F. BAIER.

AUTOMATIC SPARK CONTROL FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED OCT. 7, 1915.

1,204,730.

Patented Nov. 14, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

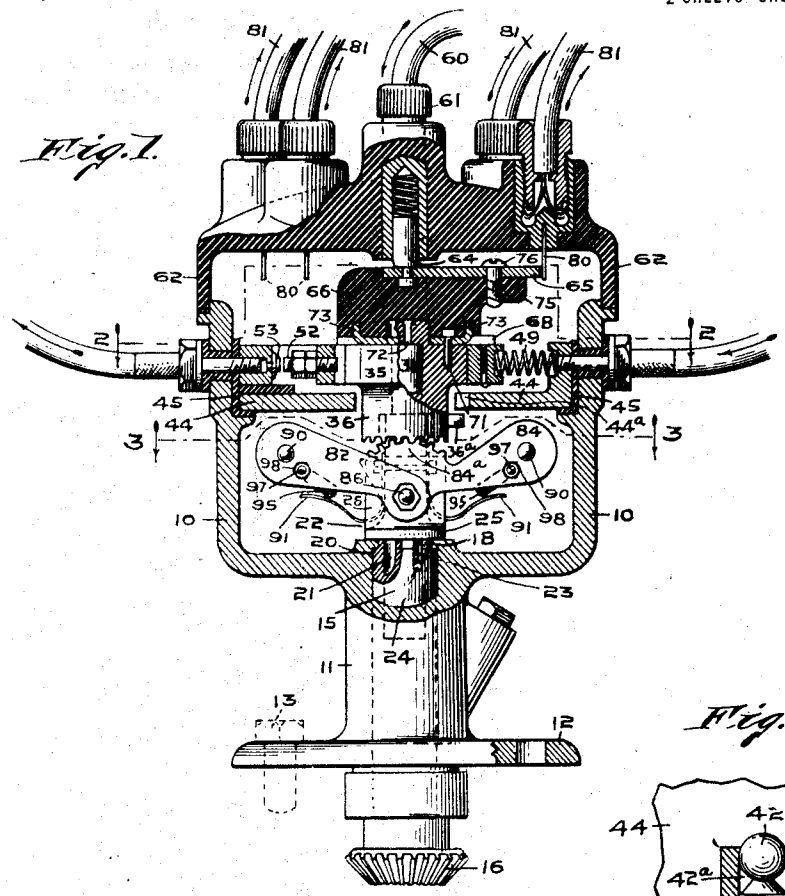


Fig. 5.

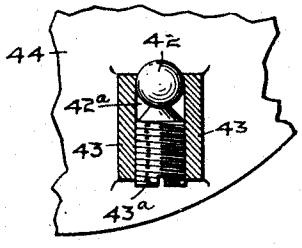
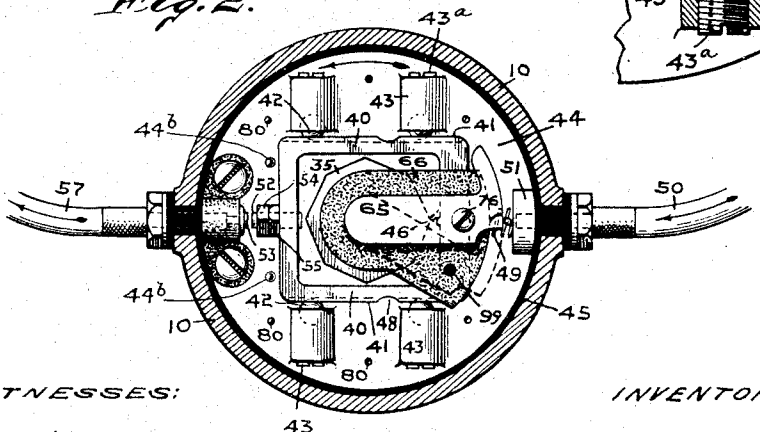


