Dec. 17, 1935. C. H. DAVIS, JR 2,024,630

IGNITION APPARATUS

Original Filed June 20, 1931

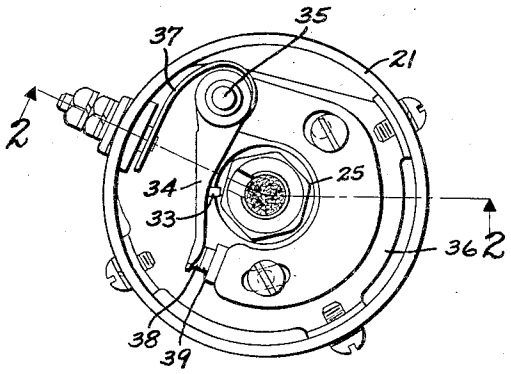


Fig. 1

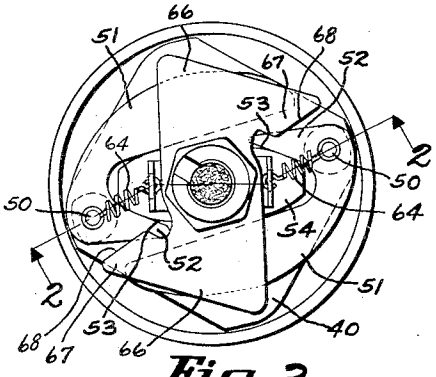


Fig. 3

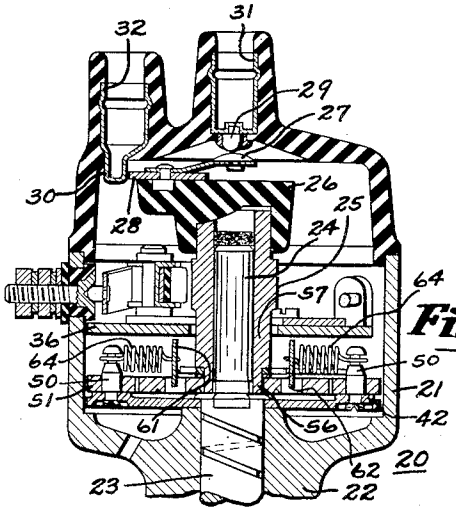


Fig. 2

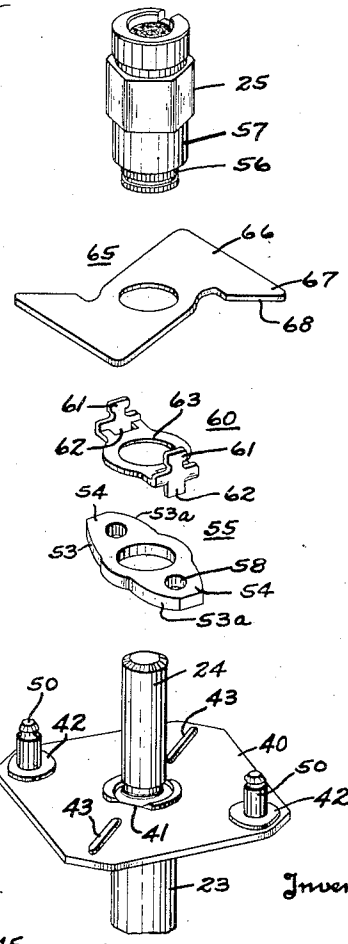


Fig. 4

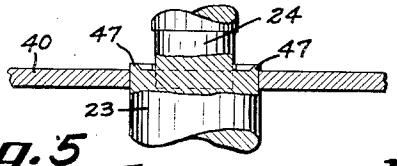


Fig. 5

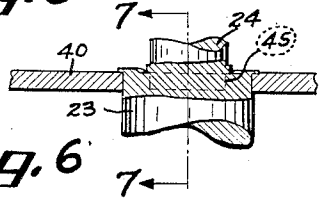


Fig. 6

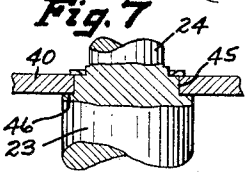


Fig. 7

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2,024,630

IGNITION APPARATUS

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Application June 20, 1931, Serial No. 545,667
Renewed May 9, 1934

27 Claims. (Cl. 200—31)

This invention relates to ignition apparatus for internal combustion engines and more particularly to the engine speed responsive mechanism for controlling the relation between the ignition timer cam and the engine part which drives it, whereby to vary the timing of the ignition relative to the operation of the engine.

