

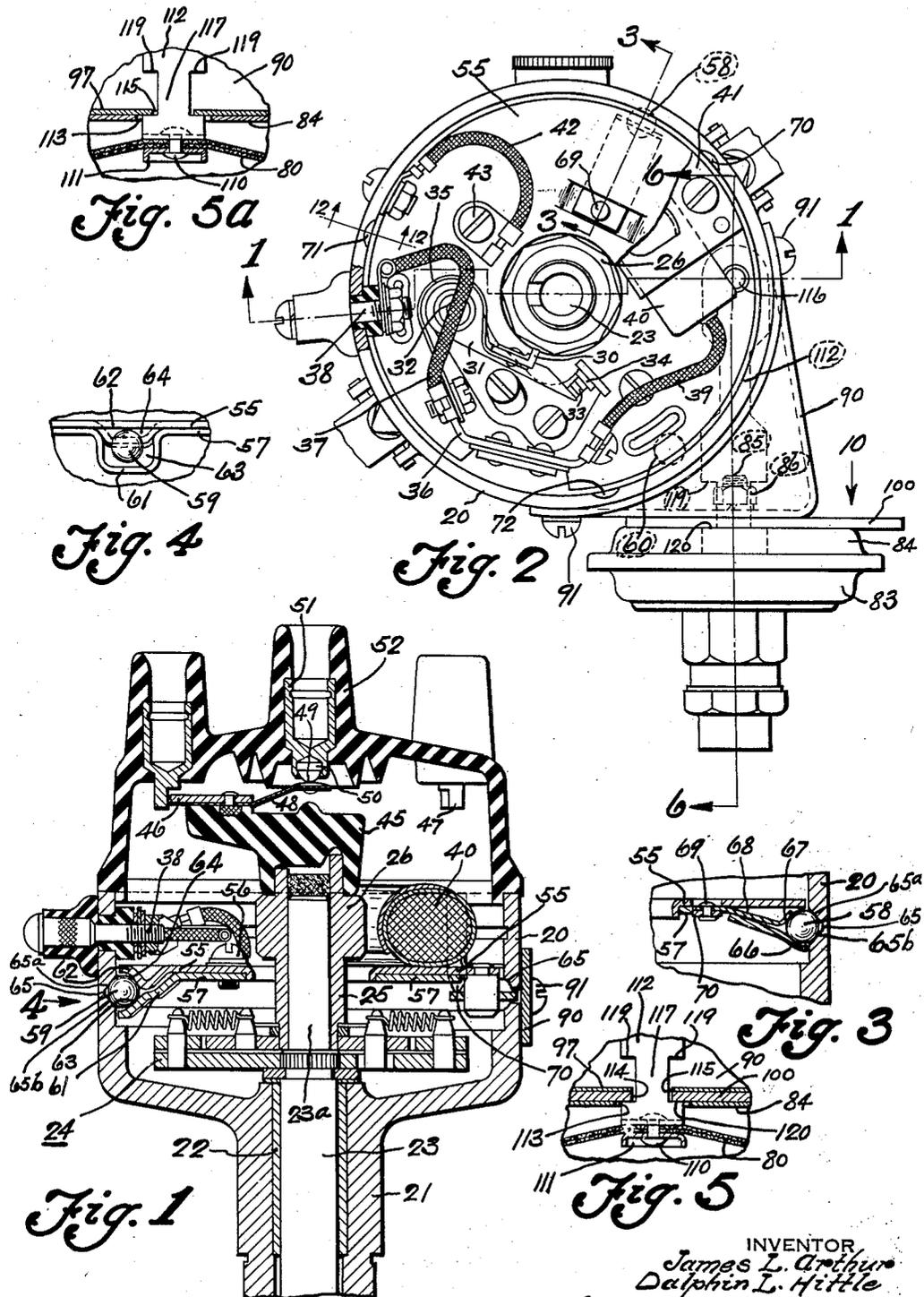
Aug. 2, 1938.

