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SPARK GAP

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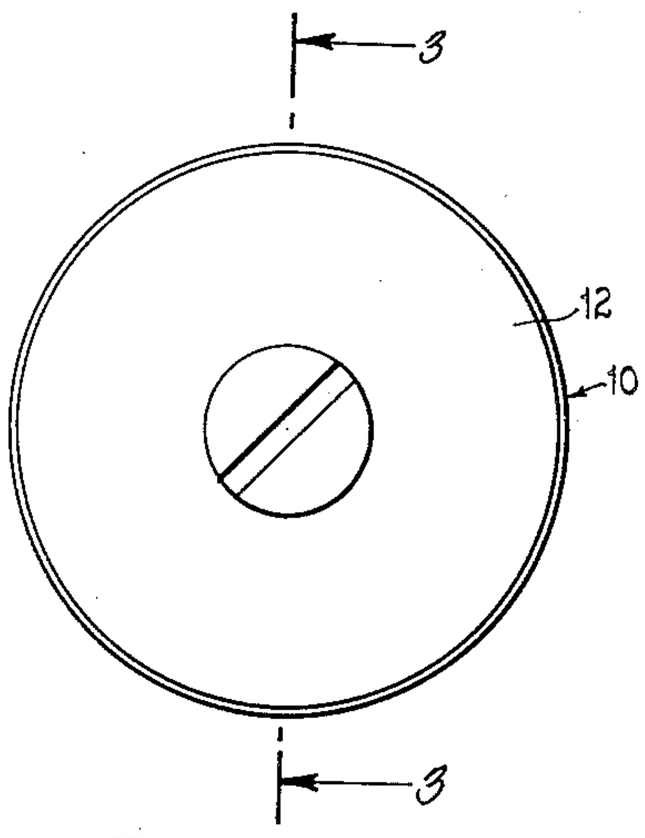

Fig. 1.

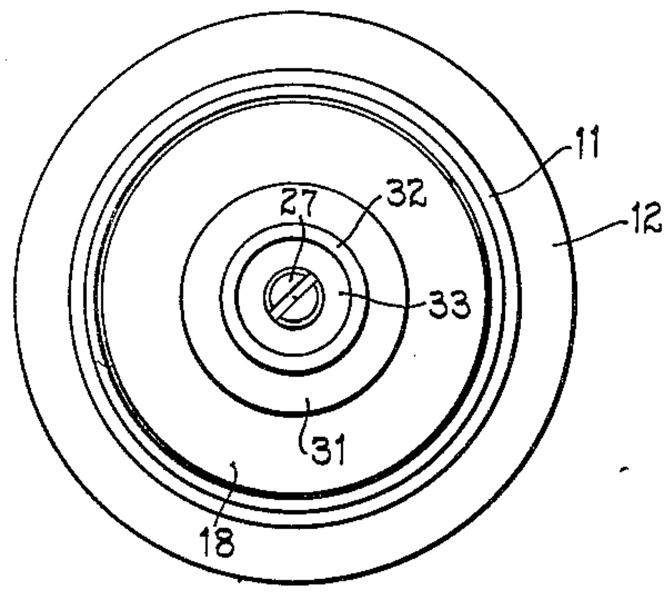

Fig. 2.