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

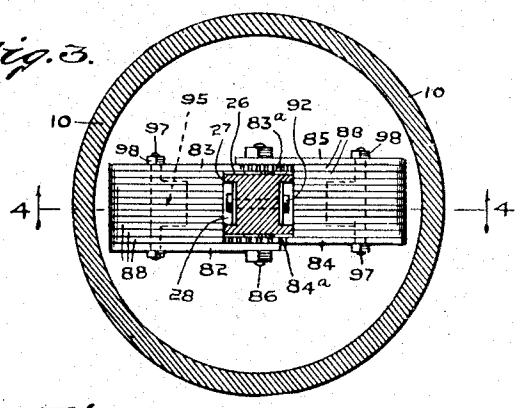


Fig. 4.

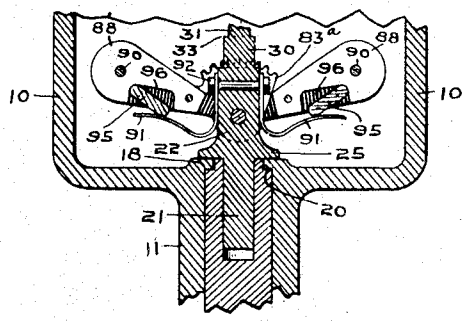
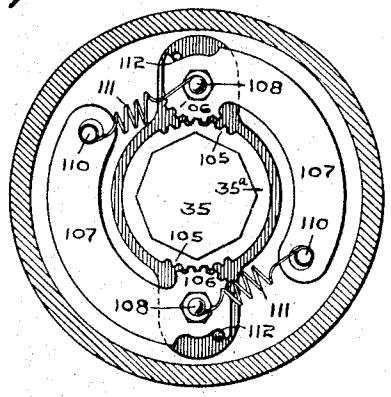


Fig. 6.



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UNITED STATES PATENT OFFICE.

FREDERICK BAIER, OF ANDERSON, INDIANA.

AUTOMATIC SPARK CONTROL FOR INTERNAL-COMBUSTION ENGINES.

1,204,730. Specification of Letters Patent. Patented Nov. 14, 1916.

Application filed October 7, 1915. Serial No. 54,658.

To all whom it may concern:

Be it known that I, FREDERICK BAIER, a subject of the Emperor of Germany, residing at Anderson, in the county of Madison and State of Indiana, have invented certain new and useful Improvements in Automatic Spark Control for Internal-Combustion Engines, of which the following is a specification.

This invention relates to an automatic spark control and electric current distributer mechanism for internal combustion engines; and one of the objects of the invention is to provide an improved and simplified spark control mechanism which will operate with certainty and with less wear on the parts than obtains in like devices in use at the present time.

A further object of the invention is to provide a device for automatically controlling the spark in electrical systems employed in connection with internal combustion engines, particularly those employed in automobile construction, in which the working parts are greatly reduced in number with a corresponding reduction in friction, thereby insuring a low cost of manufacture, accessibility and compactness.

There are other objects and advantages which will appear from a perusal of the specification and claims.

Referring to the accompanying drawings, forming a part hereof, in which—

Figure 1 is a central vertical sectional view of my improved automatic spark control for controlling the electric current in connection with internal combustion engines. Fig. 2 is a cross section on the line 2—2 in Fig. 1. Fig. 3 is a cross section on the line 3—3 in Fig. 1. Fig. 4 is a fragmentary detail sectional view on the line 4—4 in Fig. 3. Fig. 5 is a fragmentary detail horizontal sectional view through one of the ball bearings for supporting the interrupter frame. Fig. 6 is a modified construction of the governor mechanism.

Referring to the drawings, it may be stated that the distributer here shown is designed particularly for use in connection with an eight cylinder engine, but it will be understood that by merely extending or contracting the construction illustrated a greater or lesser number of cylinders may be accommodated.