J. L. ARTHUR ET AL

2,125,367

IGNITION APPARATUS

Original Filed Aug. 24, 1934 2 Sheets-Sheet 1



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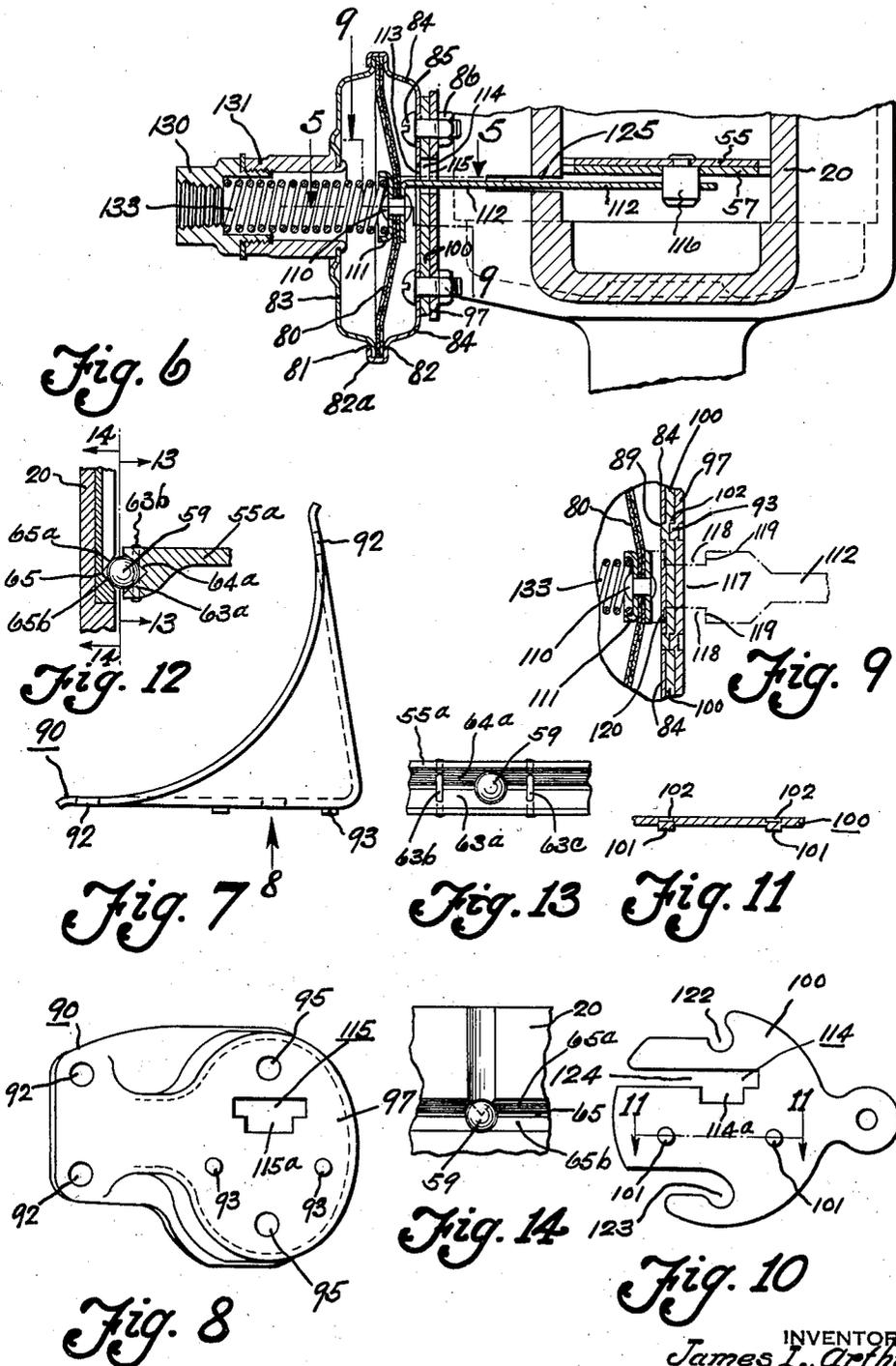
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UNITED STATES PATENT OFFICE

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IGNITION APPARATUS

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22 Claims. (Cl. 200—19)

This invention relates to ignition apparatus for internal combustion engines, and more particularly to an ignition circuit breaker the timing of which is controlled automatically in accordance with a function of the engine, for example in accordance with engine intake suction.

When controlling the timing of ignition in response to partial vacuum in the engine fuel intake passage the practice has been to utilize a vacuum-responsive displacement member, such as a piston or diaphragm, coupled with a rotatable circuit breaker plate so that the circuit interrupter will be angularly displaced with respect to the ignition timer cam, in response to variations in vacuum or unbalanced atmospheric pressure operating upon the displacement member. In devices of this sort it is essential that the rotation of the circuit breaker plate be affected by friction only to the minimum extent. Accordingly, anti-friction or ball bearings have been employed for rotatably supporting the circuit breaker plate. The ball bearings which have heretofore been employed support the circuit breaker plate axially with respect to the axis of rotation of the plate but not laterally with respect to this axis. The lateral support has heretofore been provided by a plain bearing.