It is among the objects of the present invention to provide an ignition apparatus which is efficient and reliable in operation and can be produced at a low cost. In this connection, a further object is to minimize friction between the weights and weight carrying plate, and to provide improved means limiting lateral movement of the weights with respect to the plate. Another object is to provide improved means and method for securing the weight plate to the drive shaft.

A further object is to produce an ignition apparatus which uses reversible parts, whereby the ignition apparatus can be adapted to either direction of rotation of its driving shaft. A further object is the provision of relatively movable stops cooperating with relatively stationary stops of the apparatus for limiting the maximum advance of the ignition apparatus. The relatively movable stops are adapted to be assembled with the apparatus in different degrees of angular location to suit the particular engine with which the ignition apparatus is to be used. In this manner the number of different parts required for producing apparatus for different engines will be reduced to a minimum.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of one form of the present invention is

In the drawing:

Fig. 1 is a plan of a distributor embodying the present invention with the distributor cap and rotor removed.

Fig. 2 is a vertical longitudianl sectional view of the present invention taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a plan view showing the timer cup with the automatic advance mechanism positioned therein.

Fig. 4 is a detached perspective view of parts of the automatic advance mechanism prior to assembly.

Figs. 5 and 6 are fragmentary sectional views of parts shown in Figs. 2 and 4 on an enlarged scale to show details of construction and assembly of parts.

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6.

Referring to the drawing, 20 designates a distributor housing comprising a timer cup 21 and a shank 22 providing a bearing for an ignition timer drive shaft 23. The shaft 23 has a reduced portion 24 providing a journal for a timer cam 25 mounted thereon and free to rotate relative thereto. The lower end of the shaft 23 is connected to mechanism (not shown) to drive the shaft 23. The cam 25 is drivingly connected with and supports an ignition distributor rotor 26 carrying a center contact 27 and a distributing segment 28. The center contact 27 cooperates with a central, stationary distributor contact 29; and the segment 28 cooperates with distributor posts 30 arranged in a circular row. The contact 29 and posts 30 respectively are connected with metal sockets 31 and 32 respectively adapted to receive terminal clips (not shown) by which wires may be secured thereto.

The cam 25 cooperates with a rubbing block 33 of a circuit breaker 34 pivoted upon a stud 35 carried by a circuit breaker plate 36 mounted within the cup 21. A leaf spring 37 urges the rubbing block 33 toward the cam 25 and serves to conduct current to the circuit breaker 34 and a movable contact 38 carried thereby. When the cam is out of engagement with the rubbing block, the spring 37 urges the contact 38 into engagement with the stationary contact 39.

Referring to Figs. 2, 4 to 7 inclusive, a weight plate or supporting base 40 which is preferably formed by punching from thin sheet metal, hence cannot be held or attached firmly to the timer drive shaft 23 by the conventional method of forcing it over a knurled portion of the drive shaft.

The present invention provides a weight plate 40 formed with a central opening or hole having parallel flat surfaces 41, a pair of integrally formed bosses 42 and a pair of ridges 43 which are struck up from the upper surface of the plate 40. The opening with the flat surfaces 41 of the plate 40 is adapted to fit over a similarly formed portion of the drive shaft 23. As shown more clearly in Figs. 5, 6, and 7 the shaft 23 is provided with flat portions 45 to receive the flat surfaces 41 of the opening of the plate 40. The flats 45 upon the shaft 23 form shoulders 46 on the shaft 23 upon which the plate 40 rests. A pair of diametrically opposed lips 47 provided on the shaft 23 are deformed or staked over the plate 40 to hold the plate upon the shoulders 46 of the shaft 23 as is clearly shown in Fig. 7.

