April 26, 1927. 1,626,030

J. H. EASTMAN

SPARK GAP DEVICE

Filed May 17, 1926

Fig. 1.

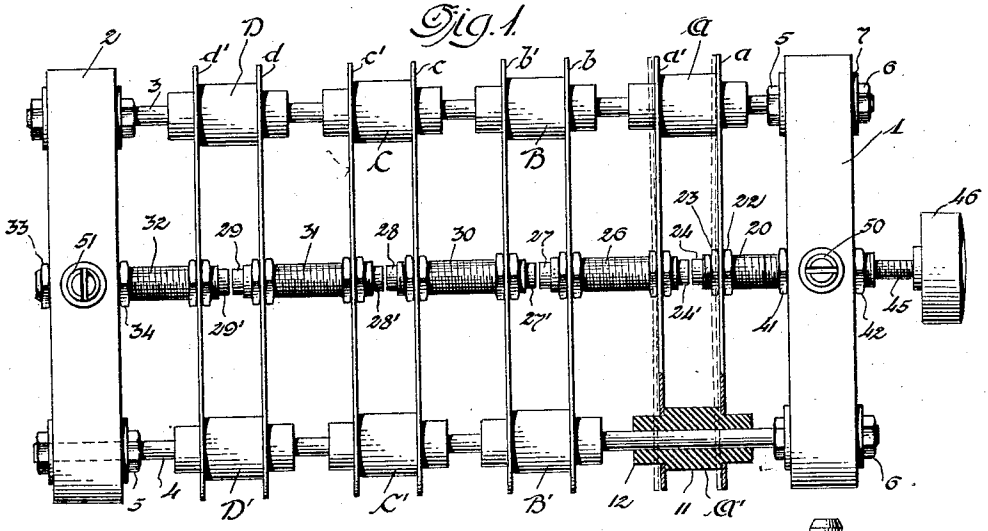

Fig. 2.

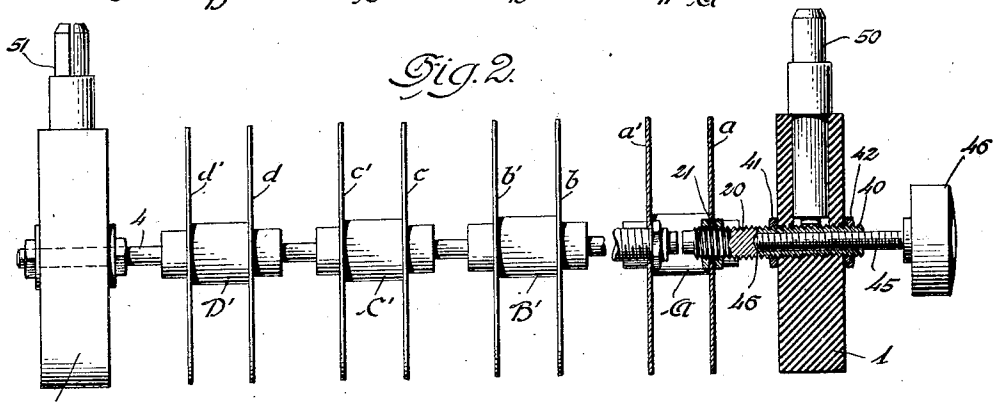

Fig. 3.

Fig. 4.

Fig. 5.

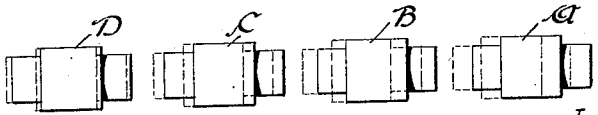

Fig. 6.

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SPARK-GAP DEVICE.

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This invention relates to electric spark gap devices and has to do more particularly with such a device adapted for use in high frequency apparatus used for electro-therapeutic purposes.

In an apparatus of the character referred to the adjustment of the spark gap must be accurately made and maintained in order to obtain the best results. This is especially true when more than one spark gap is used and difficulty has been experienced in adjusting all the spark gaps so that the apparatus operates in a proper manner.

In accordance with the invention the adjustment between the electrodes of a spark gap can be easily and accurately made, and such adjustment once made, will be maintained. The construction of the device is such that a plurality of gaps may be used, and adjustment of any one gap may be made independently of the other gaps, and further adjustment may be made which affects all of the gaps. The construction may be such as to afford for radiation of heat generated in the use of the device.