It is one of the objects of the present invention to provide a ball bearing construction which will support the circuit breaker plate laterally as well as axially with respect to its axis of rotation. A further object is to take up lost motion, laterally as well as axially between the balls of the bearing and bearing races, while at the same time minimizing interference due to friction.

A still further object is to prevent removal or axial displacement of the circuit breaker plate without introducing needless friction in rotary movement.

In the disclosed form of the present invention the outer race of the bearing is provided by an annular groove formed on the interior of the housing of the circuit interrupter or timer as by cutting the groove in the interior wall of the cup, or by cutting the groove in the inner surface of a ring fitted within the cup. The inner race is not continuous, but may be said to be an interrupted race provided by a series of pockets carried by the circuit breaker plate, each pocket receiving a ball bearing. Each pocket is defined by walls which diverge outwardly toward the outer race, so that each ball will engage the walls of its pocket and the outer race each at two points; thus each ball has a four-point engagement with its races. A wall of at least one of

the pockets is made of resilient metal, so that it will yieldingly urge the ball against the other confining wall of the pocket, and against the outer race.

To facilitate assembly and removal of the plate assembly, vertical grooves are formed in the cup wall running from the edge to the outer ball race and so spaced as to coincide with the balls when placed in the inner race. There are preferably three substantially equi-distant balls so that the act of urging one of the balls outwardly by its resilient pocket wall against the outer race effects such a reaction upon the circuit breaker plate laterally as to cause all play, laterally as well as axially, to be taken up between the other balls and their races. In effect the circuit breaker plate is supported by three balls, each ball being yieldingly urged into a wedging engagement with four surfaces, namely, the two surfaces provided by the pocket for the ball and the two surfaces provided by the outer race. In other words, the balls projecting across the space between the edge of the circuit breaker plate and the wall of the cup and into the races provided by these parts, acts as a lock that prevents removal of the circuit breaker plate from the cup until either the clamping screws are removed or the plate assembly is revolved so that the balls coincide with the vertical grooves. While the plate assembly is in its normal working position, the balls are displaced from the vertical grooves, so that lateral movement during that relation is not possible. The outer race, being formed so that it is concentric with respect to the ignition timer cam, the circuit breaker plate and its circuit interrupter, will be rotated axially of the cam. Hence, the circuit breaker will operate in the intended manner regardless of the adjusted position of the circuit breaker plate. Furthermore, the automatic adjustment of the plate by an instrument such as a device responsive to engine suction can be effected with the minimum of resistance due to friction.

A further object is to provide for mounting upon the ignition timer housing an automatic instrument, such as a device responsive to engine suction, by means of a bracket so constructed and arranged that it will conceal the element which connects the device with the circuit breaker plate within the housing and will therefore cover the opening in the housing through which this element extends.

A further object of the present invention is to provide a convenient means for varying the range of adjustment of the circuit breaker plate.