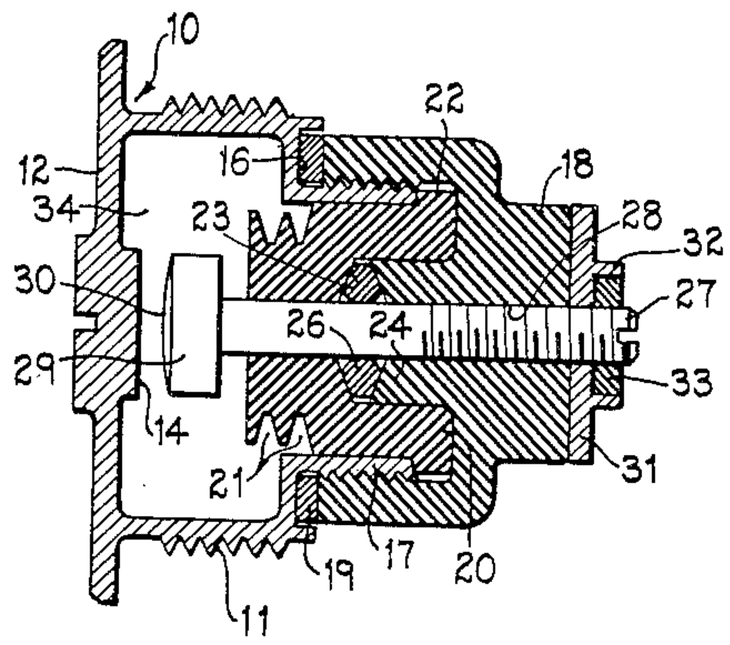

Fig. 3.

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SPARK GAP

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This invention relates to electrical apparatus and more particularly to a device embodying a spark gap and adapted for the use among others of controlling the discharging of the condenser or the like in an electrical circuit.

One of the objects of the present invention is to provide novel apparatus embodying a spark gap the breakdown voltage of which will remain relatively constant throughout long periods of continuous or intermittent operation.

Another object of the invention is to provide apparatus of the above character which is novelly constructed to permit accurate adjustment of the gap between the electrodes to provide for accurate initial assembly and compensation for wear from operation.

A further object is to provide a novel spark gap structure which will spark consistently during operation at a predetermined voltage to thereby insure a uniform and constant sparking rate in an electrical system, such as in the ignition system of a jet type or other combustion engine.

Another object is to provide a novel spark gap device having the above characteristics, which may be readily and inexpensively manufactured and assembled in quantities while insuring uniform quality and operating characteristics.

Still another object is to provide a spark gap which is constructed and assembled in a novel manner so as to enclose the active surfaces of the electrodes in a substantially air and moisture tight chamber.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended to define the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawing, wherein like reference characters refer to like parts throughout the several views;

Figures 1 and 2 are left- and right-hand end views, respectively, of the device shown in Figure 3; and

Figure 3 is a sectional side elevation view, on an enlarged scale, illustrating one form of spark gap device embodying the present invention, the section being taken substantially on line 3—3 of Figure 1.

The single embodiment of the invention illustrated in the drawings by way of example is

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shown in the form of a control spark gap adapted for use in the circuits of ignition systems, such as for jet type engines, wherein a high frequency condenser discharge is employed for creating sparks between spaced electrodes in a combustion chamber for igniting a combustible mixture therein or for ionizing the space between said electrodes to initiate a low-voltage high-energy discharge across the same for igniting the charge. As shown, the novel construction contemplated by the invention comprises a hollow shell 10 of suitable electrically conducting metal, such as Monel metal. Said shell is externally threaded at 11 for purposes of mounting on a support or in a larger unit, but any other suitable means of mounting may be adopted. The inner face of the end wall 12 of the shell is provided with a boss 14 which functions as an electrode in a manner to be fully hereinafter pointed out. The open end of shell 10 is reduced in diameter to provide an external shoulder or gasket seat 16 and the reduced portion 17 is externally threaded to receive a cap member 18 which is preferably made of a suitable insulating material such as hard synthetic rubber. A sealing gasket 19 is interposed and compressed between shoulder 16 and the adjacent edge of cap nut 18.

Extending into the reduced portion 17 of shell 10 is an insulating gland member 20 of some suitable material, such as teflon, which possesses the properties of good resistance to heat and good electrical insulation. The outer periphery of member 20 is provided with annular grooves 21 at the inner end thereof and with an external flange 22 at the other end in engagement with the end edge of reduced shell portion 17. Said member has a differential bore therethrough, the larger portion of which preferably terminates in a bevelled shoulder 23 and receives a gland extension or boss 24 within gland nut 18, the end of said boss being bevelled oppositely to said shoulder. A resilient gasket 26 is interposed between the oppositely bevelled or inclined surfaces of said shoulder and boss so that as the latter moves into the bore of gland member 20, the gasket is pressed radially inwardly into sealing engagement with the shank 27 of an electrode to be next described.

