electrodes, a percussion-plate secured in close relation to one of said electrodes and slightly back from the point thereof.

12. In an electric spark-gap, an electrode having a metal percussion-plate, secured slightly back from the discharge-point thereof and extending laterally therefrom for producing an even, uniform discharge of an alternating current.

13. An electric spark-gap, having a percussion-plate mounted on opposite sides of its discharge-point slightly back from the point thereof, and extending transversely to the direction of discharge.

14. An electric spark-gap, having an electrode provided with a conductor-plate mounted in contact therewith, slightly back from the point of discharge for preventing improper action in discharging an alternating current.

15. An electric spark-gap, comprising opposite electrodes, having discharge edges extending lengthwise, parallel to each other, and a percussion-plate mounted transversely to the air-gap between said electrodes and adjacent thereto, as and for the purpose set forth.

16. An electric spark-gap, comprising opposite electrodes having discharge edges extending lengthwise, parallel to each other, and opposite percussion-plates, mounted transversely to the air-gap between said electrodes and adjacent thereto, said percussion-plates restricting the active area of the electrode to the edges thereof.

17. An electric spark-gap, having an electrode provided with a central discharge-point of small area and adjacent receptive portions of large area, of conductive material extending in planes approximately at right angles to the direction of discharge.

18. An electric spark-gap, having a gap formed by laterally-extended discharge parts, and a percussion-plate coextensive with said gap.

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,
R. S. FORD.