- This is accomplished by providing a series of spacer, or range limiting plates, any one of which is adapted to be interposed between the automatic instrument and the timer housing, and to form a part of the structural unit. Each range or spacer plate is provided with an opening through which passes the element connecting the instrument with the circuit breaker plate, the element having stops spaced a distance greater than the thickness of the plate and adapted respectively to bear against appropriate stops on opposite sides of the plate. Range plates of different thickness are provided for different ranges of adjustment of the circuit breaker plate. Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown. In the drawings:
- Fig. 1 is a longitudinal sectional view of an ignition timer embodying the present invention, the section being substantially as indicated by the line and arrows 1—1 of Fig. 2.
- Fig. 2 is a plan view of the timer with the cap and rotor removed, showing the vacuum unit, spacer, and attaching bracket in assembled relation.
- Fig. 3 is a fragmentary sectional view taken substantially as indicated by the line and arrows 3—3 of Fig. 2.
- Fig. 4 is a view illustrating one of the bearing balls and pocket therefor provided by the breaker plate, and is taken substantially in the direction of the arrow 4 of Fig. 1.
- Fig. 5 is a fragmentary sectional view taken substantially as indicated by the line and arrows 5—5 of Fig. 6.
- Fig. 5a is a view similar to Fig. 5, with the range plate removed, for increasing the range of link movement.
- Fig. 6 is a fragmentary sectional view taken substantially as indicated by the line and arrows 6—6 of Fig. 2.
- Fig. 7 is a plan view of the bracket which supports the vacuum unit upon the ignition timer housing.
- Fig. 8 is a view of the bracket taken substantially as indicated by the arrows 8 of Fig. 7.
- Fig. 9 is a fragmentary sectional view taken substantially as indicated by the line and arrows 9—9 of Fig. 6.
- Fig. 10 is a side view of a spacer plate used to determine the timing range effected by the vacuum unit.
- Fig. 11 is a sectional view taken substantially as indicated by the line and arrows 11—11 of Fig. 10.
- Fig. 12 is a fragmentary view of a modification, also illustrating the removal grooves.
- Fig. 13 is a detail view as indicated by the line and arrows 13—13 of Fig. 12.
- Fig. 14 is a detail view as indicated by the line and arrows 14—14 of Fig. 12.
- 20 designates a timer cup or housing having a shank 21 by which it may be secured to the frame of the engine. The shank 21 carries a bearing 22 that rotatably supports the timer driving shaft 23 having a reduced portion 23a upon which is journaled a hollow shaft 25 providing a timer cam 26 and drivingly connected with shaft 23a by a speed-responsive device designated in its entirety by numeral 24. As is well known to those skilled in the art, the device 24 varies the angular relation between the shaft 23 and the cam 26 in accordance with the speed of the engine. Cam 26 cooperates with the rubbing block 30 of a circuit breaker lever 31 pivotally supported at 32 upon the circuit breaker plate 55 and carrying a contact 33 that cooperates with a stationary contact 34 grounded upon the breaker plate 55. The rubbing block 30 is urged toward the cam 26, or the contact 33 toward the contact 34, by a leaf spring 35 fixed at one end to the lever 31 and at the other to a conductor strap 36 that is attached by an ultra-flexible insulated wire 37 to an insulated terminal 38. An insulated wire 39 connects the strap 36 with a condenser 40 supported by a bracket 41, that is secured to the plate 55 and provides the grounded terminal of the condenser. In Fig. 2 only fragments of the condenser 40 and its bracket 41 are shown. The electrical connection of the parts is completed by an ultra-flexible insulated wire 42 forming a ground lead between the breaker plate 55 and the housing cup 20. Screw devices 43 and 44 respectively operate to connect the wire 42 to the plate and cup. The cam 26 supports and drives a distributor rotor 45 carrying a distributor segment 46 that moves past a circular row of posts 47 and that is electrically connected with a leaf spring conductor 48 carrying a button 49 adapted to bear against a button 50 carried by a central socket 51 of a distributor cap 52.
- A circuit breaker plate assembly is provided and as illustrated in Figs. 1 to 6 inclusive, constitutes a breaker plate 55 that is secured by screws 56 to a sub-plate 57, the plates 55 and 57 being so shaped as to provide three pockets substantially equiangularly spaced, each pocket receiving a bearing ball. The three balls are designated by numerals 58, 59 and 60 respectively. Ball 58 appears in Figs. 2 and 3, ball 59 in Figs. 1 and 4, and ball 60 in Fig. 2. The pockets for the balls 59 and 60 are alike; hence the one for ball 59 will be described with reference to Figs. 1 and 4. The plate 57 provides a downwardly projecting lip 61, and the plate 55 with an upwardly projecting lip 62. The lips 61 and 62 provide outwardly diverging surfaces 63 and 64 respectively that engage the ball 59 at spaced points. The surfaces 63 and 64 provide in effect an inner race for the ball 59, the outer race being provided by an annular groove 65 formed by diverging groove walls 65a and 65b on the interior of the timer cup 20, so that the groove will be located in a plane at right angles to the axis of the shaft 23, and concentric therewith. An alternative form for the outer race is shown in Fig. 12, where a ring 23a is secured within the housing, and grooved as at 65. As stated before the pocket for the ball 60 is the same as that for the ball 59.
- A modified form of breaker plate assembly is illustrated in Figs. 12 and 13, where a plate 55a is peripherally grooved to form the diverging surfaces 63a and 64a within which are disposed the balls, the pockets or interrupted race portions being defined by pins 63b and 63c that pass through the edge of the plate 55a intersecting the said groove, and thus limit the extent of travel of the balls as do the pockets of the composite plate assembly 55 and 57.
- The pocket for the ball 59 is defined in the composite plate assembly by the downwardly extending lip 66 of the plate 57, and by the upwardly extending portion 67 of leaf spring member 68 attached by rivets 69 to a bar 70 integral with the plate 55. Similarly, one of the balls may be

