July 25, 1939. M. MALLORY 2,167,366

CENTRIFUGAL ADVANCE MECHANISM

Original Filed Jan. 4, 1937 2 Sheets-Sheet 1

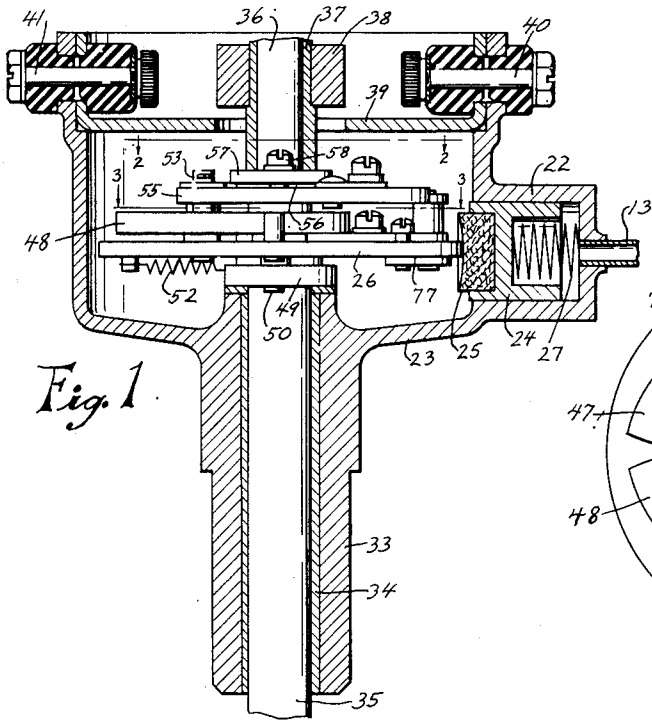


Fig. 1

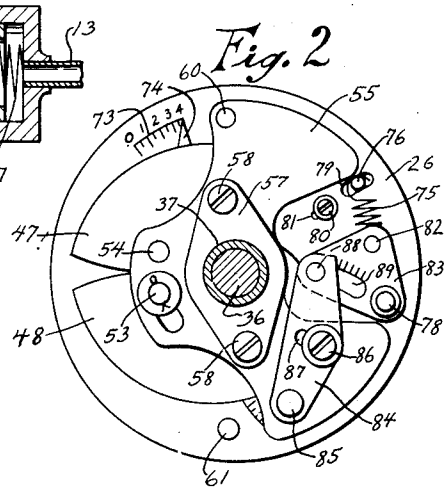


Fig. 2

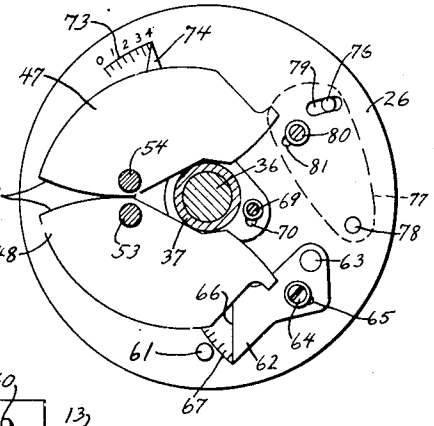


Fig. 3

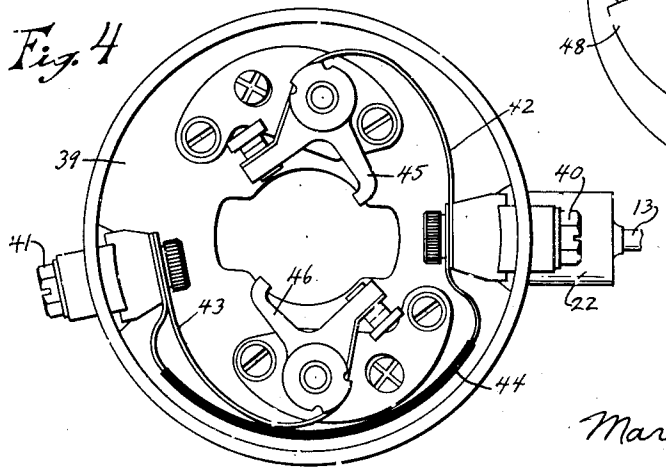


Fig. 4

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CENTRIFUGAL ADVANCE MECHANISM

