Aug. 7, 1945. F. W. CURTIS 2,381,648

SPARK GAP

Filed June 16, 1943 3 Sheets-Sheet 1

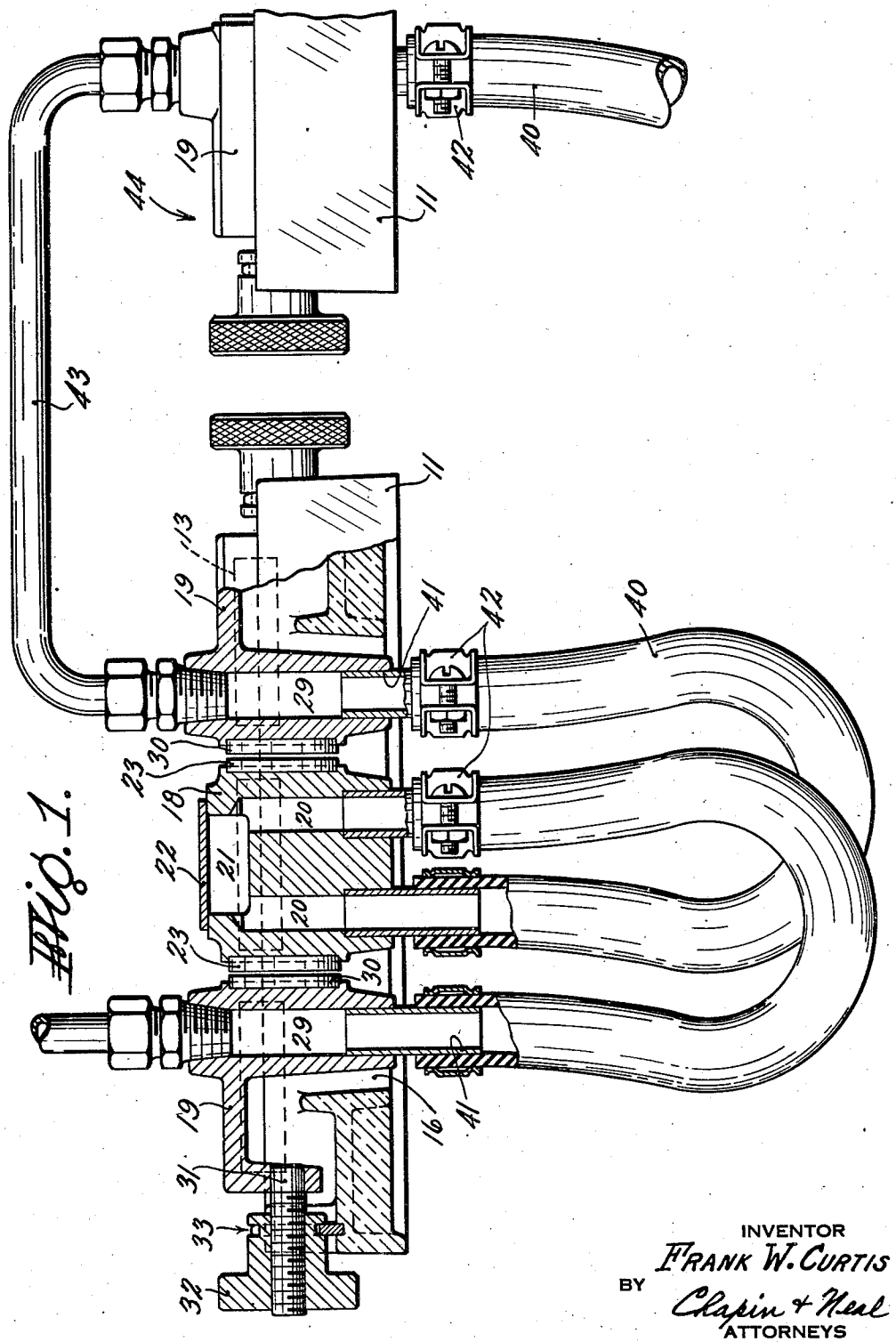


Fig. 1.

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SPARK GAP

Filed June 16, 1943 3 Sheets-Sheet 2

Fig. 2.