spring urged in the modified form of plate. The action of the spring 68 through its portion 67 is to urge the ball 58 against the lip 66 and against the outer race 65. The reaction resulting from urging the ball 58 against the outer race 65 is to urge the breaker plate 55 as a whole toward the balls 59 and 60, and to cause each of those balls to be wedged in four different respects, namely, the ball 59 is wedged between surfaces 63 and 64, between the surfaces 63 and 65b, between the surfaces 65a and 65b and between the surfaces 64 and 65a. Therefore, each of the balls is confined between four tangent surfaces so constructed and located that all lost motion both laterally and axially is taken up between the balls and the outer race and the interrupted inner race defined by the three spaced pockets. In other words, the breaker plate assembly has a three-point support provided by the three balls 58, 59 and 60.

One of these balls, the ball 58 is yieldingly urged against the outer race thereby causing the other two balls to be yieldingly urged against the outer race. This action is due to the spring 68 that takes up all lost-motion between the circuit breaker plate assembly and the outer race, so that the plate is supported laterally without any play, while at the same time the plate assembly is permitted to be rotated concentrically with respect to the ignition timer cam and with the minimum of frictional resistance. This is very essential, because the circuit interrupter must cooperate with the cam in the intended manner regardless of the angular adjustment of the plate assembly with respect to the cam. Furthermore, since each of the balls 58, 59 and 60 is confined yieldingly between angularly arranged surfaces due to the action of the spring 68, axial end play of the plate is taken up without introducing any undesirable friction. Consequently, the plate assembly is supported with substantially perfect rigidity, without introducing frictional resistance, such that would hinder its automatic control by a sensitive instrument, such as a device responsive to engine intake suction.

In order to facilitate insertion and removal of the breaker plate assembly with respect to the housing 20, three vertical grooves 70, 71 and 72 are formed in the inner wall of the housing so as to extend from the edge thereof to intersect the groove 65 forming the outer race. These vertical grooves are spaced for coincidence with the balls 58, 59 and 60 respectively, but are so angularly displaced about the housing wall as to be out of registry with the respective balls while the plate assembly occupies any position within its range of normal angular movement. That is, while the plate assembly is coupled with the suction responsive device as illustrated in Figs. 2 and 6, movement of the plate assembly by the suction responsive device will never bring the balls into registry with the vertical grooves. Once the plate assembly is completely assembled with housing and suction responsive device, it will be necessary in order to withdraw the plate assembly from the housing, to disconnect the linkage between the suction device and the plate assembly. When this has been done, the plate assembly may be rotated to a point beyond the normal range of movement until the balls are in registry with the grooves, substantially as shown in Figs. 12 and 14, under which relation only is it possible to withdraw the breaker plate assembly. If that procedure is not followed, it then becomes necessary to separate the plates 55 and 57 by withdrawing

the screws 56, or perhaps remove the screws 56 and take out the assembly part by part.

In order to insert the plate assembly, the balls are placed in their respective pockets, and arranged with respect to the housing 20, that the balls will coincide with the vertical grooves, whereupon the plate assembly may be inserted axially of the housing, with the balls traveling along the vertical grooves until they rest in the outer race 65. The plate assembly is then rotated to bring about the coupled relation of the plate assembly and the link 112. This coupling causes the balls to move along the outer race and destroy their registry with vertical grooves.

The device responsive to engine intake suction hereinafter known as the vacuum-responsive unit will now be described with reference to Figs. 2 and 5 to 9. A flexible diaphragm 80 is clamped at its peripheral edge between the flanges 81 and 82 of cup-shaped members 83 and 84, respectively, the flange 82 being crimped around the flange 81 as indicated at 82a in Fig. 6. The member 84 is secured by bolts 85 and nuts 86 to a wall 97 of a bracket 90, shown in detail in Figs. 7 and 8. Bracket 90 is secured by screws 91 passing through holes 92 in the bracket to the ignition timer housing 20. The part 84 may not bear directly against the wall 97 of the bracket 90, but against an intermediate spacing, range plate 100. As shown particularly in Fig. 9 the member 84 and the range plate 100 and the wall 97 of the part 90 are fixed together in a predetermined relation by providing the range plate 100 with projections 101 that mate with suitably spaced holes 89 in the member 84. The operation of providing the plate 100 with the projections 89 causes said plate 100 to be provided with recesses 102 in alignment with the projections 101 and adapted to receive suitably spaced projections 93 integral with the wall 97 of the bracket 90.

