Nov. 3, 1925. 1,560,390

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SPARK GAP

Filed Sept. 24, 1923

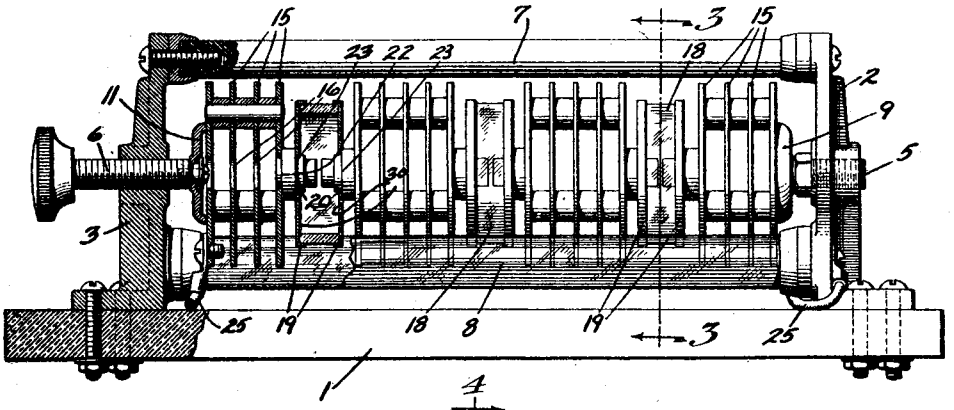

Fig. 1

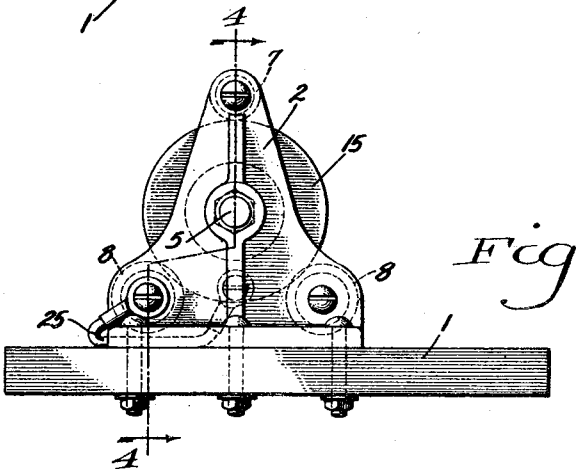

Fig. 2

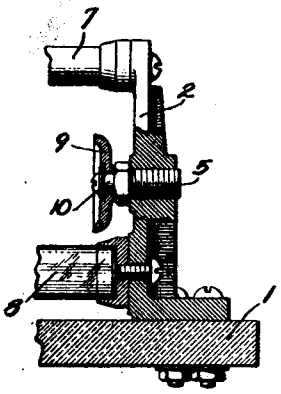

Fig. 4

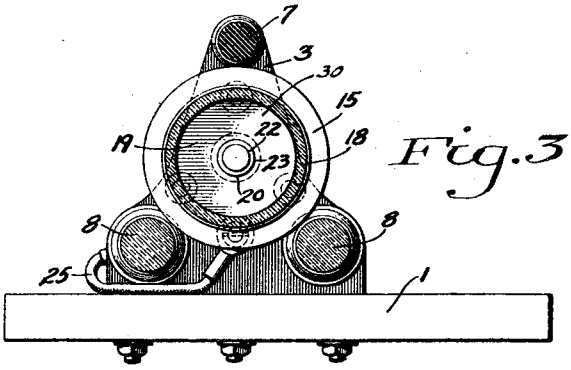

Fig. 3

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UNITED STATES PATENT OFFICE.

JOHN G. H. LIEBEL AND EDWIN S. FLARSHEIM, OF CINCINNATI, OHIO.

SPARK GAP.

Application filed September 24, 1923. Serial No. 664,639.

To all whom it may concern:

Be it known that we, JOHN G. H. LIEBEL and EDWIN S. FLARSHEIM, citizens of the United States, and residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and useful Improvement in Spark Gaps, of which the following specification is a full disclosure.