With the structure herein illustrated in mind, the device comprises a hollow bowl or casing 10 within which the revoluble mechanism is housed, and the said casing terminates in a suitable hollow stem 11 which is provided with a foot-plate 12 for securing the casing in operative position by means of the bolts 13. The stem 11 is provided with a longitudinally extending bore adapted to receive a vertically disposed driving shaft 15, and the latter is provided on its lower end with a suitable bevel pinion 16 which meshes with a corresponding pinion, of proper ratio on the engine shaft (the engine shaft and its pinion not being shown), through which movement of rotation is transmitted to the movable parts of the device.

The upper end of the bore in the stem 11 is reduced in diameter to form an annular shoulder 18, and the upper end of shaft 15 is reduced in diameter to form an annular shoulder 20 adapted to abut the shoulder 18, so as to limit the insertion of said shaft into said hollow stem. The upper end of the driving shaft 15 is provided with a longitudinal bore to form a pocket which receives a spindle 21 formed on the lower end of a mechanism supporting shaft 22, the latter shaft being in axial alinement with the driving shaft 15. The shaft 22 supports a part of the revoluble mechanism of the device and is subject to severe strains which may cause its impairment, and in order to conserve as many parts of the device as possible in case of any impairment is, from a constructive point of view, the reason for forming the shaft 22 and its spindle 21 independently of the driving shaft 15 and such other parts as are to be hereinafter described. To enable a defective shaft 22 to be easily removed and replaced, without destroying its relative position with the other mechanism, or, in other words, to preserve its registered position with respect to the other mechanism, I provide the driving shaft 15 with a recess or slot 23 adapted to receive a pin 24 on the spindle 21. This arrangement enables a new shaft 22, having a properly located pin 24, to be easily brought into registration with the driving shaft 15, or vice versa. The shaft 22 is normally round in cross section as at 25, but its opposite sides are cut down to present the flat faces 26 (see Fig. 3) to afford sufficient bearing for a governor mechanism, to be hereinafter described, and the sides of the shaft 22 and at right angles of the faces

26 are also squared as at 27, and these faces are provided with the channels 28 which form seats for suitable springs adapted to apply a tension to the governor mechanism. The shaft 22 above its squared portion is reduced in diameter and is left round in cross section to form a shaft 30, and this shaft is still further reduced in diameter to form the cam supporting shaft 31 and the intervening annular shoulder 33 upon which the cam-block 35 is loosely mounted. To eliminate a certain amount of friction the hub 36 of cam-block 35 is bored out a part of its length in which the diameter of the bore is lightly in excess of the external diameter of shaft 30. The lines of force due to the formation of the cam are in a plane at right angles to its longitudinal axis, and the function is to actuate the interrupter frame which is interposed within the primary circuit. As before stated, the cam-block 35 is loosely mounted on its supporting shaft 31 and may be easily removed therefrom when the mechanism needs cleaning or in making repairs. In order that a cam-block can be replaced so as to occupy the same relative position on the shaft 31 as it occupied before, the hub 36 is provided with a laterally projecting lug 36^a and the division plate 44 with a recess 44^a, and these two must be brought into registration before the cam-block can be removed or replaced.

The interrupter for interrupting the current in the primary circuit comprises a rectangular frame 40 having a central opening of sufficient area to freely surround the cam-block 35, and in order that said frame may freely move and readily respond to the action of said cam, I mount the interrupter frame 40 in suitable ball bearings, while the edges of the frame 40 are provided with grooves 41 forming ball-races for the balls 42. The balls 42 project into the ball-races in the frame 40 and the balls are retained in recesses 42^a (see Fig. 5) formed in the enlargements 43, the latter being formed integrally with the division plate 44. The plate 44 is insulated from the casing 10 by suitable insulating material 45. The metal of the enlargements 43 surrounding the mouths of the recesses 42^a are swaged inward and above the axis of the balls 42 sufficiently to prevent the balls from accidental displacement without interfering with their free rotation, and the balls are held in proper working relation with the interrupter frame 40 by means of screws 43^a which bear against the sides of the balls opposite their points of contact with said frame 40. The frame 40 is also provided on opposite edges with the notches 48 which communicate with the ball-races 41, and these notches are arranged a sufficient distance back toward the center of the frame to be beyond the normal travel of the frame when the latter is actuated by the cam-block 35. However, when it is desired to remove the frame 40 for any cause it can be accomplished by manually advancing the frame until the notches 48 register with the adjacent balls 42 when that end of the frame can be freed, then by further advancing the frame until the other end passes over the balls in the remaining bearings the said frame can entirely be removed and replaced as necessity dictates. The interrupter frame is further provided with a contact-point 46 which is engaged by the projections on the cam-block 35 for shifting the frame 40 in one direction to close the primary circuit, and the frame 40 is returned to its normal position to break the primary circuit under the influence of spring 49.