In a satisfactory form of the invention a frame is provided, and upon this frame are mounted a plurality of electrodes arranged in pairs, each pair providing a spark gap. These electrodes are carried by interconnected supports, and an adjusting device is provided which acts upon the supports, affords simultaneous adjustment of all the spark gaps, and the supports may include members which radiate heat generated by the spark gaps while in use. Also, each electrode is mounted on its respective support so that each spark gap may be more or less permanently adjusted independently of the other spark gaps.

In the accompanying drawings:

Fig. 1 is a plan view of the device showing one portion in section.

Fig. 2 is in part a side elevation, and in part a sectional view.

Figs. 3, 4 and 5 are enlarged diagrammatical views showing the manner in which the electrodes move during adjustment.

Fig. 6 is a diagrammatical view showing in a magnified manner the movements of members which assist in supporting the electrodes.

Referring to the drawings, and particularly to Fig. 1, the device is shown as comprising a frame having end pieces 1 and 2 which are preferably of insulating material. These end pieces are connected by rods 3 and 4, the rods being securely fastened to the end pieces by nuts 5 and 6, there being, if desired, a washer 7, placed between each nut and the end pieces.

Slidably mounted upon the rod 3 are spool-like members A, B, C and D of insulating material which have an enlarged central portion 11 and reduced ends 12. Similar members A′, B′, C′ and D′ are mounted upon the rod 4. These spool-like members carry plates, the plates having holes therein which more or less loosely fit over the reduced ends 12 of the spools. The enlarged central portion of the spools serve to space the two plates carried thereby. These plates are arranged in pairs, one pair, plates *a* and *a′* being carried by the spools A and A′, and the other pairs being similarly carried by the other spools.

Each pair of plates support the terminals of a spark gap. The plate *a*, carries a threaded member 20 which extends through an aperture 21 in the plate. Nuts 22 and 23 are screwed onto member 20 and tightened against the plate to thus hold the member 20 fixed with relation to the plate. One end of the member 20 forms a terminal 24, and this end of the member may be of any material suitable for the purpose. Plate *a′* supports a terminal 24′ spaced from the terminal 24. This terminal 24′ is one end of a member 26, which extends through an aperture in the plate *a′* and is fixed to the plate by lock nuts similar to the manner in which the member 20 is fixed to the plate *a*. This member 26 is not only fixed to the plate *a′* but also extends through the plate *b* and lock nuts secure the member to the plate *b*. The end of the member 26 which protrudes through the plate *b* provides a terminal 27.

A member 30, similar to the member 26, is secured to plates *b′* and plate *c*, and this member provides terminals 27′ and 28. A member 31 similar to the members 27 and 30 connects plates *c′* and *d*, and provides spark terminals 28′ and 29. A terminal 29′ opposes terminal 29, and this terminal is provided on the end of a member 32 which extends through the end piece 2 and is secured thereto by nuts 33 and 34. This mem-

ber 32 extends through an opening in the plate d' and lock nuts fix the member to this plate similarly to the manner in which lock nuts secure other terminal carrying members to other plates.

By this construction it will be observed that a spark gap is positioned between the plates which are carried by the spool members, and that each pair of plates are centrally connected by the rigid members 26, 30 and 31 to the next adjacent pair. The distance between the spark gaps may be adjusted more or less permanently by the adjustment of the nuts which fix the spark terminal carrying members to the plates. For example, the distance between the spark terminals 27 and 27′ is adjustable by the adjustment of the lock nuts which fix the members 26 and 30 to the plates b and b' respectively, and in a like manner each of the other spark gaps are adjustable. Owing to the fact that the members 26, 30 and 31 are rigid the adjustment is made by a slight flexing or bending of the plate members which is permitted by the loose connection between the plates and their respective spools.

In addition to this more or less permanent adjustment of the spark gaps, which may be made on each spark gap independently of the others, further adjustment is provided which acts on all the spark gaps simultaneously. This adjusting mechanism is shown in section in Fig. 2, and consists of a tubular member 40 which extends through the end piece 1, and is adjustably secured thereto by nuts 41 and 42. Through this tubular member extends a screw member 45 provided with an enlarged head 46 which may be turned by the fingers of the operator. The opposite end of the screw 45 is shaped to fit within the slightly recessed end 46 of the member 20.