Cap member 18 has a central bore 28 which is internally threaded and coaxial with the bore in gland member 20. The shank 27 of an electrode extends through these aligned bores and has threaded engagement with the bore of cap member 18. At the inner end of shank or spindle 27 is a head portion or electrode 29 that is in spark

gap relation with boss or electrode 14. Although it is not necessary, the operative face 30 of electrode 29 is somewhat spherical in order to concentrate the sparks during operation within a reasonably small area. Monel metal or other suitable electrical conductors may be used for making electrode 27, 29.

The outer threaded end of electrode shank 27 projects beyond the end surface of gland nut 18 and is adapted to threadedly receive a lock nut 31 which engages the end of member 18 when the electrode is in adjusted position. Preferably, a suitable adhesive or cement is applied to the adjacent surfaces of member 18 and nut 31 prior to final assembly to enhance the tightness of the final construction. An axially projecting annular flange 32 on lock nut 31 surrounds the end of shank 27 in spaced relation thereto for providing an annular cup or container for a sealing compound 33. Hydroline (tar) has been found to be a suitable compound for this purpose.

The various elements of the above described structure are so constructed that during assembly thereof gaskets 19 and 26 will be placed under compression during the mounting of nut 18 shortly before rigid flange 22 is compressed between the end edge of shell portion 17 and the inner wall of cap member 18. In this manner the seal provided at 19 is complemented by the pressure seal effected by compressive engagement of the opposite surfaces of rigid flange 22 with surfaces of members 17 and 18. The gasket 26 which is pressed inwardly against spindle 27, the sealing compound 33 and the surface engagement of nut 31 with member 18 or the cement interposed therebetween constitute satisfactory means for sealing the electrode chamber 34 against leakage along the periphery of spindle 27. Accordingly, the pressure within chamber 34 is substantially fixed or constant at all altitudes. The pressure within the chamber is preferably atmospheric, but a higher or lower pressure may be provided therein in any suitable manner known to the art. If desired, a gaseous medium other than air may be enclosed in chamber 34.

In order to obtain best results all the components of the above structure should be thoroughly cleaned and dried before assembly. After all the parts except nut 31 and sealing compound 33 have been assembled, the gap between electrodes 14 and 29 should be adjusted until it will break down at the predetermined or selected operating voltage. The gap should then be presparked at the rate of about 15 to 20 sparks per second for at least two hours. Thereafter, the parts should be disassembled by removing cap nut 18 from shell 10. After reassembly and tightening of the cap to the shell the electrodes should be readjusted to provide the proper spark gap and the lock nut 31 should be applied and tightened after the application thereto of an adhesive, such as Glyptal.

Either electrode of the spark gap thus described may be connected to the high potential terminal of a source of electrical energy, and the other terminal may be connected to the low potential terminal, such as to ground. Preferably, however, electrode 29 is employed as the high potential electrode. The danger of sparking or creepage between shank 27 or electrode 29 and shell 10 along the surface of gland member 20 is substantially eliminated by increasing the creepage distance by providing grooves 21 in said member. Gap structures constructed in accordance with this invention have operated satisfactorily and continuously without appreciable variation in the sparkover or breakdown voltage at temperature extremes ranging from +165° F. to −67° F.

There is thus provided a novel and thoroughly dependable spark gap device for controlling the discharging of stored electrical energy at a predetermined voltage during long periods of continuous or intermittent operation. This novel construction also insures sparking at a constant voltage and at a uniform rate irrespective of whether the energy is supplied to the storage condenser in single or plural pulses. The gap structure provided is readily adjustable thereby eliminating the high cost of accurate machining and molding of the parts and substantially eliminating waste heretofore occasioned by the rejection of completed devices which failed to meet the specifications as to operating characteristics.

Although only a single embodiment of the invention is illustrated in the accompanying drawing and described in the foregoing specification, it is to be expressly understood that the same is not limited thereto. Various changes such as in the size, shape, design and arrangement of the parts illustrated as well as in the various materials suggested for use in making the several parts may be made without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. Spark gap apparatus comprising a hollow body having opposed cup-like threadedly connected parts one of which is conductive and the other of which is insulating, and adjustable electrode means mounted in spark gap relation in said apparatus.