The electric current in the primary circuit enters the device by means of the conductor wire 50 and is delivered to the terminal 51, which is insulated from the casing 10, and thence passes to the interrupter frame 40 through the spring 49. The end of frame 40 opposite the end carrying the contact 46, is provided with a suitable contact 52 which is composed of platinum or other suitable material for the purpose, and this contact is provided with external threads and is mounted in a threaded aperture in the frame 40 in order that the contact can be extended or retracted to maintain a proper working relation with an exteriorly located contact 53, carried by the casing 10. This arrangement of parts permits the contact 52 to be adjusted to overcome lost motion due to the action of attrition at the end of the points of the contacts 52 and 53, and when the contact 52 has been properly adjusted it can be secured by means of the lock-nuts 54 and 55. Attention is also called to the fact that the frame 40 is mounted so that its movement of travel is in a plane which is parallel with the longitudinal axis of contact 53, which insures that the ends of contacts 52 and 53 at all times will meet squarely and that said ends will remain square even as they wear away through the action of attrition, so that the flow of electric current will remain constant. In time the ends of contacts 52 and 53 will wear and thus increase the gap between the points of contact which will allow the frame 40 to be shifted a greater distance, which in turn will set up a severe pounding and thus reduce the ends of the contacts and increase the width of the gap abnormally. To prevent a condition which results in prematurely reducing the points of contacts 52 and 53 I provide suitable stop-pins 44^b which are mounted in division plate 44 at a point to limit the movement and take the jar of frame 40 when the end of contact 52 becomes worn down to a determined

length, at which time the contact 52 can be adjusted to its normal position before there is any interference with the current in the circuit.

The electric current in the primary circuit leaves the interrupter frame 40 through contacts 52 and 53 and through conductor wire 57 to the usual and well known induction coil from whence it is returned as a high tension current through conductor wire 60 to the central terminal 61 which is mounted in the cap 62, formed of insulating material, and forms a cover for casing 10. The high tension current passes through terminal 61 and is delivered to the distributer-segment 65 through a spring seated member 64. The segment 65 is supported and rotated by the cam-block 35, but is insulated from said cam-block by means of the insulating block 66, the latter being interposed between said segment and cam-block 35. The insulating block 66 is loosely mounted on cam 35 and to insure that the block 66 will be rotated in a positive manner a plate 68 is inserted between said block and cam, and this plate is provided with the spurs 73 which are embedded in the body of block 66, and a pin 71 carried by the plate projects into an aperture in the cam-block 35, whereby the segment 65, block 66 and plate 68 will rotate in unison. The pin 71 and its engagement with an aperture in cam-block 35 enables the segment, block and plate to be removed and replaced without destroying or disarranging their working relation with cam-block 35, and, also, serves the additional purpose of allowing the cam-block 35, cam supporting shaft 31 and shoulder 33 to be lubricated through an oil hole in the end of the trunnion on plate 68. Examining Fig. 1, it will be noted that the forward end of the insulating block 66 is cut away leaving a projecting ledge 75, and passing through this ledge is a binder-screw 76 which secures the free end of the distributer-segment 65 firmly in place upon the face of block 66. The air gap existing between the end of screw 76 and end of plate 68 allows the high tension current to jump to said plate under abnormal conditions—for instance, when the electrodes in the spark-plugs become fouled which will interfere with or entirely prevent the current from pursuing its normal course. Under normal conditions, the high tension current is distributed by the segment 65 to the various electrodes 80 from whence it is delivered through the several conductor wires 81 to their respective spark-plugs in the cylinders of the engine, in the usual way. The time for normally bringing the segment 65 into position coincident with the several electrodes 80 in successive order, or to advance and retard said segment from an assumed normal position, so as to bring said segment coincident with the electrodes 80 at an earlier or later period of time, is controlled entirely by the rotation of the engine, by increasing or decreasing the supply of fuel. In view of the increased or decreased movement of the engine, which is immediately reflected by an increased or decreased movement of the revoluble parts of the device, causing the segment 65 to advance or retreat from an assumed normal position, certain means must be employed to prevent sudden impulses, accompanying the acceleration and diminution of movement of rotation from a normal ratio of movement of rotation, reaching segment 65. This is accomplished, first, by loosely mounting cam-block 35 on cam-supporting shaft 31, and, second, by providing a governor mechanism by which variations in the movement of rotation can gradually be imparted to cam-block 35, block 66 and distributer-segment 65.