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Fig. 5

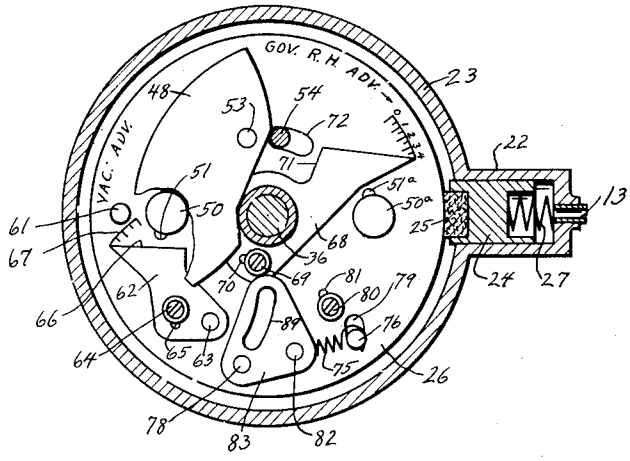


Fig. 7

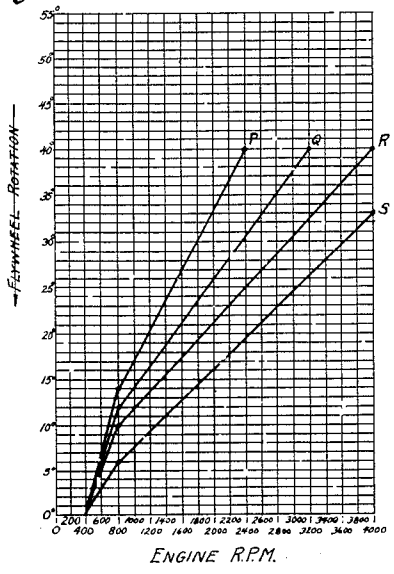
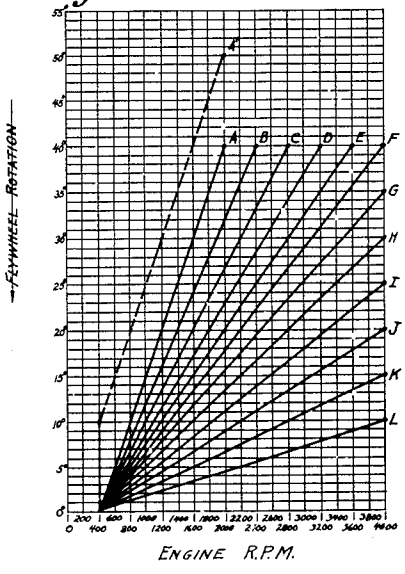


Fig. 6



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UNITED STATES PATENT OFFICE

2,167,366

CENTRIFUGAL ADVANCE MECHANISM

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Original application January 4, 1937, Serial No. 119,006. Divided and this application March 31, 1937, Serial No. 134,180.

11 Claims. (Cl. 200—31)

This invention relates to centrifugal advance mechanism which is primarily adapted for use in connection with the ignition timer of an internal combustion engine. The present application is a division of my earlier application on an Ignition timer, Serial Number 119,006, filed January 4, 1937.

In order to obtain an ideal automatic control of the timing, the spark advance must be dependent upon both speed and load. For smooth idling, an extreme retardation of the timing is necessary, but upon a slight opening of the throttle, there should be an appreciable immediate advance of the timing. Following this, there should be a further gradual advance as the speed increases, but when the engine is working under full load with wide open throttle at either low or high speeds, it is desirable to retard the advance to some extent to prevent pre-ignition.