A rivet 110 passes through the diaphragm 80 and secures thereto a cup washer 111 and a link 112 that passes through openings 113, 114 and 115, provided respectively by the parts 84, 100 and 90. The link 112 is provided with a hole at its right-hand end, as viewed in Fig. 6 or at its upper end as viewed in Fig. 2, which hole receives a stud 116 attached to the plate 55. Link 112 is also provided with a neck 117, wide enough to be received within the narrower portion 114a of the opening 114 of part 100, shown in Fig. 10, and within the narrower portion 115a of the opening 115 in wall 97 of bracket 90. The neck 117 of link 112 is defined by notches 118, shoulders 119 and shoulders 120. The shoulders 119 engage the right-hand side of the wall 97 of bracket 90, as viewed in Fig. 6, and the shoulders 120 may engage the left-hand side of the wall of plate 100 as viewed in the same figure, or the opposite side of the wall 97 as viewed in Fig. 5a. The plate 100 may be one of a series of interchangeable plates of varying thickness. The thicker the plate the shorter the range of movement of link 112, and the thinner the plate the greater the range of movement. In fact no plate at all may be used, in which case the part 84 would be secured directly to the wall 97 of bracket 90, in which case the range of link movement would be marked by the shoulders 119 and 120 engaging either side wall of the bracket part 97 as illustrated in Fig. 5a. It is not necessary to remove the nuts 86 entirely from the bolts 85, nor to disconnect the link 112 from the stud 116 which could be done only by removing the plate 55, in order to remove one range plate 100 and to sub-

stitute another. All that is required is to loosen the nut 86 sufficiently to disengage the parts 84, 100 and 90 from interlocking relations shown in Fig. 9, whereupon the range plate 100 may be withdrawn. This withdrawal of plate 100 is permitted due to the fact that the plate 100 is not provided with round or closed holes for receiving the bolt shanks and link, but with notches 122, 123 and 124. Due to the fact that the opening 114 and notches 122 and 123 as not completely surrounded by metal, but open out through the notches, the plate 100 may be passed between and taken from the interposed relation between the parts 84 and 90. The withdrawal of the range-limiting plate 100 of course permits the bolts 85 to remain in position. Preferably the bolts 85 are permanently and nonrotatably secured to the part 84 so that they function as studs projecting through the holes 95 provided for them in the wall 97 of the bracket 90. It is apparent that the bracket 90 conceals the link 112 and covers the opening 125 provided by the housing 20 for receiving the link.

The member 63 and the diaphragm 80 provide a suction chamber which is connected with the intake manifold of the engine by suitable piping, not shown, through the agency of a coupling 130 threaded into a bushing 131 permanently attached to the part 83. Partial vacuum in the engine intake will effect an unbalance of atmospheric pressure acting upon the right-hand side of the diaphragm 80, thereby causing it to move toward the left in Fig. 6, thereby producing clockwise rotation of the plate assembly. The direction of rotation of the cam 26 being counterclockwise, the timing of the ignition will be advanced as suction increases. When suction decreases a spring 133 confined between the coupling 120 and the washer 111 urges the diaphragm 80 toward the right in Fig. 6 causing the plate 55 to be rotated counterclockwise to produce a more retarded spark.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Ignition apparatus for an internal combustion engine comprising, in combination, a housing, a circuit breaker, a cam for operating the breaker, a breaker plate supporting the circuit breaker, said housing having an annular groove, means supporting the breaker plate including a plurality of balls, means spring urging the balls into the housing groove, and means for varying the angular relation between the cam and the breaker by rotating the plate in the groove.

2. Ignition apparatus for an internal combustion engine comprising, in combination, a timer housing having an annular groove, a circuit breaker, a cam for operating the breaker, a breaker plate, balls supporting the plate that operate in the groove, a second plate secured to the breaker plate, and having equally spaced pockets for the accommodation of the balls, spring means urging the balls into the housing groove, and means for varying the angular relation between the cam and the breaker by rotating the breaker plate on the ball support.

3. Ignition apparatus for an internal combustion engine comprising, in combination, a timer housing having an annular groove, a circuit breaker, a cam for operating the breaker, a

breaker plate, balls seated in the groove formed in the distributor housing, a second plate fastened to the breaker plate and having deformed portions for each ball, a spring urging one of the balls into the groove whereby all of the balls are wedged between the deformed portion of the plate and the housing groove to eliminate axial and lateral lost motion.

