Feb. 15, 1966 A. G. BILLIN 3,235,764

SEMI-AUTOMATIC SPARK GAP SETTER

Filed Nov. 14, 1962 2 Sheets-Sheet 1

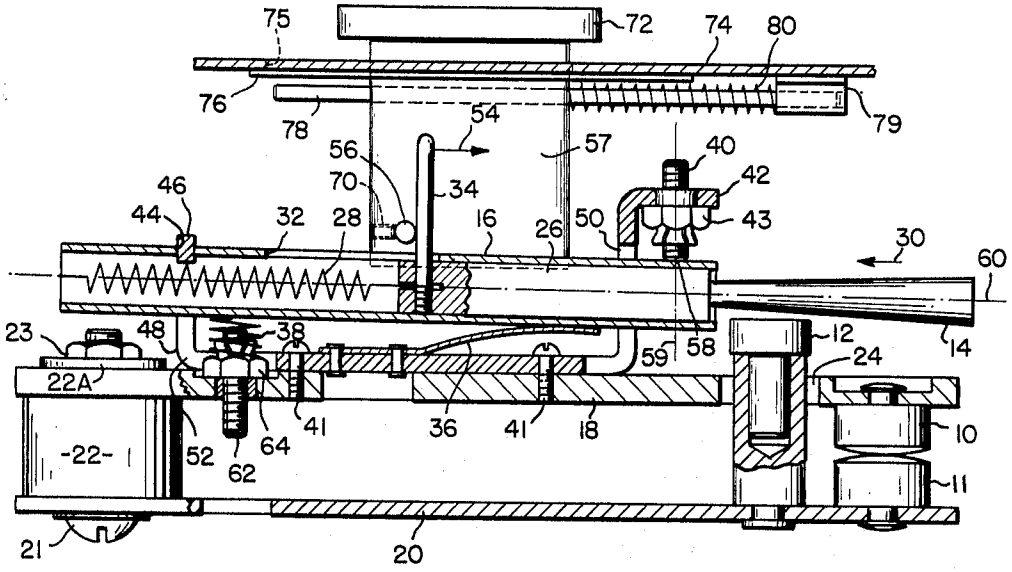


FIG. 1

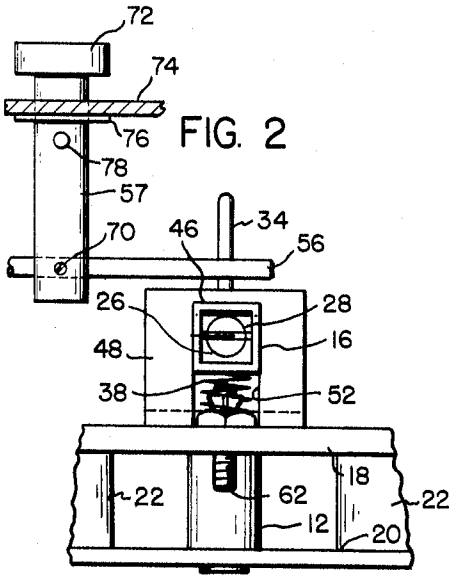
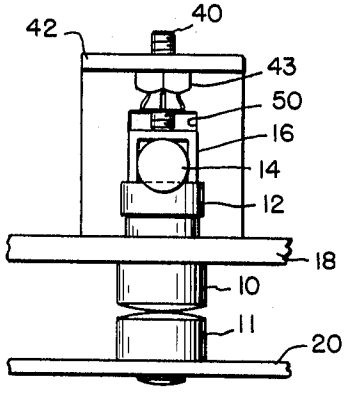


FIG. 2

FIG. 3



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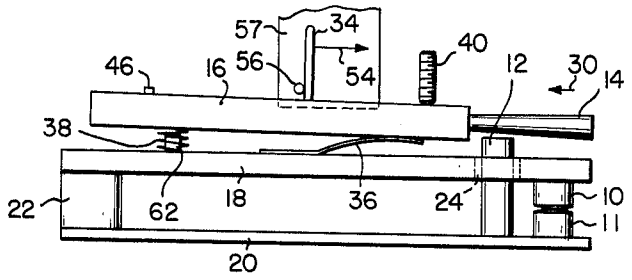