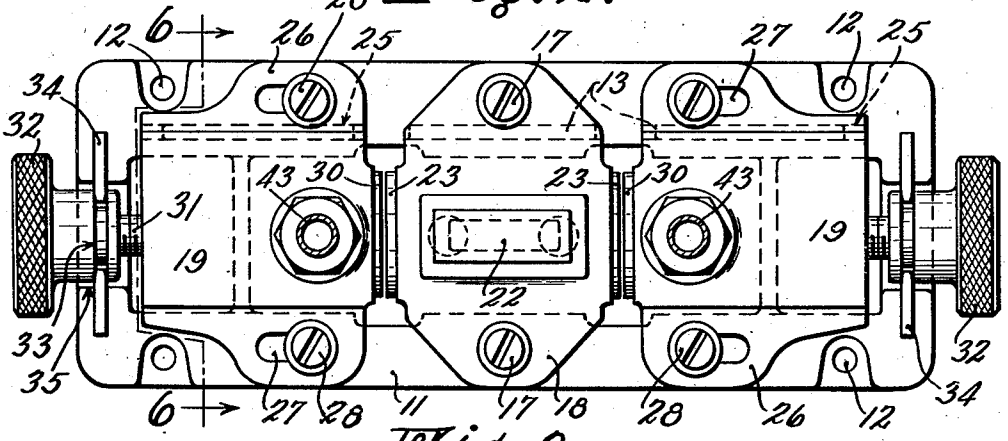


Fig. 3.

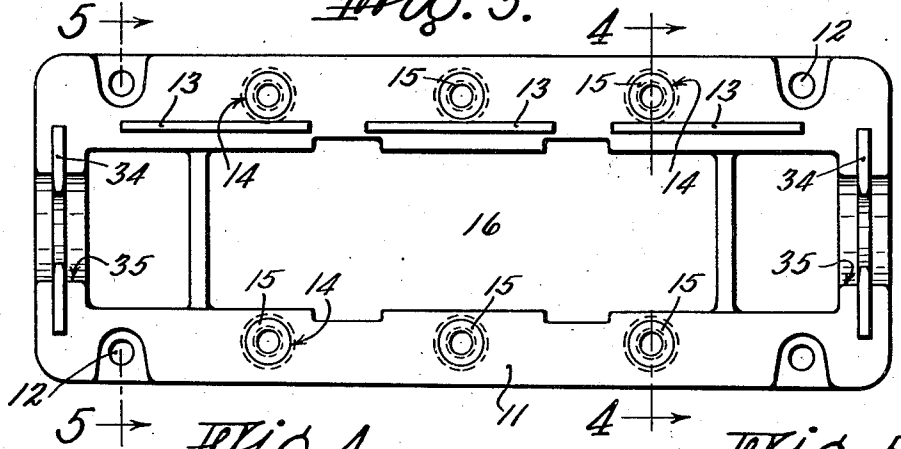


Fig. 4.

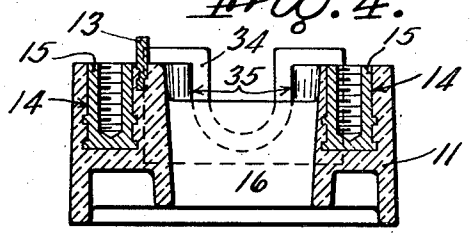
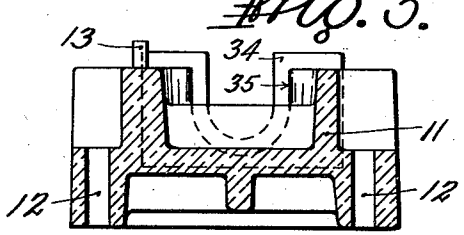


Fig. 5.



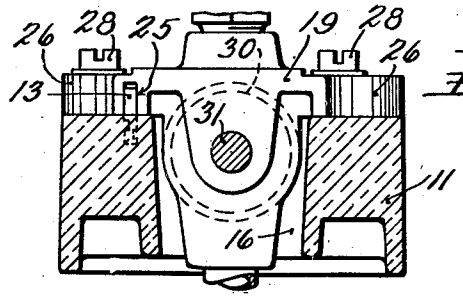


Fig. 6.

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Aug. 7, 1945. F. W. CURTIS 2,381,648

SPARK GAP

Filed June 16, 1943 3 Sheets-Sheet 3

Fig. 7.

