Aug. 24, 1965 I. J. C. SCOTT 3,202,777

IGNITION DISTRIBUTOR WITH FRICTION PREVENTIVE MEANS IN THE ADVANCE MECHANISM

Filed Oct. 4, 1961

4 Sheets-Sheet 1

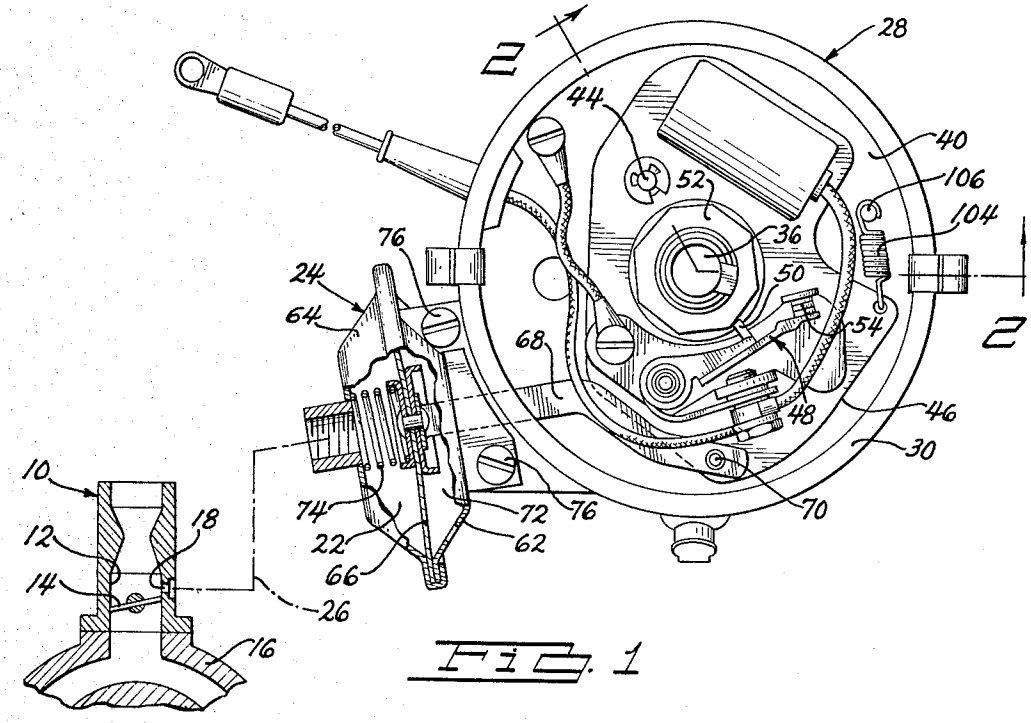


Fig. 1

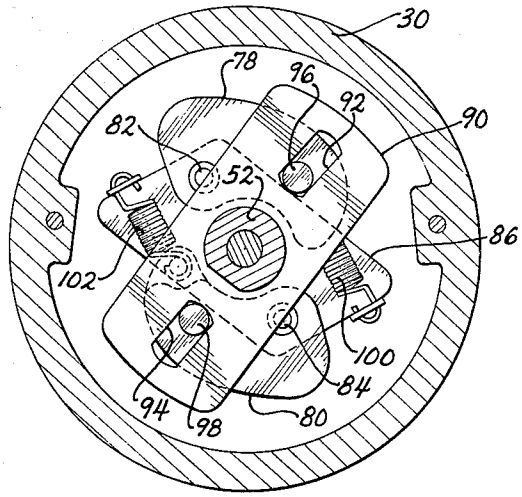


Fig. 3

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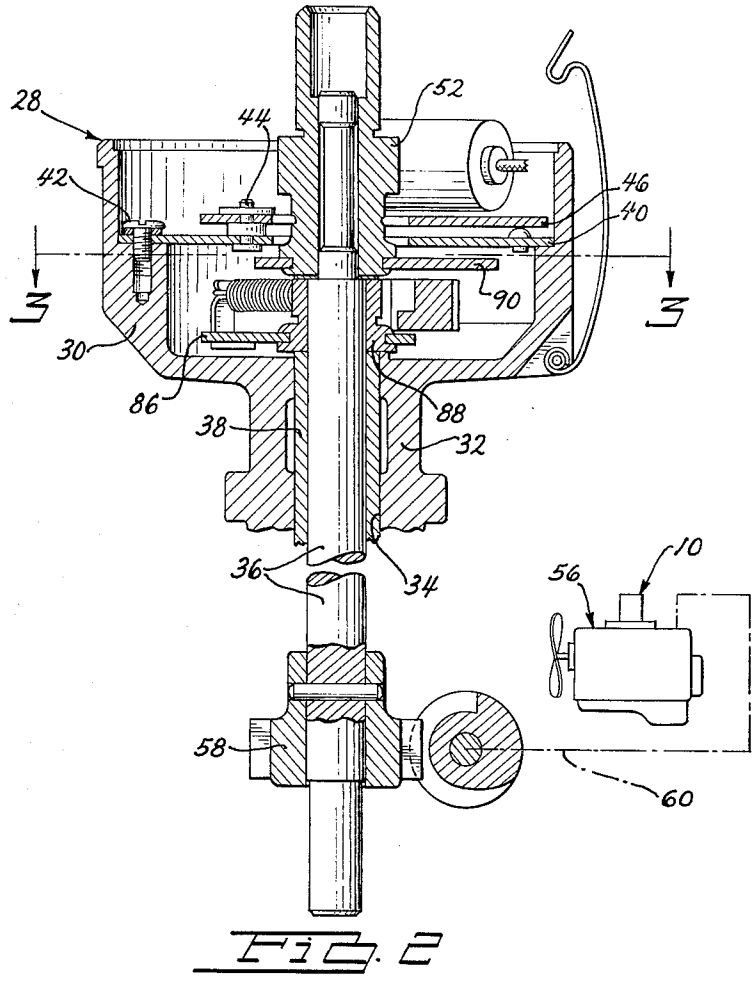


Fig. 2

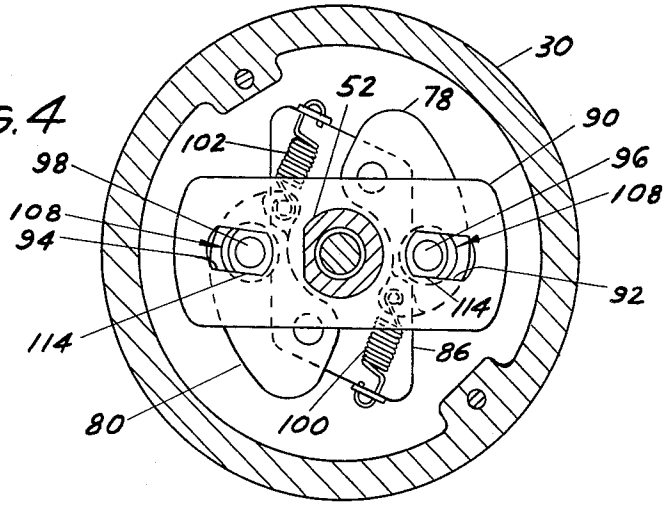