The plate 40 carries studs 50 held firmly on the bosses 42 in any suitable manner. The posts or studs 50 provide pivots for the weights 51 that rest upon shoulders 42 and ridges 43 provided by the plate 40. This construction tends to reduce the surface friction which would retard the movement of a weight 51 about its pivot 50. Each weight has a lever arm 52 cooperating with a surface 53 on an arm 54 of a spider 55. The spider is forced upon a knurled shank 56 of a hub 57 formed integral with the cam 25. The arms 54 are provided with camming surfaces 53 and 53a. The surfaces 53 and 53a of the arms 54 are symmetrical and the pivot posts 50 are diametrically opposite each other so that the weights 51 may be mounted upon the posts 50 either side up upon the weight plate. Thus with the surfaces 53 and 53a of the same contour with respect to camming actions on each side of the arms 54, the lever arms 52 of the weight 51 can engage either side of the arms 54 of the spider 55 to provide for either clockwise or counter-clockwise rotation of parts as desired.

The spider 55 can be provided with surfaces 53 and 53a of different contour to provide for advancing the spark according to two different speed-spark advance curves in order to provide ignition timing for two different types of engines. In such case the spider must be assembled on the timer cam member with due regard for the direction of rotation of the timer cam.

Each arm 54 of the spider cam 55 is provided with an aperture or recess 58. A washer 60 of novel construction is provided with integral upwardly projecting ears 61, downwardly projecting ears 62, and an aperture 63 to extend over the shank 56 of the hub 57. The ears 62 are adapted to protrude into the recesses 58 of the arms 54 anchoring the washer upon the spider cam 55. The ear 61 cooperates with an adjacent stud 50 for receiving the ends or eyes of one of a pair of springs 64, each of which tends to urge the surface 53 of an arm 54 toward a lever arm 52 of a weight 51.

A Z-shaped retainer or hold-down plate 65 is secured upon the knurled shank 56 of the hub portion 57 adjacent the washer 60. The retainer plate is provided with radially extending wings 66. The wings have ears 67 provided with stop-surfaces 68 adapted to engage studs 50 to limit the advance movement of the cam 25 caused by centrifugal force swinging out the weights 51 toward the periphery of the plate 40 which will cause the spider arm 55, the plate 65 and the cam 25 to be rotated in a clockwise direction to advance the ignition as the speed of the engine increases as viewed in Fig. 3. The wings 66 with the ears 67 project above the weights and are so constructed that each wing 66 extends over the heel portion of one weight and the toe portion of another weight in any position thereof thereby keeping the weights from rocking on their pivot posts. The wings 66 and ears 67 limit the upward movements of the weights with respect to the plate 40.

The elements 65, 60, and 55 are secured to the knurled shank portion 56 of the cam hub 57 by press fitting the retainer plate 65 and spider cam thereon with the washer 60 interposed between them. The washer 60 is anchored to the spider cam 55 by the downwardly projecting ears 62 extending into the recesses 58 in the arms 54 forming an assembly with the cam 25 having its hub 57 mounted upon the extension 24 of the shaft 23 and free to rotate relative thereto. The retainer plate 60 can be assembled with the cam assembly in various positions of angular adjustment within certain limits thereby permitting the use of plate 60 to be assembled with various ignition apparatus requiring different ranges of ignition advance and retard.

As viewed in Fig. 3, the springs 64 are connected to the upwardly projecting ears 61 and adjacent posts 50 in which the spring tends to urge the cam assembly in a counter-clockwise rotation relative to the plate 40. As the speed of the shaft increases, centrifugal force acting upon the weights 51 will overcome the resistance of the springs 64 causing these weights to rotate counterclockwise about their pivots 50 thereby causing the arms 52 to rock along the surfaces 53 of the arms 54 thus causing the cam assembly to move in a clockwise rotation relative to the plate 40, to advance the timing of ignition with increasing speed of the shaft 23. The advance movement of the cam in a clockwise rotation is limited by the stop-surfaces 68 of the ears 67 engaging their respective pivot post 50. As the speed decreases, the springs 64 overcome centrifugal force acting upon the weights 51 to cause the weights to move toward the cam assembly thereby causing the weights 52 to move in a clockwise direction relative to the posts 50 whereby the ignition timing will be retarded as the speed decreases.