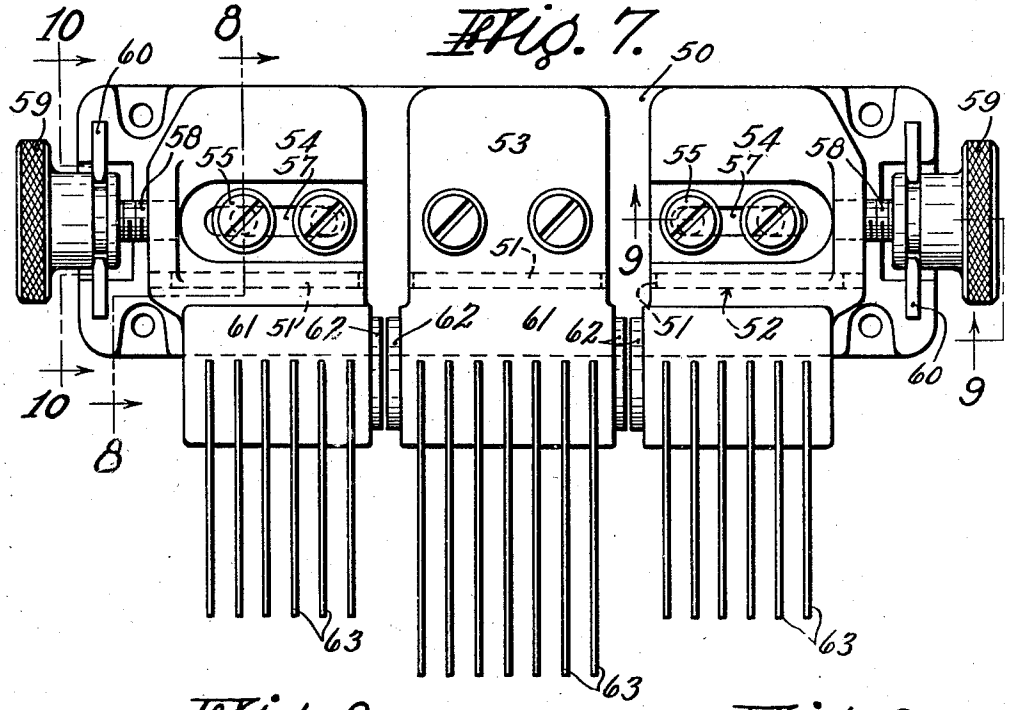


Fig. 8.

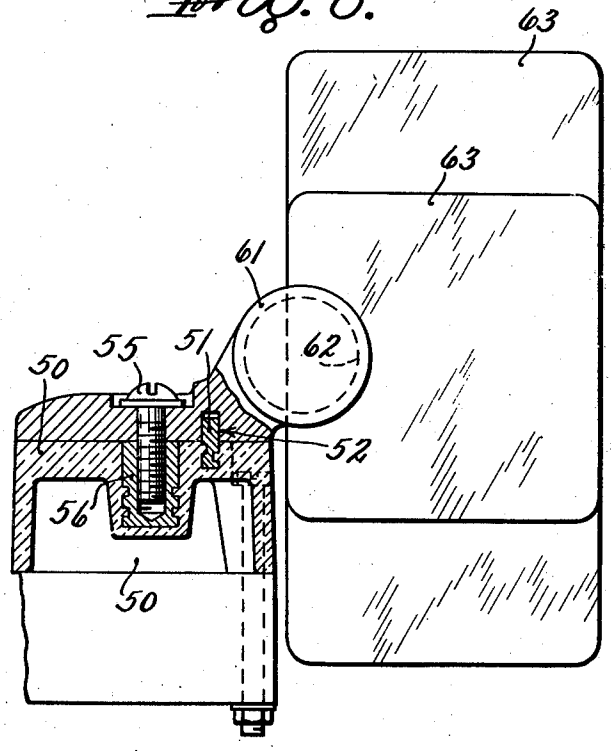


Fig. 9.

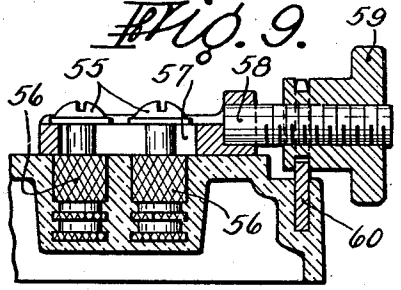
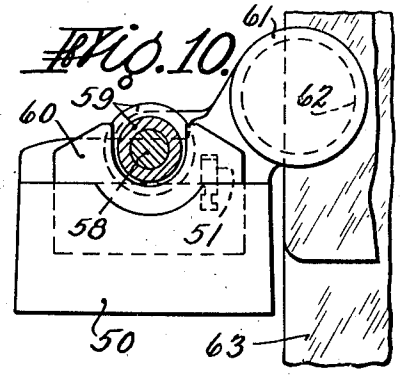


Fig. 10.



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SPARK GAP

Frank W. Curtis, Springfield, Mass., assignor to Van Norman Company, a corporation of Massachusetts

Application June 16, 1943, Serial No. 491,063

9 Claims. (Cl. 250—38)

This invention relates to the construction of cooled spark gaps intended for series use in high frequency converting apparatus such as that used for induction heating equipment. One object of the invention is to make spark gaps which will be readily adjustable and which will preserve the parallelism of the spaced surfaces during adjustment. A further object is to provide an improved construction for the cooling of series spark gaps. Additional objects will appear from the following description and claims.