An object of the present invention is to provide improved means for automatically advancing the time of the spark in response to a predetermined increase in speed and this speed controlled advance is herein shown in connection with the supplemental suction controlled advancing means described and claimed in the above mentioned application. The present invention, however, may be used either with or without such supplemental advancing means.

A further object of the invention is to provide convenient means for adjusting the speed controlled mechanism to adapt it to the individual timer or the individual engine with which it is used. Such adjustment may include the maximum range of speed governor advance or the rate of such advance, or both combined.

The construction of the invention, in its present embodiment, will be more particularly described in connection with the accompanying drawings, in which—

Fig. 1 is a vertical section through the timer housing, the circuit breakers and springs being omitted.

Fig. 2 is a section taken on the line 2—2 of Fig. 1.

Fig. 3 is a section taken on the line 3—3 of Fig. 1.

Fig. 4 is a plan view of the circuit breakers and plate.

Fig. 5 is a horizontal section through the timer housing above the brake plate, the latter being shown in retard position.

Figs. 6 and 7 are charts representing the governor curves resulting from various adjustments of the timer.

As illustrated in the drawings, the invention is associated with a timer located within a housing 23 formed with a shank 33 which is lined with a bushing 34 to provide a bearing for the timer shaft 35 adapted to be driven from the engine. The shaft 35 has a reduced extension 36 on which is mounted a sleeve 37 carrying the circuit breaker cam 38. A circuit breaker plate 39 fits into the housing 23 and is secured by insulated screws 40 and 41, to which the circuit breakersprings 42 and 43 are also secured. The terminal screws 40 and 41 are electrically connected by an insulated conductor 44 and the inner ends of the springs 42 and 43, which constitute parts of the primary circuit, are secured to overlapping circuit breakers 45 and 46. Since the mountings of the latter do not constitute a part of the present invention, it is not necessary to describe the same here in detail.

The sleeve 37 is formed with a flange 56 to which a governor plate 55 is clamped by means of a clamping member 57 and screws 58. A drive plate 49 is fixed to the shaft 35. A circular brake plate 26 floats on the timer shaft 35 between the plates 49 and 55.

The plate 55 and circuit breaker cam 38 are adapted to be advanced with reference to the plate 26 by the centrifugal governor mechanism, which is constructed in accordance with the present invention and which may be termed the primary timing control.

In the timer herein shown, the brake plate 26 is adapted to be held in an advanced position with reference to the drive plate 49 by a spring 52, except when it is held in a retard position by the engagement of a brake 25 with its periphery. This brake is carried by a piston 24 which operates in a cylinder 22 connected to the timer housing 23. Under certain operating conditions, the cylinder 22 is adapted to be in communication with the engine intake manifold through a conduit 13. A spring 27 holds the brake in engagement with the plate 26, except when there is sufficient vacuum in the cylinder 22 to overcome the action of this spring, thereby retracting the piston 24 and permitting an immediate advance of the plate 26 with a corresponding advance in the timing. This may be termed a supplemental or vacuum timing control and its operation is more fully discussed in my above mentioned earlier application, of which the present application is a division.

The centrifugal advance mechanism, which embodies the subject matter of the present invention, comprises two governor weights 47 and

48. One of these weights, as 48, is pivotally mounted on a pin 53 secured to the plate 26. The other weight 47 is pivotally mounted on a pin 54 which projects downwardly from the plate 55 secured to the sleeve 37. As the weights fly outwardly about their pivots 54 and 53 under the influence of centrifugal force, the edges 59 roll on each other, forcing the pivots 54 and 53 farther apart and causing an advance of the plate 55, sleeve 37 and circuit breaker cam 38 with reference to the plate 26. The extreme outward movement of the weights 47 and 48 is limited by their engagement with the pins 60 and 61 secured in the respective plates 55 and 26.