2. Spark gap apparatus being a hollow sealed body comprised of a cup-like conductive part and a cup-like cooperating insulating part, said parts being threadedly connected together, and an electrode mounted on the insulating part in gap relation to an electrode integral with and wholly within said conductive part.

3. Spark gap apparatus including a cell comprising assembled cups sealed rim to rim, one of said cups being conductive and having an integral portion acting as a gap electrode and the other of said cups being dielectric, and an electrode in spark gap relation to said gap electrode having a shank projecting through the dielectric cup and adjustably mounted thereon.

4. Spark gap apparatus including a cell comprising assembled halves, one of said halves being conductive and having a portion acting as a gap electrode, the other of said halves being dielectric and internally screw threaded, a screw electrode projecting from the cell, threaded in the said internal screw threads and having an inner portion acting as a cooperating gap electrode, and an insulator interposed between said screw electrode and conductive parts of said cell.

5. Spark gap apparatus including a cell having screw threaded halves in assembled relation, one of said halves being conductive and having a portion acting as a gap electrode and a portion constructed and arranged for mounting, the other of said halves being dielectric and being internally screw threaded, a screw electrode projecting from the cell, threaded into the said internal screw threads and having an inner portion acting as a cooperating gap electrode, and an insulator inter-

posed between said screw electrode and conductive parts of said cell.

6. Spark gap apparatus including a cell having screw threaded halves in assembled relation, one of said halves being conductive and having a portion acting as a gap electrode and a portion constructed and arranged for mounting, the other of said halves being dielectric and being internally screw threaded, a screw electrode projecting from the cell, threaded into the said internal screw threads and having an inner portion acting as a cooperating gap electrode, an insulator interposed between said screw electrode and conductive half, said insulator having a flange gripped between the halves of the cell, sealing means compressed between the halves of said cell, and sealing means compressed between the dielectric portion of the cell and the insulator.

7. Spark gap apparatus including a cell having screw threaded halves in assembled relation, one of said halves being conductive and having a portion acting as a gap electrode and a portion constructed and arranged for mounting, the other of said halves being dielectric and being internally screw threaded, a screw electrode projecting from the cell, threaded into the said internal screw threads and having an inner portion acting as a cooperating gap electrode, an insulator interposed between said screw electrode and conductive parts of said cell, said insulator having a flange gripper between the halves of the cell, compressible sealing means gripped between the halves of said cell, and a plurality of annular sealing means about the screw electrode, one of said means being compressed between the dielectric portion of the cell and the insulator.

8. Spark gap apparatus including a cell having screw threaded halves in assembled relation, one of said halves being conductive and having a portion acting as a gap electrode and a portion constructed and arranged for mounting, the other of said halves being dielectric and being internally screw threaded, a screw electrode projecting from the cell, threaded into the said internal screw

threads and having an inner portion acting as a cooperating gap electrode, an insulator interposed between said screw electrode and conductive parts of said cell, said insulator having a flange sealed between the halves of the cell, compressible sealing means interposed between the halves of said cell, and a plurality of annular sealing means about the screw electrode, one of said means being compressed between the dielectric portion of the cell and the insulator, and another being seated about the projecting end of the screw.

9. Spark gap apparatus comprising a unitary cup-like conductive member having an internal portion at the closed end thereof acting as a gap electrode, an insulator removably secured across the open end of said member, means for substantially sealing the joint between said member and insulator against the leakage of gases, and an electrode in spark gap relation with said gap electrode having a shank extending through and adjustably supported by said insulator.

10. Spark gap apparatus as defined in claim 9 comprising sealing means around said shank for substantially preventing leakage of gases between said shank and insulator.

11. Spark gap apparatus as defined in claim 9 comprising a second insulator extending into said member around said shank and having telescopic relation with said first-named insulator, and sealing means compressed between said insulators around said shank.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,297,627	Wing	Mar. 18, 1919
1,322,610	Pfanstiehl	Nov. 25, 1919
2,469,154	Oles	Apr. 20, 1948
2,469,215	Smith, Jr.	May 3, 1949