Suitable terminals 50 and 51 are provided and these terminals may have a split head as indicated for the purpose of receiving an electrical conductor, or the heads may be of any other desirable construction for this purpose. These terminals extend into the body of the end pieces 1 and 2. The terminal 50 contacts with the tubular member 40 and the terminal 51 contacts with the member 32 so that the spark gaps are connected in series.

In the use of the apparatus the spark gaps are all adjusted so that the distance between each pair is substantially the same. This is accomplished as heretofore set forth by the adjustment of the lock nuts. With the spark gaps thus adjusted the single operation of turning the thumb piece 46 simultaneously adjusts all the spark gaps in an equal degree. By turning the thumb piece 46 so that the screw 45 moves through the tubular member 40 from right to left, Fig. 2, the member 20 is forced away from the tubular member 40. This forcing away of the member 20 acts on the plate a and slides the spool members A and A′ which carry this plate from right to left along the rods 3 and 4. This causes the plate a' to also move from right to left and this movement is communicated through the rigid member 26 to the plate b, the spools B and B′ which carry the plate b and thence to the plate b'. The plate b' moves the rigid member 30 which communicates the motion to plates c, c' and so on to the last plate d'.

This adjustment causes a flexing of each pair of plates towards each other and the spark gap terminals are thus brought closer and closer. This flexing is indicated in Fig. 1 by the dotted lines which show the way plates a and a' are flexed, it being understood that each pair of plates are similarly flexed. Also as indicated by the dotted lines both plates move from right to left. When the member 20 is forced inwardly it acts on the plate a centrally. However, all the rest of the plates resist this action through their central connections. For example, plate a' is connected rigidly to plate b, and when the adjustment is made plate b is flexed inwardly toward plate b' but it resists this movement through the rigid member 26, thus causing a like flexing of plate a'. It will be understood that all of the plates are of substantially the same elasticity. Also the plates are sufficiently stiff to overcome friction between the spools and rods.

The relative movements of the spool members are diagrammatically shown in Fig. 6. The solid lines indicate the relative position of the spools when the adjustment of the screw 45 permits the member 20 to abut against the member 40. In dotted lines, the relative positions of the spools are indicated after the screw 45 has been adjusted inwardly for a considerable distance. It will be observed that the spool A has moved a considerable distance from right to left and that the movements of the spools B, C and D have diminished progressively.

The peculiar movement of the spark gap which results from this progressively diminishing movement of the spools is indicated in Figs. 3, 4 and 5 respectively. Fig. 3 indicates the relative position of the spark gaps before an adjustment has been made. The distance between each pair of spark terminals is substantially the same. Fig. 4 indicates the relative position of the spark gaps after an adjustment has been made and the distance between each two cooperating terminals has been lessened to an equal degree. The spark gaps per se have been moved from right to left with a progres-

sively diminishing degree of movement similar to the progressively diminishing movements of the spools. However, the relative movements between any two cooperating terminals is the same. The terminal 24 has been moved from right to left toward the terminal 24′, but at the same time the terminal 24′ has receded from its original position but its movement has not been so great and the gap is thus lessened. The terminal 27 has been moved from right to left the same distance as the terminal 24 has receded. The terminal 27′ has receded, but this movement has been less than the movement of the terminal 27 and thus this gap has been lessened. In the same manner, the gap between the terminals between 28 and 28′ have been lessened. The terminal 29′ has remained stationary by reason of its rigid connection to the end piece 2 through the member 32, but the terminal 29 has moved towards the terminal 29′ and thus this gap has been lessened. Thus it will be observed that all of the gaps per se move from right to left, but the relative movement between the terminals 24 and 24′, 27 and 27′, 28 and 28′, 29 and 29′ has been the same.

Fig. 5 shows the position of the terminals after a still further adjustment has been made, and the terminals have been brought quite close together. Here again it will be observed that each gap has moved from right to left, but the degree of movement between each pair of cooperating terminals has been equal.