The characteristics of the spark advance curve necessary for the most economical operation vary widely in different cars and different engines, and even in the same engine at different periods of its life. This invention therefore provides for universal adjustment of these characteristics.

In order to adjustably limit the maximum advance of the governor plate 55 and cam 38 with reference to the plate 26, as controlled by the governor weights 47 and 48, an arm 68 is mounted for pivotal adjustment about the shaft 36 and is secured in its adjusted position by a clamping screw 69, which extends through a slot 70 in said arm into the plate 26. The cam edge 71 of the arm 68 is adapted to engage the downwardly projecting end of the pin 54, which extends into a slot 72 in the plate 26, and thereby progressively decreases the maximum range of advance of the plate 55 with reference to the plate 26, as the arm is adjusted anti-clockwise. The position of the adjustment is indicated on the scale 73 by the pointer 74 on the end of the arm 68.

The action of the governor weights 47 and 48 in advancing the plate 55 is resisted by a spring 75, which is so mounted that the point where the advance begins and the ratio of such advance to the increase in speed may be adjusted. One end of the spring 75 is connected to a pin 76 secured to an arm 77 which is mounted on the under side of plate 26. A pivot pin 78 secured to the arm 77 has its bearing in a hole in the plate 26 and projects upwardly above the plate. The pin 76 projects upwardly through an arcuate slot 79 in the plate and the arm 77 is secured in adjusted position by a clamping screw 80 which extends through a slot 81 into the arm. The other end of the spring 75 is connected to a pin 82 on a lever arm 83 which is pivotally mounted on the pin 78. An arm 84 is mounted for pivotal adjustment about a pin 85 on the plate 55 and is secured in adjusted position by a clamping screw 86, which extends through a slot 87 in said arm and into the plate 55. A pin 88 secured to the arm 84 engages an arcuate slot 89 in the arm 83.

Adjustment of the arm 84 about its pivot 85 varies the position of the pin 88 in the slot 89 and the consequent leverage of the arm 83 about its pivot 78, when the governor weights act to advance the plate 55 in opposition to the resistance of the governor spring 75 transmitted through the pin 82, arm 83, pin 88 and arm 84 to the plate 55. This adjustment therefore varies the tension of the governor spring and the ratio of the speed controlled advance of the timing as compared to the speed.

Adjustment of the arm 77 about its pivot 78 toward the outer edge of the plate 26 increases the tension on the governor spring 75.

Adjustment of the arm 68 about the shaft 36 as a center causes said arm to cover more or less of the end of the slot 72, into which the pin 54 projects, and the engagement of the pin with the edge 71 of the arm variably limits the maximum advance of the plate 55 and consequently the maximum speed controlled advance of the spark.

The brake plate 26 is held adjacent the drive plate 49 by two pins 50 and 50a which are inserted through slots 51 and 51a in the brake plate and secured in the drive plate. These slots therefore limit the rotational displacement of the plate 26 with reference to the plate 49. In order to adjustably limit the maximum relative advance of the plate 26, and consequently the vacuum controlled spark advance, an arm 62 is mounted for adjustment about a pivot 63 on the plate 26 and is secured in adjusted position by a clamping screw 64 which extends through a slot 65 into said plate. The inclined end 66 of the arm 62 is adapted to engage the head of the pin 50 and thereby progressively limit the effective length of the slot 51. The maximum advance of the brake plate 26, thus limited, is indicated by the point of the arm 62 on the scale 67.

Adjustment of the arm 62 about its pivot 63 causes the end 66 of the arm to variably limit the range of movement of the brake plate 26 with reference to the plate 49, thereby adjustably limiting the possible advance of the spark when the piston 24 is retracted by vacuum in the cylinder 22.