4. Ignition apparatus for an internal combustion engine comprising, in combination, a timer housing having an annular groove, a circuit breaker, a cam for operating the breaker, a breaker plate, balls upon which the plate may turn, and operating in the housing groove, said breaker plate being superimposed upon a second plate having deformations for cooperation with said breaker plate to form races for the balls, means for urging at least one of said balls into said grooves whereby the breaker plate will be secured against lateral movement.

5. Ignition apparatus for an internal combustion engine comprising, in combination, a timer housing having an annular groove, a circuit breaker, a cam for operating the breaker, a breaker plate, a series of balls operating in the groove for supporting the plate, a second plate secured to the underside of the breaker plate, said second plate having angularly deformed portions located along the side thereof and adjacent the breaker plate, thus forming tapering recesses for the reception of said balls, spring means urging the balls into the groove of the housing, thus preventing any lateral movement of the breaker plate with respect to the cam axis.

6. Ignition device for an internal combustion engine comprising, in combination, an ignition timer housing having a groove in the inner wall, a breaker plate, a ball bearing interposed between the said housing and the breaker plate, and a spring connected at one end to the breaker plate, said spring urging and maintaining said ball in proper seating engagement with the housing groove whereby the breaker plate will be axially and laterally supported with the minimum of lost motion.

7. An ignition device for an internal combustion engine comprising, in combination, a housing, a breaker plate, a circuit interrupter supported by the breaker plate, a rotatable cam for operating said interrupter, a drive shaft for operating the cam, a bearing member adapted to be secured to the engine, and in which the drive shaft is journaled, said bearing member providing a mounting for the housing, a ball bearing interposed between the housing and the breaker plate, ball retainers provided by the breaker plate, spring means secured at one end to the breaker plate for urging the ball bearing into engagement with the housing groove, and means attached to the housing and connected with the breaker plate for rotating the breaker plate relative to the drive shaft and housing.

8. An ignition device for an internal combustion engine comprising, in combination, a housing having an inner wall, said wall being grooved to provide an outer ball race, a plate within said housing, having spaced recesses adjacent its outer edge, a ball bearing in each recess, a breaker plate secured to the first mentioned plate, and lips on the breaker plate fitting upon the ball bearings carried by said first mentioned plate, said lips and recesses providing ball retainers carried by the plates, and each having a ball bearing which engages the annular wall groove of the housing and laterally supports the plate, a circuit inter-

rupter on the plate, a member for operating said interrupter, and means extending into the housing and engaging the plate for rotatably adjusting the plate to vary the angular relation between the interrupter and its operating member.

9. An ignition device for an internal combustion engine comprising, in combination, a cup-shaped housing having an annular wall provided with an inner groove, a breaker plate and a sub-plate having a shiftable support from the housing, said support including a plurality of ball bearings, pockets provided by cooperating deformations in the breaker plate and sub-plate for substantially enclosing a ball in each pocket, and spring means located in one of the pockets for forcing the balls outwardly to seat in the housing groove, and means securing the breaker plate to the sub-plate whereby the breaker plate is locked within the housing by the ball bearings and prevented from removal until the plates are separated.

10. An ignition device for an internal combustion engine, comprising in combination, a cup-like housing, an engine operated shaft having a journal bearing in the housing, a circuit breaker adapted to be operated by the shaft, a breaker plate, means supporting the plate independent of the shaft for rotation relative to the shaft and housing including ball bearings situated in spaced relation about the periphery of the plate, an outer race for the balls comprising a grooved member supported by the housing wall, and means including parts of the plate forming an inner race for the balls and for maintaining the balls within the outer race whereby the breaker plate is secured within the housing and maintained against axial and lateral movement relative to the shaft.

11. An ignition device for an internal combustion engine, comprising in combination, a cup-like housing, an engine operated shaft having a journal bearing in the housing, a circuit breaker adapted to be operated by the shaft, a breaker plate, ball bearings supporting the breaker plate independent of the shaft and having an outer race provided by the housing inner wall, a movable element for operating the breaker plate, means operatively connecting the movable element to the breaker plate, a sheet metal bracket supporting the movable element and secured to the housing, said connecting means having notched portions cooperating with the bracket for defining the range of movement of the breaker plate, and a spacer insertable between the bracket and chamber for varying the range of breaker plate movement.