Referring to the drawings,

Fig. 1 is a side elevation, partly in median section, showing one water-cooled spark gap unit comprising two gaps in series, together with a portion of an adjacent unit;

Fig. 2 is a top plan of a unit such as shown in Fig. 1;

Fig. 3 is a detail of a base upon which the unit is mounted;

Fig. 4 is a section on line 4—4 of Fig. 3;

Fig. 5 is a section on line 5—5 of Fig. 3;

Fig. 6 is a section on line 6—6 of Fig. 2;

Fig. 7 is a top plan similar to Fig. 2 but showing a unit designed for air cooling;

Fig. 8 is a section on line 8—8 of Fig. 7;

Fig. 9 is a section on line 9—9 of Fig. 7; and

Fig. 10 is a section on line 10—10 of Fig. 7.

Each unit preferably comprises two gaps in series, as this forms a suitable group out of which a bank containing any desired quantity of gaps may be built up. The unit is mounted on a base 11, preferably formed of a moldable organic plastic having high electrical insulating properties. The base is molded to provide attaching means, such as bolt holes 12, by which it may be mounted on a suitable frame. The base is also provided with three aligned embedded guide rails 13 and three pairs of holes 14 having screw threaded metallic inserts 15 for purposes to be described. The guide rails are preferably undercut as shown to insure firm anchorage when they are molded in the plastic base. The base has a central opening 16 permitting the passage of certain cooling connections and also serving to lighten the construction.

Mounted upon the middle guide rail 13 and secured by screws 17 to the central pair of inserts 15, is a central gap element 18 which serves with a pair of end elements 19 to form two spark gaps in series. This central gap element is formed of a hollow casting of a conducting material such as brass, having two hollow passages 20 near its ends and connecting passage 21 which for convenience in manufacture may be made initially as an external recess and then closed off by a plate 22 brazed in place. The ends of the central element are machined flat and at right angles to the guide rails, and have a surfacing member 23 of tungsten secured to them as by brazing. The passages 20 are sufficiently close to the tungsten plates so that if water or other cooling liquid is circulated through them in the manner to be described the temperature of the tungsten will be kept sufficiently low to avoid burning.

The two end sections 19 are identical and a description of one will be sufficient. Each of these sections is formed of a brass casting with a machined groove 25 to receive and slide upon one of the end guide rails 13, and has side lugs 26 each slotted at 27 to receive a headed screw 28 threaded into one of the end inserts 15. The brass is machined out to form a passage 29 extending close to the end surface of the section 19, which is provided as in the case of the central section with a tungsten facing 30. Secured in the end section 19 in any suitable way is a threaded stud 31 upon which is screwed a thumb nut 32 provided with a circumferential groove 33. When the section 19 is placed upon the base 11 this circumferential groove receives a pair of opposed plates 34 molded into the base and projecting into the recess 35 in which the stud and nut lie loosely. If now the screws 28 are loosened and the thumb nut is rotated, the end section will be moved bodily toward or away from the central section 18, being guided with its tungsten facing in exact parallelism with the adjacent facing on the central section by the longitudinally extending rail 13 and groove 25. When the desired adjustment is secured the screws 28 are drawn tight and the end section fixed in place. This construction is of great value in the operation of multiple spark gaps, in which the adjustment of all gaps must be held constant and equal. The spacing of the gaps may be checked by an accurately ground metal thickness gauge, and the necessary adjustment made, without creating any disturbance in the accuracy of the parallelism between adjacent tungsten surfaces. This avoids trouble occurring in prior types of gap in which adjustment of spacing frequently threw the gap surfaces out of parallelism, resulting in a concentration of the spark at the points of closest approach with consequent irregular operation and burning of the tungsten surfaces.

Circulation of cooling water, which may be artificially chilled if desired, is readily obtained through the passages in sequence by means of flexible tubes 40 of insulating plastic held in place as by nipples 41 and clamps 42. In the case shown cooling water passes through the passage 29 of one of the end sections, from this to the remote passage 20 of the central section (in order to avoid too sharp a bend in the connecting tube) through the passage 21 and the other passage 20, from this to the passage 29 of the second end section, and from this through a connecting tube 43 to an adjacent unit 44. All the units forming a bank may thus have the cooling water pass in

series through successive passages, or individual units or groups of units may have their water supplies arranged in multiple or parallel. No short circuit will be produced through the water connections since the resistance of the water path will be many times higher than the direct path through the spark gaps. The tubes **43** connecting adjacent units are preferably made of copper in order to form an elctrical series connection between them.