As heretofore set forth the plates are substantially of the same elasticity. As the screw 45 forces the plate *a* inwardly at its central portion, this movement is opposed by the rigid connection 32 of the plate *d*′. This opposing force is communicated through all of the plates and spools, thus causing an equal flexing of each pair of plates towards each other and resulting in an equal adjustment between each pair of terminals.

The supporting plates are shown as being of such a size as to radiate efficiently the heat which is generated during the use of the device, although they may not be so constructed, but may take the form of strips of material connecting the spools. Should additional radiation of heat be required, plates or fins can be secured to the centrally disposed terminal carrying members such as the member 26. These additional fins or plates could be arranged so as not to connect with the side rods.

What I claim is:

1. A spark gap device comprising a plurality of electrodes arranged in pairs, means for supporting the electrodes including elastic plates, each electrode being mounted in such a way that it can be adjusted relatively to its respective plate, and adjusting means acting upon the plates to flex the same for simultaneously adjusting the spark gaps.

2. A spark gap device comprising a frame having end portions and side portions, a pair of elastic cross members carried by the side portions of the frame, an electrode of a spark gap carried by each cross member and means for flexing the cross members to adjust the spark gap.

3. A spark gap device comprising a frame having end portions and side portion, a pair of elastic cross members slidably carried by the side portions of the frame, an electrode of a spark gap carried by each cross member and means for flexing the cross members to adjust the spark gap.

4. A spark gap device comprising a frame having end portions and side portions, a pair of elastic cross members slidably carried by the side portions of the frame, an electrode of a spark gap carried by each cross member, means for flexing the cross members to adjust the spark gap, and means for adjusting each electrode relative to its respective supporting cross member.

5. A spark gap device comprising a frame having end portions and side portions, a pair of plates bridging the side portions of the frame and slidably carried thereby, an electrode of a spark gap carried by each plate, means for flexing the cross members for adjusting the spark gap and means for adjusting each electrode relative to its respective carrying plate.

6. A spark gap device comprising a frame having end portions and side portions, a plurality of cross members slidably carried by the side portions of the frame, these cross members being arranged in pairs, an electrode of a spark gap carried by each cross member and means for flexing the plates to adjust the spark gaps.

7. A spark gap device comprising a frame having end portions and side portions, a plurality of elastic plates slidably carried by the side portions of the frame, these plates being arranged in pairs, an electrode of a spark gap being carried by each plate and means for flexing the plates to adjust the spark gaps.

8. A spark gap device comprising a frame having end portions and side portions, a plurality of heat radiating plates slidably carried by side portions of the frame, these plates being arranged in pairs, an electrode of a spark gap being carried by each plate, means for adjusting each electrode relative to its respective plate and means for flexing the plates to adjust the spark gaps.

9. A spark gap device comprising a frame having end portions and side portions, a plurality of elastic plates slidably carried by the side portions of the frame, these plates being arranged in pairs, an electrode of the

spark gap being carried by each plate, means for adjusting each spark gap independently and means for flexing the plates to adjust all of the spark gaps simultaneously.

10. A spark gap device comprising a frame having end portions and side portions, a plurality of elastic plates slidably carried by the side portions of the frame, these plates being arranged in pairs, rigid means connecting each pair of plates, an electrode of a spark gap being carried by each plate, means for adjusting each spark gap independently, and means for flexing the plates to adjust the spark gaps simultaneously.

11. A spark gap device comprising a frame having end portions and side portions, a plurality of plates arranged in pairs and carried by the side portions of the frame, each pair of plates being slidable on the side portions, an electrode of a spark gap carried by each plate and means for flexing each pair of plates for adjusting the distance between the electrodes carried thereby.

12. A spark gap device comprising a frame having end portions and side portions, a plurality of plates arranged in pairs and carried by the side portions, each pair of plates being slidable on the side portions and being connected to the next adjacent pair of plates, an electrode of the spark gap carried by each plate and means for flexing each pair of plates for adjusting the distance between the electrodes carried thereby.

13. A spark gap device comprising a frame having end portions and side portions, a plurality of elastic plates arranged in pairs and carried by the side portions of the frame, each pair of plates being slidable on the side portions, an electrode of a spark gap carried by each plate, and means for sliding each pair of plates along the side portions of the frame with a progressively diminishing degree of movement to adjust the several spark gaps.

In testimony whereof I affix my signature.

JAMES H. EASTMAN.