While the form of 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 circuit breaker and a cam for operating the same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising, a weight plate driven by the shaft, weights movably supported by the plate, cooperating lever arms provided by the cam, spring means for restraining outward movement of the weights relative to the shaft; and means for securing the weight plate to that portion of the shaft which is of larger diameter and is immediately adjacent that portion of the reduced diameter, said means comprising angular ledges provided adjacent the end of the shaft portion of larger diameter, said ledges being defined each by a portion at right angles to the shaft axis and by a flat portion parallel to the shaft axis, said weight plate being provided with a hole which receives the end of the portion of larger diameter of the shaft, said weight plate hole being defined by flat surfaces which fit with the flat surfaces of the shoulders of the shaft which are parallel with the axis of the shaft, one side of the plate resting upon the shaft shoulder surfaces which are at right angles to the axis of the shaft, and means provided by the shaft for retaining the weight plate upon shoulders of the shaft.

2. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the

same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising, a weight plate driven by the shaft, weights movably supported by the plate, cooperating lever arms provided by the cam, spring means for restraining outward movement of the weights relative to the shaft; and a weight retainer plate attached to the hub of the cam and having end portions, each of said end portions covering a section of all of the weights in any position thereof and cooperating with stop means to limit the outward movement of said weights.

3. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising a weight plate driven by the shaft, weights movably supported by the plate, cooperating lever arms provided by the cam, spring means for restraining outward movement of the weights relative to the shaft; and means extending over said weights for engaging a stop carried by the weight plate to limit axial and outward movements of said weights from normal position.

4. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising a weight plate driven by the shaft, weights movably supported by the plate, cooperating lever arms provided by the cam, spring means for restraining outward movement of the weights relative to the shaft; and a hold-down plate carried by said cam extending over said weights to limit sidewise movement of the weights relative to their pivots and said plate having stop surfaces cooperating with said weight pivots to limit outward movements of said weights.

5. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising, a weight plate driven by the shaft, a spider cam having symmetrical arms secured to said cam; weights having arms movably supported by said weight plate, said weights adapted to be mounted either side up upon said weight plate to allow the weight arms to cooperate with either side of the spider arms; and a weight retainer plate having symmetrical wings, said plate adapted to be mounted on the cam with either side up with said wings extending over a plurality of weights.

6. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising, a weight plate driven by the shaft, a spider having symmetrical arms secured to said cam; weights having projecting arms movably supported by said weight plate, said weights adapted to be mounted either side up upon said weight plate to allow the weight arms to cooperate with either side edges of the spider cam arms; a stop on said weight plate; and a weight hold-down plate having stop surfaces so located with respect to the stops of the weight plate as to permit the hold-down plate to be reversed to allow the stop surfaces to contact with either side of the stops on the weight plate.

7. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a shaft for driving the cam and having an extension of reduced diameter upon which the hub of the cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising a weight plate driven by the shaft, weights movably supported by the plate, cooperating lever arms provided by the cam, spring means for restraining outward movement of the weights relative to the shaft; and a weight retainer plate having a plurality of wing portions extending over a section of each weight and operable to limit axial movement of said weights upon their pivots and one of said wing portions cooperating with one of said weight pivots to limit the angular relation between the cam and drive shaft and a weight retainer plate having a plurality of wing portions, one of said wing portions cooperating with a stop to limit the angular movement between the cam and drive shafts.

8. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker; a cam for operating said circuit breaker, said cam having a hub with a shank portion; a shaft for driving the cam and having an extension of reduced diameter upon which the shank and hub of said cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising a spider having arms secured to the shank portion of said cam, a weight plate driven by the shaft, weights cooperating with said arms and movably supported by said weight plate, spring means for restraining outward movement of the weights relative to the shaft and a weight retainer plate located on the shank of the cam.

9. Ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker; a cam for operating said circuit breaker, said cam having a hub with a shank portion; a shaft for driving the cam and having an extension of reduced diameter upon which the shank and hub of said cam is journalled; speed responsive means for connecting the cam and drive shaft for varying the angular relation between them, said means comprising a spider having arms secured to the shank portion of said cam, a weight plate driven by the shaft, weights cooperating with said arms and movably supported by said weight plate and a retainer plate interposed between the spider and the shoulder of the timer cam hub joining the main portion of the hub with the shank of lesser diameter.