Vacuum control of the brake 25, to cause the plate 26 to assume either an advanced or retarded position, is not a part of the invention claimed in this application. It may be stated, however, that this control is preferably arranged so that the plate 26 will be retarded when the engine is idling, but will immediately advance as soon as the throttle is opened slightly, say, for operation at 14 or 15 miles per hour. This advance may be in the neighborhood of 10° or 15°, depending upon the adjustment of the arm 62. This vacuum advance is added to the speed controlled advance, which increases gradually through a predetermined range of speed and which is effected by advancing the circuit breaker cam with respect to the brake plate 26.

From the foregoing description, it will be seen that this timer is provided with all the adjustments necessary to secure the desired spark advance curve for the most satisfactory performance of any given engine, as illustrated in Figs. 6 and 7. As above stated, the desired rate of spark advance by the governor, as compared to increased speed of the engine, is obtained by variation in the tension of the governor spring 75, which is effected by adjusting the arm 84. Each graduation on the edge of the slot 89 represents a difference of approximately 400 R. P. M. on the governor advance curve. These curves for different adjustments are represented at A, B, C, D, E, F, in Fig. 6. When adjusting the governor for a smaller advance, such as 20° or less, to finish at 4000 R. P. M. or later as illustrated by governor advance curves G, H, I, J, K, L, it may be necessary to place additional tension on the governor spring 75 by adjusting the arm 77 toward the outer edge of the plate, as above explained. Curves A, B and C may be produced by using an 8-ounce governor spring. Curves D to L inclusive may be produced by using a 16-ounce governor spring.

When the engine is operating under full throttle and heavy load and the vacuum in the intake manifold drops to approximately 12" mercury or under, the spring 27 will cause the brake 25 to engage the plate 26, bringing it into retard posi-

tion and effecting a like retardation of the centrifugal governor assembly and circuit breaker cam. The governor curve will then be similar to that shown at A. As the engine speed increases, or the throttle is partly closed, the vacuum in the intake manifold will build up to a point in excess of 12" mercury, at which point the piston **24** will be retracted, releasing the brake plate **26**, whereupon the governor drive spring **52** will immediately advance the brake plate and the governor and cam assemblies. The governor will then produce a light load curve similar to that shown by the broken line A', which has for illustration been set 10° higher than the load curve A.

On some engines the initial timing is set very close to top dead center. With this setting a rapid intermediate advance of the governor is necessary from approximately 400 R. P. M. to 800 R. P. M. of the engine, as shown by curves P, Q, R, S, on Fig. 7. To produce these curves, it is necessary to use a special governor spring lever adjustment arm **84**, stamped 6°, 10°, 12° or 14°, indicating the point at which the slower advance of the timing begins. With this adjustment arm, a 24-ounce governor spring should be used. The normal position of the spring post **76** is in the end of the slot **79** nearest the center of the plate. In case the governor advances too fast through the lower speed range, resulting in a slight spark knock, the spring post **76** should be adjusted toward the other end of the slot.

While I have shown and described the centrifugal advance mechanism in connection with a specific type of timer, it will be understood that this is merely for the purpose of illustration and that the invention also includes such modifications as may fall within the scope of the appended claims.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. In an ignition timer, circuit breaker mechanism including a circuit breaker cam, centrifugal governor weights operable to advance said cam, a spring resisting such advance, a lever arm through which said spring acts, and means for adjusting the effective length of said lever arm.

2. In an ignition timer, centrifugal timing mechanism comprising two coaxial rotatable plates, two centrifugal weights, one mounted on each plate, said weights being co-engageable to advance one plate with respect to the other as the weights are moved outwardly, and an arm mounted on one plate and adjustable into the path of the weight pivot on the other plate to adjustably limit the maximum centrifugal advance of one plate with respect to the other.

3. In an ignition timer, centrifugal timing mechanism comprising two coaxial rotatable plates, two centrifugal weights associated therewith, means to progressively advance one plate with respect to the other as the weights are moved outwardly, a projecting member carried by one plate and an arm carried by the other, said arm being adjustable into the path of said projecting member to adjustably limit the maximum centrifugal advance of one plate with respect to the other.