12. An ignition device for an internal combustion engine, comprising in combination, a cup-like housing, an engine operated shaft having a journal bearing in the housing, a circuit breaker adapted to be operated by the shaft, a breaker plate, ball bearings supporting the breaker plate independent of the shaft and having an outer race provided by the housing inner wall, a movable element, means operatively connecting the movable element to the breaker plate, and a sheet metal bracket supporting the movable element and secured to the housing so as to substantially enclose the operative connection between the movable element and breaker plate.

13. Ignition apparatus for an internal combustion engine comprising, in combination, a timer housing having an annular groove, a circuit breaker, a cam for operating the breaker, a plate assembly supporting the circuit breaker, balls operating in the housing groove upon which the

plate assembly may turn, said plate assembly having circumferentially spaced race-ways for the balls, means for urging at least one of said balls into said grooves whereby the breaker plate will be secured against lateral movement.

14. Ignition apparatus for an internal combustion engine comprising, in combination, a timer housing having an annular groove, a circuit breaker, a cam for operating the breaker, means including a breaker plate for revolvably supporting the circuit breaker from the housing groove, balls disposed in spaced relation along the groove, means provided by the breaker plate forming race-ways for each of the balls and means for urging the balls into the housing groove and maintaining the revolvable support against displacement relative to the housing.

15. An ignition device for an internal combustion engine comprising, in combination, a housing, a breaker plate, a circuit interrupter supported by the breaker plate, a rotatable cam for operating said interrupter, a drive shaft for operating the cam, a bearing member adapted to be secured to the engine, and in which the drive shaft is journaled, said bearing member providing a mounting for the housing, a ball bearing support for the breaker plate comprising, an outer ball race supported from the housing wall, an inner ball race supporting the breaker plate, and a plurality of spaced balls having a bearing in both races.

16. In an ignition timer, a housing having a recess therein, friction reducing bearings extending into said recess, a retainer holding said bearings in spaced relation, a breaker plate, and means for supporting said breaker plate upon said bearings.

17. In an ignition timer, a housing having a bearing surface formed therein, friction reducing bearings in contact with said surface, a breaker plate, depending flanges carried by said plate, and a channeled bearing surface formed upon said flanges to cooperate with said bearings.

18. In an ignition timer, a housing having a recess therein, friction reducing bearings extending into said recess, a retainer holding said bearings in spaced relation, a breaker plate, and flanges carried by said plate cooperating with said bearings to form a support for said plate.

19. In an ignition timer, a housing, an adjustable breaker plate, and friction reducing bearings supporting the breaker plate laterally and axially from the housing side wall comprising, an outer raceway provided by a groove in the housing wall, an inner raceway provided at the periphery of the breaker plate, and balls disposed between the housing and plate and engaging both raceways.

20. In a ball bearing timer the combination comprising, a cylindrical housing wall internally grooved to provide a race way, a cam mounted on a shaft for rotation within the housing, a breaker plate providing an inner race way, a series of ball bearings disposed in both race ways for supporting the breaker plate from the housing wall, said cylindrical housing wall having vertical grooves in its inner surface extending from the edge of the wall to the race way whereby the ball bearings may be inserted in the race way of the breaker plate at the edge of the housing wall and thence depressed in assembled relation, so that the ball bearings pass down the vertical grooves to the outer race way, said vertical grooves being circumferentially displaced from the operative position of the ball bearings, and means attached to the breaker plate for rotating

the breaker plate relative to the housing wall, and for maintaining the ball bearings out of registry with the vertical grooves.

21. In an ignition timer the combination comprising, a housing having a cylindrical wall, said cylindrical wall having an internal peripheral groove spaced from the terminating edge of said housing, and a plurality of equally spaced vertical grooves leading from the edge of the housing to said peripheral groove, a breaker plate having a flat bottom wall and flanges, said flanges providing circumferentially extending groove portions and adapted when disposed within the housing to confine ball bearings within the housing groove and the breaker plate grooves, and means for effecting limited rotation of the breaker plate relative to the housing wall and out of registry with the vertical grooves.

22. In a ball bearing timer the combination comprising, a cylindrical housing wall internally grooved to provide a race way, a cam mounted on a shaft for rotation within the housing, a breaker plate providing an inner race way, a series of ball bearings disposed in both race ways for supporting the breaker plate from the housing wall, said cylindrical housing wall having a passage connecting with the outer race way by which the ball bearings may be passed to position and be disposed between the race ways, said passage being angularly offset, from the ball position in the working assembly.

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