FIG. 4

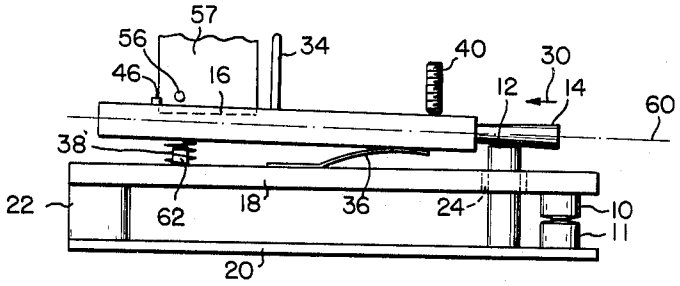


FIG. 5

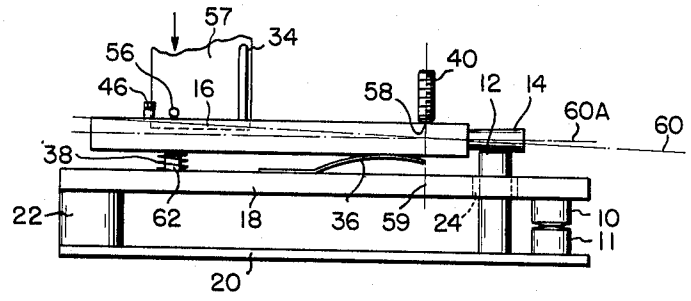


FIG. 6

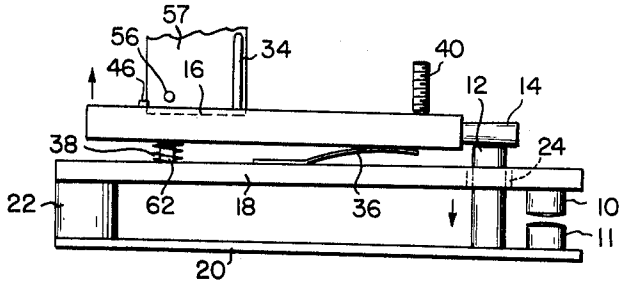


FIG. 7

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3,235,764

SEMI-AUTOMATIC SPARK GAP SETTER

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Filed Nov. 14, 1962, Ser. No. 237,473
12 Claims. (Cl. 313—146)

This invention relates to spark gap mechanism and more particularly to an improvement in spark gap mechanism.

My invention is an improvement in spark gap mechanism of the nature described in the G. P. Goode Patent 2,519,647.

My invention contemplates a spark gap mechanism capable of adjusting the gap in a manner compensating for wear of the electrodes as an incident to adjustment of the mechanism for operation thereof.

Although I have elected to describe a single pair of electrodes, it will be understood that my invention is adapted for use with a plurality of pairs of electrodes which may be interconnected for simultaneous control thereof.

As mentioned in the Goode Patent 2,519,647, more satisfactory results are normally obtained where a series of gaps are provided by a plurality of pairs of electrodes connected electrically in series in order to minimize deterioration of the electrodes at the gap. Thus, each pair may be individually put into operational position generally in the manner described below or a plurality might be simultaneously controlled by linkage such as described hereinafter.

It is one object of my invention to provide an improved spark gap mechanism yielding more accurate space than heretofore known.

It is a significant object of my invention to provide a greatly simplified apparatus for providing uniform spacing between spark electrodes.

It is another object of my invention to provide less expensively manufactured apparatus for providing uniform spacing of spark electrodes than heretofore known.

It is an important object of my invention to provide an improved spark gap mechanism by which separate pairs of electrodes may be easily and conveniently adjusted semi-automatically with improved accuracy. Existing spark gap mechanisms of the semi-automatic variety are somewhat inaccurate in operation and complicated to adjust and operate as contrasted to applicant's invention.

It is a further object of my invention to provide an improved method for setting the gap between spark electrodes thereby to provide more accurate and uniform spacing than by prior known methods.