4. In an ignition timer, centrifugal timing mechanism comprising two coaxial rotatable plates, two centrifugal weights associated therewith, means to progressively advance one plate with respect to the other as the weights are moved outwardly, a spring held lever fulcrumed on one plate, an adjustment arm mounted on the other plate and engageable with said lever to move it against the resistance of its spring as the weights are moved outwardly, and means to adjust the position of said adjustment arm to cause it to engage said lever at different distances from its fulcrum, thereby varying the ratio of the plate advance as compared to the speed of operation.

5. In an ignition timer, centrifugal timing mechanism comprising two coaxial rotatable plates, two centrifugal weights associated therewith, one weight being pivotally mounted on each plate, means to progressively advance one plate with respect to the other as the weights are moved outwardly, a spring held lever fulcrumed on one plate, an adjustment arm mounted on the other plate and engageable with said lever to move it against the resistance of its spring as the weights are moved outwardly, means to adjust the position of said adjustment arm to cause it to engage said lever at different distances from its fulcrum, thereby varying the ratio of the plate advance as compared to the speed of rotation, and means to adjustably limit the maximum possible plate advance.

6. In an ignition timer, centrifugal timing mechanism comprising two coaxial rotatable plates, two centrifugal weights associated therewith, one weight being pivotally mounted on each plate, means to progressively advance one plate with respect to the other as the weights are moved outwardly, a spring held lever fulcrumed on one plate, an adjustment arm mounted on the other plate and engageable with said lever to move it against the resistance of its spring as the weights are moved outwardly, means to adjust the position of said adjustment arm to cause it to engage said lever at different distances from its fulcrum, thereby varying the ratio of the plate advance as compared to the speed of rotation, a projecting member on one plate, and an arm mounted on the other plate and adjustable into the path of said projecting member to adjustably limit the maximum possible advance of one plate with respect to the other.

7. In a centrifugal advance mechanism, a drive member, a driven member coaxial therewith, flyweights operable by centrifugal force to advance the driven member with reference to the drive member, means to adjustably limit the maximum range of such advance, and independent means to effect a predetermined adjustment of the rate of advance as compared to the increase in speed.

8. In a centrifugal advance mechanism, a drive member, a driven member coaxial therewith, flyweights operable by centrifugal force to advance the driven member with reference to the drive member, a spring resisting such advance, means to adjustably limit the maximum range of such advance, and independent means to effect a predetermined adjustment of the rate of advance, as compared to the increase in speed, without changing the initial position or the initial tension of said spring.

9. In a centrifugal advance mechanism, a drive member, a driven member associated therewith, flyweights operable by centrifugal force to advance the driven member with reference to the drive member, a lever fulcrumed on one of said members and having a slot radial to its fulcrum, an arm mounted on the other member and having a projection engaging said slot, thus acting through said lever to determine the relative advance of the driven member with reference to the drive member, and a spring resisting movement of said lever in response to the centrifugal

action of the flyweights, said arm being adjustable to position the projection in the slot at different distances from the fulcrum of the lever, whereby to vary the rate of advance as compared to the speed of rotation without affecting the initial tension of the spring.

10. In an ignition timer, the combination with circuit breaker mechanism including a rotatable member, of centrifugal weights to advance the timing, an arm angularly adjustable about the axis of said rotatable member as a center, an abutment connected with one of said weights and engageable with said arm as the weights move outwardly, whereby the adjustment of said arm adjusts the limit of the weight movement, and suction controlled means to effect a supplemental advance of the timing.

11. In an ignition timer, the combination with a rotatable circuit breaker member and a driving member therefor, of centrifugal means to advance the circuit breaker member with respect to the driving member, suction controlled means to effect a supplemental advance of the circuit breaker member, said suction controlled means including a plate relatively movable with respect to the driving member, a pivotally adjustable arm on said plate, and an abutment on the driving member engageable with said arm to limit the relative movement of the plate with reference to the driving member, whereby the adjustment of said arm varies the maximum suction controlled advance.

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