The governor mechanism comprises a plurality of wings composed of thin metal sheets 82, 83, 84 and 85 which are mounted upon a common shaft 86 passing transversely through the squared portion of shaft 22. The blades 82 and 83 form the end members of one governor wing and the blades 84 and 85 form the end members of the other governor wing. To impart the necessary weight to each governor wing the blades 82 and 83, and the blades 84 and 85 are mounted some distance apart and the intervening space between each set of blades is filled with a plurality of thin plates 88 which are of less length than the length of the end members. The abridgment in length of the plates 88 is for the purpose of providing sufficient clearance for the supporting shaft 22. Building the governor wings up out of a plurality of thin metal sheets is merely a mechanical expedient from an economical manufacturing point of view, and the several sheets of each wing are securely held together by means of the transverse rivets 90. The plate 83 of one governor wing and the plate 84 of the other governor wing are provided with the toothed segments 83^a and 84^a which are cut on arcs concentric with the longitudinal axis of the supporting shaft 86. These segments are arranged to stand on opposite sides of the shaft 22 with their teeth engaging corresponding teeth in the lower end of the hub 36 of cam 35.

The governor wings are normally held above a plane drawn through the horizontal axis of shaft 86, upon which the wings are mounted, by means of suitable springs 91 which are seated in the channels 28 in shaft 22, and these springs are held in proper position by means of a bolt 92. When a sudden impulse is imparted to shaft 22 through shaft 15, and presuming that the effect will be to increase the movement of rotation of

the parts, the governor wings, on account of the effect of centrifugal action, will move toward a plane drawn through the horizontal axis of shaft 86. This independent movement of the governor wings and the independent mounting of the cam 35, in view of their toothed engagement, will cause the effect of any sudden impulse to be neutralized, while the ultimate increase in movement of rotation realized will gradually be reflected in the cam, causing the latter to move forward in the path of the general direction of travel and coincide and deliver the high tension current to the electrodes 80 at an earlier period of time than prevailed before. On the other hand, any impulses arising when suddenly reducing the movement of rotation of the parts, as when the supply of fuel fed to the engine is reduced, will gradually be imparted to the cam 35. As the speed of the engine is reduced a corresponding reduction of movement of rotation of the governor wings will result, so that as the springs 91 overcome the effect of centrifugal action exerted upon the governor wings the latter are moved away from a plane drawn through the horizontal axis of shaft 86. This reverse direction of travel of the governor wings is transmitted through segments 82^a and 84^a to cam 35, causing the latter together with segment 65 to move backward in the path of general direction of travel, so that the segment 65 will coincide with electrodes 80 at a later period of time, which, after passing rearward of an assumed normal position, is called a retarded position.