Other objects and advantages of this invention will be particularly set forth in the claims and will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of one embodiment of my invention;

FIG. 2 is a left hand end elevational view of the FIG. 1 embodiment, with parts broken away and parts removed;

FIG. 3 is a right hand end elevational view of the FIG. 1 embodiment, with parts removed; and

FIGS. 4–7 are diagrammatic illustrations of the embodiment of my invention illustrated in FIG. 1 shown in sequential operational positions.

It is the desired result of spark gap devices to provide uniform spacing between spark electrodes, regardless of the deterioration and wear of the electrodes. In order to fulfill this end, applicant provides a cam or wedge which engages a spark gap separating means or linkage at a first reference position along the cam dependent upon the wear of the electrodes; thereafter, the cam is pivoted or retracted a predetermined distance in a first or counter-clockwise direction until the cam engages the spark gap separating means or linkage at a second reference position along the cam; finally the cam is pivoted or advanced a predetermined distance in the direction opposite or clockwise thereby to uniformly space the spark electrodes regardless of the wear factor.

The basic elements of the illustrated mechanism comprise a pair of electrodes **10** and **11** yieldingly biased into engaging position. The electrodes are spaced by the coaction of a cam or wedge compensating element **14** and electrode separation means comprising a vertical pin **12** rigidly coupled with the lower electrode **11** yieldingly biased into engagement with the upper electrode **10**. Downward vertical actuation of the pin **12** is provided by cam or wedge compensating element **14** slidably mounted in and controlled by a cam support or cam housing **16** pivotally coupled to the upper electrode **10** in a manner hereinafter described.

As used hereinafter, the term "cam" not only refers to the cam **14** but broadly includes wedges or other wear compensating elements.

I have not shown the electrical connections extending from the electrodes **10** and **11** since such electrical circuitry does not constitute part of my invention.

The upper electrode **10** is carried on a substantially rigid horizontally extending plate **18**. The lower electrode **11** is carried on a semi-rigid resilient horizontally extending plate **20**, secured in vertically spaced parallel relationship to plate **18** by a pair of horizontally spaced insulators **22** (FIG. 2) intermediate plates **18** and **20**; a pair of horizontally spaced insulators **22A** above plate **18** and axially aligned with insulators **22**; a pair of contact bolts **21** extending vertically through the plates and insulators and threadedly receiving nuts **23** lockingly engaging insulators **22A**. Resilient plate **20** is yieldingly biased to maintain the electrodes **10** and **11** in a normally closed engaging position shown in FIG. 1. It will be understood that any suitable yieldingly biasing construction might be utilized for maintaining this normally closed relationship.

One or both of electrodes **10** and **11** are slightly crowned for alignment thereof. The means for separating the electrodes **10** and **11** responsive to the cam **14**, includes the pin **12** rigidly carried by the resilient plate **20** and extending through an opening **24** provided in the upper rigid plate **18**. Thus, responsive to a caming action applied to the upper end of the pin **12**, the lower electrode **11** is actuated vertically away from the upper electrode **10** in opposition to the yielding biasing effect of the lower resilient plate **20**.

The cam **14** has a longitudinally extending body portion **26** preferably of square cross section, slidably keyed inside of cam support or housing **16**. A tension spring **28** fastened at the left end of cam body portion **26** is attached to the left end of support **16** thereby yieldingly biasing the cam **14** to the left as indicated by the arrow **30** from an open position of FIG. 1 into an engaging position with vertical pin **12** illustrated in FIG. 5. Cam housing **16** is provided with a longitudinally extending slot **32** in the upper surface thereof adapted to slidably receive and guide a mechanically or manually operated handle **34** rigidly mounted to cam body portion **26**.