10. An ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a cam drive shaft in alignment with the cam; and a speed responsive means for connecting shaft and cam for varying the angular relation between them, said means comprising a weight plate carrying movable weights, a spider member carried by the cam against which the weights operate; and an integral sheet metal member located on the cam hub adjacent one side of the spider member, said member providing anchoring means for springs which connect the arms of said spider member with said weight plate.

11. An ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a cam drive shaft in alignment with the cam; and a speed responsive means for connecting shaft and cam for varying the angular relation between them, said means comprising a weight plate carrying movable weights, a spider member carried by the cam against which the weights operate; and an integral sheet metal member located on the cam hub adjacent one side of the spider member, said member providing anchoring means for springs which connect the arms of said spider member with the pivots for the movable weights.

12. An ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a cam drive shaft in alignment with the cam; and a speed responsive means for connecting the shaft and cam for varying the angular relation between them, said means comprising a weight plate carrying movable weights, a cam spider having arms provided with locating recesses, said spider carried by the cam hub against which the weights operate; an integral sheet metal member located on the hub of the cam adjacent the spider member, said member having integral projections extending into said locating recesses of the spider member for anchoring said member to the spider member and said member having integral ears, and spring members attached to said ears and to the weight plate.

13. An ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a cam drive shaft in alignment with the cam; and a speed responsive means for connecting the shaft and cam for varying the angular relation between them, said means comprising a weight plate carrying movable weights, a cam spider attached to the hub of the cam and located adjacent said weight plate to cooperate with the weights, a spring anchor plate located upon the cam spider, a weight retainer plate located upon the spring anchor plate, said spring anchor plate spacing said retainer plate slightly from the weights, and springs connecting the weight plate and anchor plate.

14. An ignition apparatus for an internal combustion engine comprising in combination; a circuit breaker and a cam for operating the same; a cam drive shaft in alignment with said cam; a speed responsive means connecting the cam and shaft for varying the angular relation between them, said means comprising a weight plate driven by the shaft, weights movably supported by the plate, cooperating lever arms provided by the cam, spring means for restraining outward movement of the weights relative to the shaft, and means for reducing and maintaining substantially constant the friction between the weight plate and the weights, said means comprising integral shoulders on the weight plate to which studs are attached to movably support the weights, a plurality of ridges provided by the weight plate, a plurality of lips provided by the drive shaft extending through and above the weight plate retaining said weight plate upon said cam drive shaft, said shoulders, ridges and lips providing bearing surface of small contact area and bringing the weights and the cam arms in the same plane when said speed responsive means is assembled thereby reducing and keeping substantially constant the friction between said weights and said weight plate and between said lever arms and said lips respectively.

15. In an ignition apparatus for internal combustion engines, the combination comprising; a driven shaft; a drive shaft; and speed responsive means for connecting the driven and drive shaft for varying the angular relation between them, said means comprising a weight plate carried by the drive shaft, a weight pivotally supported upon said plate, an arm connected to said driven shaft and cooperating with said weight, spring means for restraining outward movement of said weight, and means carried by the driven shaft for retaining the said weight upon its pivot and said means cooperating with the pivot of said weight for limiting the angular relation between the driven and drive shafts.

16. In an ignition apparatus for internal combustion engines, the combination comprising; a driven shaft; a drive shaft; and speed responsive means for connecting the driven shaft and drive shaft for varying the angular relation between them, said means comprising a weight plate carried by the drive shaft, weights pivotally supported upon said plate, arms connected to said driven shaft and cooperating with said weights, a washer anchored to said arms and providing provisions for springs which connect the arms with the pivots of said weights, said springs restraining outward movement of the weights relative to the plate; and a weight retainer plate carried by the driven shaft and having end portions, said end portions disposed over a section of all of the weights limiting axial movement of the weights upon their pivots and said end portions cooperating with said pivots to limit the outward movements of said weights.

17. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pivotally mounted weight adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, and means carried by the driven shaft and positioned above said weight for preventing any movement of said weight axially of the drive shaft during the first mentioned movement of said weight, said last named means being so constructed to act as a stop to limit the movement of said weight effected by centrifugal force.

18. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pivotally mounted weight adapted to be moved in a plane normal to the

axis of the drive shaft by centrifugal force; an arm secured to said driven shaft and cooperating with the weight during the movement of the latter to effect angular movement of the driven shaft, and a member carried by the driven shaft and positioned above said weight so as to hold the weight upon its pivot, said last named member being so constructed as to also limit the movement of said weight effected by centrifugal force.

19. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pivotally mounted weight adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, means for opposing the outward movement of said weight under the influence of centrifugal force, and a member carried by the driven shaft and positioned above said weight so as to hold the weight against movement axially of the drive shaft during the first mentioned movement of said weight, said last named member being so constructed as to also positively limit the movements of the weight as effected by centrifugal force.

20. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pivotally mounted weight adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, a spring for yieldingly opposing the outward movement of said weight under the influence of centrifugal force, and a member carried by the driven shaft and positioned above said weight so as to hold the weight against movement axially of the drive shaft during the first mentioned movement of said weight, said last named member being so constructed as to positively limit the movements of the weight as effected by centrifugal force.

21. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a weight plate operated by the drive shaft, a weight pivotally supported on said plate and adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, and a member carried by the driven shaft and positioned above said weight so as to hold the weight against movement axially of the drive shaft during the pivotal movement of said weight, said last named member being so constructed as to limit the pivotal movement of said weight.

22. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a weight plate operated by the drive shaft, a weight pivotally supported on said plate and adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force as the drive shaft is rotated, an arm carried by the driven shaft and adapted to be engaged and moved by the weight during its pivotal movement to effect angular motion of the driven shaft relative to the drive shaft, and a member carried by the driven shaft and positioned above said weight so as to hold the weight against movement axially of the drive shaft during its pivotal movement, said member being so constructed as to positively limit the pivotal movements of the weight.

23. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pivotally mounted weight adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, an arm secured to said driven shaft and cooperating with the weight during the movement of the latter to effect angular movement of the driven shaft, a spring for yieldingly opposing the pivotal movement of the weight under the influence of centrifugal force and for holding the weight in engagement with a surface of said arm whereby the pivotal movement of said weight is caused to move the arm and vary the angular position of the driven shaft with respect to said drive shaft, and a member carried by the driven shaft and positioned above said weight so as to hold the weight against movement axially of the drive shaft during its pivotal movement, said member being so constructed as to also positively limit the pivotal movements of said weight.

24. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pair of pivotally mounted weights adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, and a single member carried by the driven shaft and positioned above said weights so as to be operable to prevent any movement of either of said weights axially of the drive shaft during their pivotal movement, said member being so constructed as to also positively limit the movement of both of said weights as effected by centrifugal force.

25. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pair of pivotally mounted weights adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, an arm carried by the driven shaft and having surfaces adapted to be engaged by both said weights during their pivotal movement whereby the angular position of the driven shaft relative to the drive shaft is varied, and a single member carried by the driven shaft and positioned above said weights so as to be operable to prevent any movement of either of said weights axially of the drive shaft during their pivotal movement, said member being so constructed as to also positively limit the movement of both of said weights as effected by centrifugal force.

26. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a pair of pivotally mounted

weights adapted to be moved in a plane normal to the axis of the drive shaft by centrifugal force, arms carried by the driven shaft and having surfaces adapted to be engaged by both said weights during their pivotal movement, whereby the angular position of the driven shaft relative to the drive shaft is varied, resilient means for opposing the pivotal movement of said weights and for holding said weights in engagement with surfaces on said arms, and a single member carried by said driven shaft and positioned above said weights so as to be operable to prevent any movement of either of said weights axially of the drive shaft during their pivotal movement, said member being so constructed as to positively limit the pivotal movement of said weights.

27. In an ignition apparatus for internal combustion engines the combination of, a driven shaft, a drive shaft, speed responsive means for connecting the driven and drive shafts and for varying the angular relation between them, said means comprising a weight plate operated by the drive shaft and having two pins projecting therefrom, a pair of weights pivotally mounted on said pins and adapted to be moved in a plane normal to the axis of the drive shaft upon rotation thereof, and a single member carried by the driven shaft and positioned above said weights so as to prevent any movement of either of said weights axially of the drive shaft during their pivotal movement, said member having surfaces thereon adapted to engage said pins to positively limit the pivotal movement of the weights.

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