This invention relates to improvements in spark gaps for use primarily in conjunction with high frequency electric machines, such as are used for therapeutical or surgical purposes.

An object of the invention is to provide a spark gap of a plurality of electrode carrying units arranged in coaxial alignment between opposing centers and yieldingly connected for contacting or adjusting the gap spacing between opposing electrodes of the units through adjustment of one of the centers, and each unit comprising a series of spaced heat radiating plates in electric conductor connection and having an electrode extending axially from one or opposite ends of the unit.

Another object of the invention is the provision of an apparatus wherein accurate simultaneous compressive adjustment of a plurality of spark gaps may be made for changing the spacing between opposing related pairs of conducting studs or sparking surfaces of each gap.

Another object is to obtain a graded variation of spacing between the conducting studs as compression is increased or decreased.

Another object is to obtain successive engagement or non-engagement of a pluarity of pairs of gap forming studs, for increasing or reducing the power output of the machine to which the device is attached.

Another object is to provide a more efficient insulation between the pairs of gap forming studs or sparking surfaces.

Another object is to provide means whereby all gaps may be observed while in operation, so that the operator may note the degree of adjustment of the gap studs for a given output, which enables him, after having learned what output is obtainable for a certain setting, to simultaneously reset all gaps to obtain a similar output.

Another object is the provision of means for obtaining a graduated spacing between successive pairs of gap studs or sparking surfaces whereby, after a certain amount of adjustment has taken place, pairs of studs may be caused to successively approach one another at relatively different rates of speed.

Another object of the invention is to provide a spark gap unit having resilient electrode supporting disks of metal, preferably of bronze, capable of being flexed to obtain adjustment between the electrodes which are held in aligned relatively spaced position in the disks.

Another object is to prevent corrosion of the interior surface of the metallic or bronze disks, and consequent interference with spark gap action, this interference being due to action of the spark gap whereby copper carbonate is formed and deposited upon the electrode, eventually accumulating at the bottom of the glass insulating ring which forms one of the walls of the unit, and forming a conducting path for the current in parallel with the sparking surface. This object is herein accomplished by lining the interior surface of the disks with a suitable non-corrosive substance, preferably lead.

Other objects and certain advantages will appear in the description of the drawings forming a part of this application, and in said drawings:

Figure 1 is a side elevation, partly in section, of the device.

Figure 2 is an end elevation.

Figure 3 is a vertical transverse section on line 3—3, of Figure 1.

Figure 4 is a detailed vertical section on line 4—4, of Figure 2.

The device comprises a base 1 of insulating material, having attached thereto in spaced relation metallic standards, respectively 2, 3, each of substantial triangular configuration, and having vertical portions and foot portions, the latter portion being attached as by screw binding posts to the base. The binding posts may be put in suitable electrical connection with a therapeutic or other electrical machine or apparatus, the connections not herein being shown. A threaded opening is provided midway of each standard, one for the reception of a screw stud 5 in standard 2; and one for an adjusting screw 6 in standard 3, the openings being in horizontal alignment. The stud 5 and the screw 6 thus provide opposing centers between which the spark gap electrodes or their car-

riers are mounted and the screw providing a single instrument by which a plurality of electrodes are adjusted to regulate gap between the opposing electrodes or for bringing them into contact. The standards are connected by cross bars of insulating material, there being, in this instance, three such bars, the upper 7 of ebonite, and the two lower 8 of glass. Attached to the stud 5 is a thrust receiving disk 9 flexibly mounted upon its pivot screw 10, and adapted for engagement with a conductive heat radiator unit hereinafter more fully described. In axial alignment between the stud 5 and screws 6 are disposed in alternate relation a series of spark gap cell units and conductive heat radiator units. The last unit of the series at the end opposite the disk 9 is adapted to be engaged by a similar thrust disk 11, flexibly attached at the end of the screw 6.

Each conductive heat radiator unit comprises an electrode carrier of a series of metallic disks 15, having central openings 16 therein, said openings being aligned and said disks being suitably riveted together in spaced relation.