The air cooled form shown in Figs. 7 to 10 is basically similar, but some modifications are made to dispose as much of the area of the section as possible in the path of the cooling air stream. In this case the base **50** is provided with three separated but parallel guides **51** to receive grooves **52** formed in the central and end sections **53** and **54**. Screws **55** are threaded through the sections into inserts **56** molded into the base, the end sections having screw receiving slots **57** to permit adjustment. Studs **58**, thumb nuts **59**, and plates **60** are provided for delicate adjustment as in the preceding case. The sections have offset metallic portions **61** bearing tungsten facing plates **62**, and carry cooling fins **63** preferably brazed in place. Since the central section has two tungsten plates and therefore must dissipate more heat, the fins upon it are preferably made larger.

What I claim is:

1. A spark gap comprising an insulating base, spaced parallel metallic guide strips molded therein, a pair of sections slotted to receive said guides and forming spark gap surfaces therebetween, and means for adjusting one of the sections on its guide strip.

2. A multiple spark gap comprising an insulating base, three spaced parallel metallic guide strips molded therein, a plurality of sections slotted to receive said guides and forming spark gap surfaces therebetween, means for securing the central section fixedly in place, and means for adjusting the end sections independently upon their guide strips towards and from the central section.

3. A spark gap comprising an insulating base, spaced parallel metallic guide strips molded therein, a pair of sections slotted to receive said guides and forming spark gap surfaces therebetween, means for adjusting one of the sections on its guide strip, and means for cooling the sections.

4. A multiple spark gap comprising an insulating base, three spaced parallel metallic guide strips molded therein, a plurality of sections slotted to receive said guides and forming spark gap surfaces therebetween, means for securing the central section fixedly in place, means for adjusting the end sections independently upon their guide strips towards and from the central section, and means for cooling the sections.

5. A multiple spark gap comprising an insulating base, three spaced parallel metallic guide strips molded therein, a plurality of sections slotted to receive said guides and forming spark gap surfaces therebetween, means for securing the central section fixedly in place, means for adjusting the end sections independently upon their guide strips toward and from the central section, each section having a water passage adjacent its spark gap forming surface, and means including flexible tubing for passing water successively through the passages.

6. A multiple spark gap comprising an insulating base, a plurality of separated aligned metallic strips molded therein, a central spark gap section secured fixedly to the base and having a longitudinal groove engaging the central strip and having a spark gap surface on each end in a plane at right angles to the strip, a pair of end sections each having a longitudinal groove engaging the end strips and provided with a spark gap surface on its end adjacent the central section in a plane at right angles to the strips, means for securing the end sections releasably to the base, a threaded stud projecting from each end section parallel to the strips, a grooved nut threaded to said stud, and members secured to the base and engaging the groove.

7. A multiple spark gap comprising an insulating base, a plurality of separated aligned metallic strips molded therein, a central spark gap section secured fixedly to the base and having a longitudinal groove engaging the central strip and having a spark gap surface on each end in a plane at right angles to the strip, a pair of end sections each having a longitudinal groove engaging the end strips and provided with a spark gap surface on its end adjacent the central section in a plane at right angles to the strips, means for securing the end sections releasably to the base, and interconnecting adjusting means between the base and each end section for shifting said sections on their guides when said securing means are released.

8. A multiple spark gap comprising an insulating base, a plurality of separated aligned metallic strips molded therein, a central spark gap section secured fixedly to the base and having a longitudinal groove engaging the central strip and having a spark gap surface on each end in a plane at right angles to the strip, a pair of end sections each having a longitudinal groove engaging the end strips and provided with a spark gap surface on its end adjacent the central section in a plane at right angles to the strips, means for securing the end sections releasably to the base, interconnecting adjusting means between the base and each end section for shifting said sections on their guides when said securing means are released, each section having a water passage adjacent its spark gap forming surface, and means including flexible tubing for passing water successively through the passages.

9. A multiple spark gap comprising an insulating base, a plurality of separated aligned metallic strips molded therein, a central spark gap section secured fixedly to the base and having a longitudinal groove engaging the central strip and having a spark gap surface on each end in a plane at right angles to the strip, a pair of end sections each having a longitudinal groove engaging the end strips and provided with a spark gap surface on its end adjacent the central section in a plane at right angles to the strips, means for securing the end sections releasably to the base, interconnecting adjusting means between the base and each end section for shifting said sections on their guides when said securing means are released, each section being formed with a spark gap carrying portion spaced from the base, and a plurality of heat dissipating fins carried by each such portion.

FRANK W. CURTIS.