Cam support **16** is yieldingly biased upward by two horizontally spaced springs, leaf spring **36** and coil compression spring **38**. The upper outside surface of cam housing **16** is engaged at the right hand end by an adjustable stop **40** threadedly received in a nut **43** rigidly carried by horizontal flange portion of a support arm **42**, in turn rigidly mounted on upper plate **18**, as for example, by screws **41**. At substantially the left hand end of cam housing **16**, applicant has provided a horizontal slot **44** in the upper surface thereof, adapted to receive in

keyed relation a horizontally extending bridge portion 46 of a vertically extending arm 48 integral with support arm 42 and rigidly secured to the upper plate 18. Thus, adjustable screw 40 and horizontal bridge portion 46 limit the upward motion of the cam housng 16, and additionally, horizontal bridge portion 46 of the arm 48 prevents horizontal displacements of the cam housing 16 as it pivots, in a manner hereinafter described, between horizontal portion 46 and an adjustable screw 62 carried on plate 18. Cam housing 16 is vertically aligned, during pivoting motion thereof, between the vertically extending edges of a slot 50 (FIG. 3) provided in arm 42 and a vertical slot 52 (FIG. 2) provided in arm 48.

In FIG. 5, the spark gap mechanism is in the inoperative position with the electrodes 10 and 11 in the normally closed engaging position.

The heretofore described spark gap mechanism may be manually or finger operated. However, in the preferred embodiment, I have illustrated a semi-automatic device for controlling the spark gap mechanism described. Illustrated in FIGURES 1 and 2, there is a casing or housing 74 embracing one or more spark gap mechanisms of the nature described above. Housing 74 is provided with a longitudinal slot, the left hand transverse edge of which is illustrated by the broken line 75 and the right hand transverse edge of which is engaged by the right hand end of a finger operated button 57 slidably received within the housing slot 75. Button 57 has an enlarged head portion 72 and is provided with a horizontal longitudinally extending bore receiving a horizontally extending pin or shaft 78 upon which button 57 slides.

Pin 78 is rigidly carried by bracket 79, in turn flexibly mounted on housing 74. The bracket 79 is flexibly or yieldingly mounted to the casing 74 and/or the pin 78 is constructed of resilient material thereby enabling the button 57 to be pivoted downwardly in a vertical plane relative to the casing 74, responsive to a downward force on the head 72 as the operator depresses the button 57.

The button 57 is vertically aligned during sliding motion by the pin 78 and/or the longitudinal extending edges of housing slot 75.

I have also illustrated a dust shield 76 surrounding button 57 and slidable therewith. Dust shield 76 covers the longitudinal housing slot 75 regardless of the location of the button 57 along the slot. Intermediate the button 57 and bracket 79 and surrounding pin 78 is a compression spring 80 resiliently biasing the button 57 in the left hand direction as viewed in FIG. 1, to an engaging position with the left hand transverse edge of the housing slot 75.

Extending transversely through the lower left hand corner of button 57 is a horizontal bore receiving a pin 56 rigidly mounted therein by a set screw 70. Pin 56 is adapted to control the vertical handle 34 and the cam housing 16 in the manner hereinafter described. However, it will be understood that the functions of pin 56 may be carried out manually.

As illustrated in FIG. 2, it will be understood that the pin 56 may be of any desired length in order to control one or plurality of the spark gap mechanisms described previously. For simplicity of illustration, it will be noted that the left hand end of pin 56 is broken away; however, in commercial use there is usually one mechanism mounted on alternate sides of the button 57. Also, it will be understood that the pin 56 can be extended in both directions in order to control a selected number of the spark gap mechanisms.

At such time as it is the operator's desire to gap the electrodes 10 and 11, a horizontal pressure is applied by the operator's finger to the head portion 72 of button 57 in opposition to compression spring 80 in a right hand direction, which is transmitted to the handle 34 as indicated by the arrow 54, in opposition to tension spring 28 thereby to disengage the cam 14 from the upper surface of the vertical pin 12. When the handle 34 reaches the end of its stroke defined by the slot 32 of housing 16, the cam is in the forward or first reference position illustrated in FIGS. 1 and 4. Thereafter, the operator releases the button 57 thereby enabling the tension spring 28 to return the cam 14 to the engaged position with the pin 12 as illustrated in FIG. 5. During this operation, the cam housing 16 is maintained in the horizontal position by springs 36 and 38.