Each spark gap cell comprises a transparent insulating annulus 18, herein shown as of glass, engaging at opposite sides the flanged metallic disks 19, preferably of bronze, as closures to form with said annulus, a sealed chamber. Each disk 19 has a central opening 20, and within the opening and projecting beyond the disk at each side is placed a shouldered stud, the studs of each cell being aligned and ends thereof normally spaced apart. Each stud is shouldered as at 22, 23, the shoulder 23 engaging the flexible metallic disk. Each cell has the form of an air-tight transparent spark gap chamber, the annulus 18 being of sufficient width to obtain efficient insulation between the metallic parts of the cell. The shoulders 22 engage one of the plates 15 of the conductive heat radiator units, and as previously stated, the units and cells are alternately arranged, and their central axes are aligned.

The flanking plate of each end heat radiator unit has attached thereto a conducting wire 25, the opposite end of which is attached to the standard. Under normal conditions, that is, when the distance between the sparking surfaces is at a maximum, the spacing therebetween is approximately equal. When, however, the series of gap cells and radiator units are compressed by manipulating the screw 6 and as the distance between the gaps becomes smaller, the sparking surfaces nearest the point of application of pressure, close at a relatively greater rate than those at a greater distance therefrom, as a result of which the first gap is entirely closed, and as the pressure is further increased the remaining gaps are successively closed. A graduated closing of the gaps is thus obtained, the degree being equal for all gaps when pressure is not excessive, and when pressure is excessive the distance between the sparking surfaces is gradually decreased as the distance from the point of application of pressure decreases.

The transparent cell wall enables the operator to observe the sparking distances, and by noting what the output of the machine is for certain setting of the gaps, he may accurately thereafter more quickly adjust the gaps for a given output.

It is found in practice that the flexible bronze disks supporting the electrodes, corrode rapidly as a result of the formation of gases in the sparking surface, the resulting product of corrosion, copper carbonate, interfering with gap action, and a sufficient amount of the same eventually accumulating in the bottom of the glass insulating ring to form a conducting path for the current in parallel with the sparking surface. This difficulty has been overcome herein by lining each bronze disk at its interior surface 30, with a coating of lead which prevents the corrosive action mentioned, said action being probably due to the formation, by action of the spark gap, of nitrous oxide which by combining with atmosphere moisture forms nitrous acid. This acid acting on the bronze probably initially forms copper nitrite, which nitrite is acted on by carbon dioxide of the atmosphere to form copper carbonate. Quantities of this carbonate interfere with the action of the gap and a certain amount of the same accumulates at the bottom of the glass ring, and, as before stated, forms a conducting path for the current.

Having described our invention, we claim:

1. A spark gap comprising a support having opposing centers one thereof axially adjustable, electrode carriers disposed between said centers each carrier having an electrode fixed thereto and opposing an electrode of a second carrier, a yielding disk respectively engaged upon each electrode, and an insulator annulus engaged between and separating the disks of opposing electrodes adapting the opposing electrodes to be compressively adjusted toward each other for regulating the gap therebetween.

2. A spark gap comprising a support having opposing centers one thereof axially adjustable, a plurality of electrode carriers disposed in alignment between said centers each carrier having an electrode fixed thereto with the electrodes of one carrier oppoingly arranged to an electrode of a second carrier throughout the series, a yielding disk respectively engaged upon the electrode of each carrier, and an insulator annulus engaged between and separating the disks of opposing electrodes, housing the opposite ends of the electrodes, and adapting the electrodes to be adjusted toward and

from each other for regulating the gap therebetween and for bringing the same into contact.

3. A spark gap comprising a support having opposing centers one thereof axially adjustable, a plurality of electrode carriers disposed in axial alignment between said centers each carrier composed of a number of spaced disks having an electrode fixed to the end disks of the series and opposing an electrode of a second carrier, a yielding disk engaged upon the electrode, and a transparent insulator annulus engaged between and separating the disks of opposing electrodes and adapting the electrodes to be moved by said adjustable center for regulating their spacing and bringing the same into contact.

In witness whereof, we hereunto subscribe our names.

JOHN G. H. LIEBEL.
EDWIN S. FLARSHEIM.