In order to provide for a uniformity of pressure against the governor wings by the springs 91, since the springs are formed separately and may not uniformly resist a given pressure, I provide a separate cam for increasing and decreasing the resiliency of each spring. A cam 95 is mounted in each wing of the governor and to provide working room for said cams each wing is recessed as at 96. The cams are mounted on suitable trunnions 97 which pass transversely through the wings and are provided on their outer ends with the lock-nuts 98 by which the cams are securely held in a given adjustment.

The herein described movable parts of the device are capable of being rotated in the opposite direction from that indicated by the arrow in Fig. 2 in order to enlarge its field of usefulness, as, for instance, where the driving mechanism is moving in the opposite direction from that herein indicated. To enable the parts to become effective when used in connection with mechanism moving in the reverse direction, it is only necessary to change the position of segment 65 on the block 66 from the position indicated by means of full lines to the position indicated by means of dotted lines, in said figure. An aperture 99 is properly located in the face of block 66 so that the adjustment of segment 65 can be easily and accurately affected. This new position of segment 65 is sufficiently advanced from its present location (see Fig. 2), in the path of its new direction of travel, to cause segment 65 to coincide with electrodes 80 in successive order at the proper time.

Fig. 5 of the drawings illustrates a modified construction of the governor mechanism. In this instance, the cam 35 is provided in its opposite marginal edge of its base 35^a with suitable teeth 105 which engage corresponding teeth 106 in the adjacent edges of the curved governor blades 107. The free ends of the blades 107 are provided with cam-bolts 110 to which suitable springs 111 are attached. These springs are secured at their opposite ends to pivot-bolts 108, which construction allows the free ends of the blades 107 to move outward under the effect of centrifugal action, and through the engagement of teeth 106 and 105 the cam is advanced and retarded with respect to its general direction of travel. The blades 107 are limited in their movement about the bolts 108 by means of stop-pins 112. By means of the cam formation of cam-bolts 110 an increased or decreased tension can be exerted upon the blades 107 through the springs 111.

Having thus fully described my said invention, what I desire to secure by Letters Patent, is—

1. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member and provided with teeth, a centrifugally acting governor comprising a pair of independent movable blades provided with segmental toothed racks supported by said cam supporting member, said segmental toothed racks adapted to engage the teeth in the cam, and means for rotating said cam supporting member.

2. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member and provided with teeth, a centrifugally acting governor comprising a pair of independent movable blades provided with segmental toothed racks supported by said cam supporting member, said segmental toothed racks adapted to engage the teeth in the cam, yieldable means for holding said governor in an assumed normal position when the parts are at rest, and means for rotating said cam supporting member.

3. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member and provided with teeth, a centrifugally acting governor supported by said cam supporting member and having

teeth for engaging the teeth in the cam, yieldable means for holding said governor in an assumed normal position when the parts are at rest, means comprising cams for increasing and decreasing the tension on said governor, and means for rotating said cam supporting member.

4. A device of the herein described class comprising a revoluble cam supporting member, a driving member telescopically engaging said cam supporting member, means for connecting the cam supporting member and driving member for insuring uniform movement of rotation, a cam loosely mounted on said cam supporting member, said cam being provided with teeth, a centrifugally acting governor comprising a pair of independent movable blades provided with segmental toothed racks supported by and rotating with said cam supporting member, said segmental toothed racks adapted to engage the teeth in said cam, said governor actuating said cam about its axis independently of its general direction of travel.

5. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member and provided with teeth, a weighted toothed segment comprising a plurality of plates engaging the teeth in the cam to actuate the latter through centrifugal action, and means for rotating the governor and its supporting member.

6. A device of the herein described class comprising a revoluble cam supporting member, a cam provided with concentrically arranged toothed racks loosely mounted on said cam supporting member, and means for imparting a differential movement to said cam independently of its general direction of travel comprising a pair of independent centrifugally actuated governor blades provided with segmental toothed racks engaging the teeth in said cam mounted on and moving with said cam supporting member.

7. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member and provided with teeth, a centrifugally acting governor comprising a pair of independent movable segmental toothed racks engaging the teeth in said cam, an interrupter frame arranged within an electric circuit and actuated by said cam for interrupting the electric current, means for imparting a tension for returning said interrupter frame to normal, a contact-point carried by the interrupter frame, a second contact-point arranged adjacently to said frame and in axial alinement with the contact-point on the frame, and means for adjusting the contact-point on the frame for maintaining a normal working relation with said second contact-point.

8. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member, a centrifugally acting governor arranged on said cam supporting member and having a working engagement with said cam, an interrupter frame arranged within an electric circuit and actuated by said cam for interrupting the electric circuit, said interrupter frame being provided with grooves in its edges, balls providing a bearing for said frame by engaging said grooves, said frame being further provided with transverse notches communicating with the grooves for inserting and removing the frame.

9. A device of the herein described class comprising a revoluble cam supporting member, a cam provided with a concentrically arranged rack loosely mounted on said cam supporting member, means for imparting axial movement to said cam comprising a pair of independent centrifugally acting governor blades provided with teeth adapted to engage the teeth in said cam, high tension electric current distributer segment supported by said cam and susceptible to all movements imparted to the latter, and means for insulating said segment away from said cam.

10. A device of the herein described class comprising a revoluble cam supporting member, a cam provided with a concentrically arranged rack loosely mounted on said cam supporting member, means for imparting axial movement to said cam comprising a pair of independent centrifugally acting governor blades provided with teeth adapted to engage the teeth in said cam, a high tension electric current distributer segment removably carried by said cam and susceptible to all the movements imparted to the latter, means for insulating said segment away from said cam, and means for drivingly connecting said segment and cam.

11. A device of the herein described class comprising a revoluble cam supporting member, a cam provided with a concentrically arranged rack loosely mounted on said cam supporting member, means for imparting axial movement to said cam comprising a pair of independent centrifugally acting governor blades provided with teeth adapted to engage the teeth in said cam, a high tension electric current distributer segment removably supported by said cam and susceptible to all movements imparted to the latter, an insulating block for mounting and for insulating said segment away from said cam, and yieldable means impinging upon said segment for normally holding the latter and insulating block into contact with said cam.

12. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam sup-

porting member, means for imparting axial movement to said cam comprising a centrifugally acting governor, a high tension electric current distributer segment removably supported by said cam and susceptible to all movements imparted to the latter, an insulating block for mounting and for insulating said segment away from said cam, a friction reducing plate interposed between said block and cam, means on said plate for drivingly connecting said block and plate together, and means carried by said plate for drivingly connecting said plate and cam together.

13. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member, means independent of the cam supporting member for imparting axial movement to said cam, a high tension electric current distributer segment removably supported by said cam and susceptible to all movements imparted to the latter, and insulating block for mounting and for insulating said segment away from said cam, and means for changing the position of said segment on said block.

14. A device of the herein described class comprising a revoluble cam supporting member, a cam loosely mounted on said cam supporting member, means independent of the cam supporting member for imparting axial movement to said cam, a high tension electric current distributer segment removably supported by said cam and susceptible to all movements imparted to the latter, an insulating block for mounting and for insulating said segment away from said cam, securing-means extending through said ledge and segment, the end of said securing-means being remotely situated from the cam to form an air gap and providing a short circuit for the electric current when its normal course is impeded.

15. The combination, with a casing of a device of the herein described class, of a division plate provided with a central aperture having a recess in its marginal edge, a cam supporting shaft projecting through said central aperture in the plate, a cam loosely mounted on said cam supporting shaft, and means carried by said cam adapted to pass through the recess in the plate for properly locating the cam on its shaft.

In witness whereof, I have hereunto set my hand and seal at Indianapolis, Indiana, this 2nd day of August, A. D. one thousand nine hundred and fifteen.

FREDERICK BAIER. [L. S.]

Witnesses:

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L. B. WOERNER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D C."