Thereafter, the operator depresses the button 57 thereby applying a vertical component force downwardly on pin or rod 56. When downward vertical force is applied to move the pin 56 from the FIG. 5 to the FIG. 6 position, the cam housing 16 is pivoted about a pivot point 58 at the bottom of adjustable stop 40 where it engages the upper surface of the cam housing 16. Thus, the cam housing 16 is pivoted radially of the cam 14 in a counterclockwise direction in opposition to compression spring 38 until the lower surface thereof engages the upper end an adjustable screw or stop 62 being axially spaced from the lower end of stop 40 and horizontally thereof. In FIG. 1, it will be seen that stop 62 is threadedly received by a nut 64 rigidly mounted, as for example, by welding to the upper surface of plate 18.

The pivot arc made by the housing 16, between the stop 46 at the upper limit and adjustable stop 62 at the lower limit, may be varied by adjustably threading the stop 62. The cam 14 carried inside of the housing is also pivoted or retracted radially thereby pivoting the horizontal axis 60 of cam 14 in a counterclockwise direction to the 60A position of FIG. 6. The radial retraction of the cam and cam housing in a counterclockwise direction permits sliding motion of the cam 14 and cam body 26 to the left, as indicated by the arrow 30, responsive to tension spring 28 until it reaches a retracted or second reference position as diagrammatically illustrated in FIG. 6.

The operator then simply releases the button 57 which is elevated by the resilient effect of the pin 78 and bracket 79 thereby moving pin 56 upwardly from the FIG. 6 to the FIG. 7 position. The compression spring 38 is pretensioned to overcome the resilient biasing effect of lower plate 20. Thus, when pin 56 disengages cam housing 16, the cam 14 is pivoted in a clockwise direction thereby actuating the pin 12 vertically downward separating electrodes 10–11 a predetermined distance proportional to the predetermined arc through which the housing 16 pivots. Thus, the electrodes are separated to an operative position illustrated in FIG. 7.

The cam and cam housing pivot point 58 may be vertically shifted by adjustment of the adjustable stop 40, thereby adjusting the first reference position of cam 14 relative to the cam housing 16 when the cam 14 is in the FIG. 5 position. Tension spring 28 is pretensioned so that it does not have sufficient force in the absence of the above described pivoting action, to separate the electrodes 10 and 11 when the handle 34 is released and permitted to return from the FIG. 4 to the FIG. 5 position.

One of the advantages of my invention over Goode is the increased accuracy of gap setting. With the Goode construction, the cam sometimes overrides the desired reference position by reason of excess tension of the spring, such as 28, controlling the cam, thereby separating the electrodes an uncontrolled amount before the cam is moved the additional predetermined amount. In the present invention, such inaccuracies cannot occur. Assuming that the spring 28 were of sufficient strength to overcome the biasing effect of resilient plate 20 when cam 14 moves from the FIG. 4 position to the first reference position illustrated in FIG. 5, thereby slightly separating the electrodes 10 and 11 in the first reference position, the electrodes will thereafter be returned to their normally engaging position when the cam 14 moves to the second reference position shown in FIG. 6 while

the cam housing is pivoted from the FIG. 5 to the FIG. 6 position; the cam simply moves a lesser distance in the leftward direction to the second reference position in FIG. 6. Thus, irrespective to any override of the cam initially when it reaches the first reference position of FIG. 5, the step of retracting the cam to a second reference position, before it is moved the predetermined distance from the FIG. 6 to the FIG. 7 position, guarantees that the predetermined gap will be provided by my invention.

While I have shown and described the preferred form of mechanism of my invention it will be apparent that various modifications and changes may be made therein, particularly in the form and relation of parts, without departing from the spirit of my invention as set forth in the appended claims.

I claim:

1. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap, comprising,
(a) a cam cooperatively coupled with said separation means,
(b) means moving said cam into reference position relative to said separation means when the electrodes are engaged, said position being dependent upon the wear of the electrodes, and
(c) means for pivoting said cam radially thereof through a predetermined arc thereby separating said electrodes a predetermined distance.

2. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap, comprising,
(a) a cam slidably coupled to said separation means,
(b) pretensioned spring means moving said cam into a reference position relative to said separation means when the electrodes are engaged, said position being dependent upon the wear of the electrodes, and
(c) means for pivoting said cam radially thereof through a predetermined arc thereby separating said electrodes a predetermined distance.

3. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap and yieldably maintaining said electrodes in said normal position, comprising,
(a) a cam support pivotally mounted relative to said separation means,
(b) a cam slidably carried by said cam support,
(c) pretensioned spring means sliding said cam into a reference position relative to said separation means when the electrodes are engaged, said position being dependent upon the wear of the electrodes, and
(d) means for pivoting said cam and cam support radially thereof through a predetermined arc thereby separating said electrodes a predetermined distance.

4. A mechanism in accordance with claim 3 in which said pivot means comprises, pretensioned spring means opposing said yieldable separation means to separate said electrodes.

5. A mechanism in accordance with claim 4 in which said pivot means includes, stop means limiting the throw of said cam support and means yieldably biasing said support toward said normal position.

6. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap and yieldably maintaining said electrodes in said normal position, comprising,
(a) a cam,
(b) a cam support means slidably carrying said cam,
(c) means yieldably biasing said cam into co-active engaging positions with said separation means dependent upon wear of said electrodes when in said normally closed position,
(d) said cam support means being pivotally mounted relative to said separation means for radial pivoting of said cam whereby pivoting of said support through a predetermined arc separates said electrodes a corresponding predetermined distance.

7. Mechanism in accordance with claim 6 in which,
(e) the pivotal axis of said support is adjustable for varying the coactive relationship of said cam with said separation means.

8. In a spark gap mechanism having a first electrode yieldingly biased into engagement with a second electrode and separation means coupled with said first electrode for separating said electrodes, comprising,
(a) a cam,
(b) a cam support means slidably carrying said cam,
(c) pivot means coupling said cam support means to said second electrode for radially pivoting said cam and cam support means through a predetermined arc, and
(d) means yieldingly biasing said cam into coactive engaging positions with said separation means dependent upon wear of said electrodes when engaged whereby pivoting of said support through said predetermined arc separates said electrodes a corresponding predetermined distance.

9. A mechanism in accordance with claim 8 in which said pivot means comprises,
(e) a pair of longitudinally spaced stop members carried by said second electrode on a first side of said cam support means,
(f) means maintaining said cam support means into engagement with a first of said stop members closest said separation means, and
(g) spring means intermediate said stop members yieldingly biasing said support means into engagement with a second of said stop members.

10. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap, comprising,
(a) a cam cooperatively coupled to said separation means,
(b) pretensioned spring means for yieldingly biasing said cam into a first reference position relative to said separation means when the electrodes are engaged, said position being dependent upon the wear of the electrodes,
(c) means for yieldingly moving said cam a predetermined distance to bring the cam into a second reference position relative to said separation means responsive to said spring means, and
(d) mean for moving said cam a second predetermined distance whereby to separate said electrodes a predetermined distance.

11. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap, comprising,
(a) a cam cooperatively coupled to said separation means,
(b) pretensioned spring means for yieldingly biasing said cam into a first reference position relative to said separation means when the electrodes are engaged, said position being dependent upon the wear of the electrodes,
(c) means for pivoting said cam radially through a predetermined arc thereby to yieldingly move said cam into a second reference position relative to said separation means responsive to said spring means, and
(d) means for pivoting said cam oppositely a predetermined arc thereby separating said electrodes a predetermined distance.

12. In a spark gap mechanism having a pair of electrodes being engaged when in a normally closed position and separation means adapted for separating said electrodes to define a spark gap, comprising,

(a) a cam cooperatively coupled to said separation means,

(b) pretensioned spring means for yieldingly biasing said cam into a first reference position relative to said separation means when the electrodes are engaged, said position being dependent upon the wear of the electrodes,

(c) means for moving said cam a predetermined distance in a first direction thereby to bring the cam into a second reference position relative to said separation means responsive to said spring means, and

(d) means for moving said cam a second predetermined distance in a direction opposite of said first direction thereby to separate said electrodes a predetermined distance.

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