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IGNITION DISTRIBUTOR WITH FRICTION PREVENTIVE MEANS IN THE ADVANCE MECHANISM

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FIG. 4



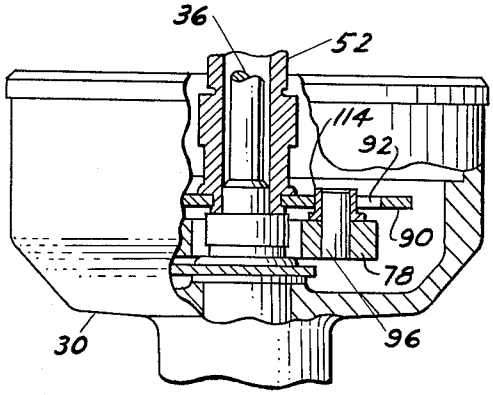


FIG. 5

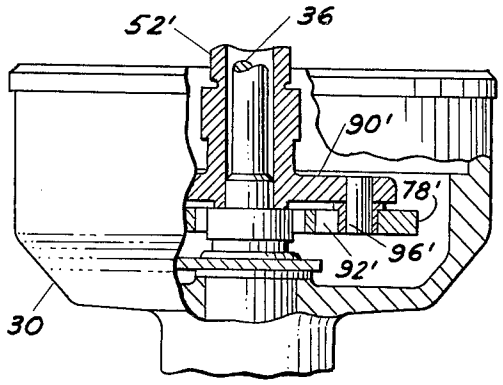


FIG. 6

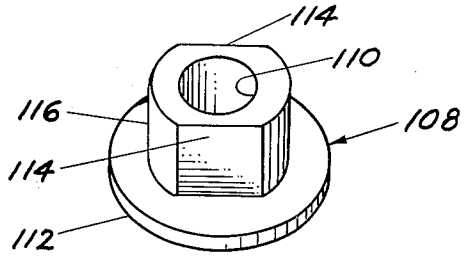


FIG. 7

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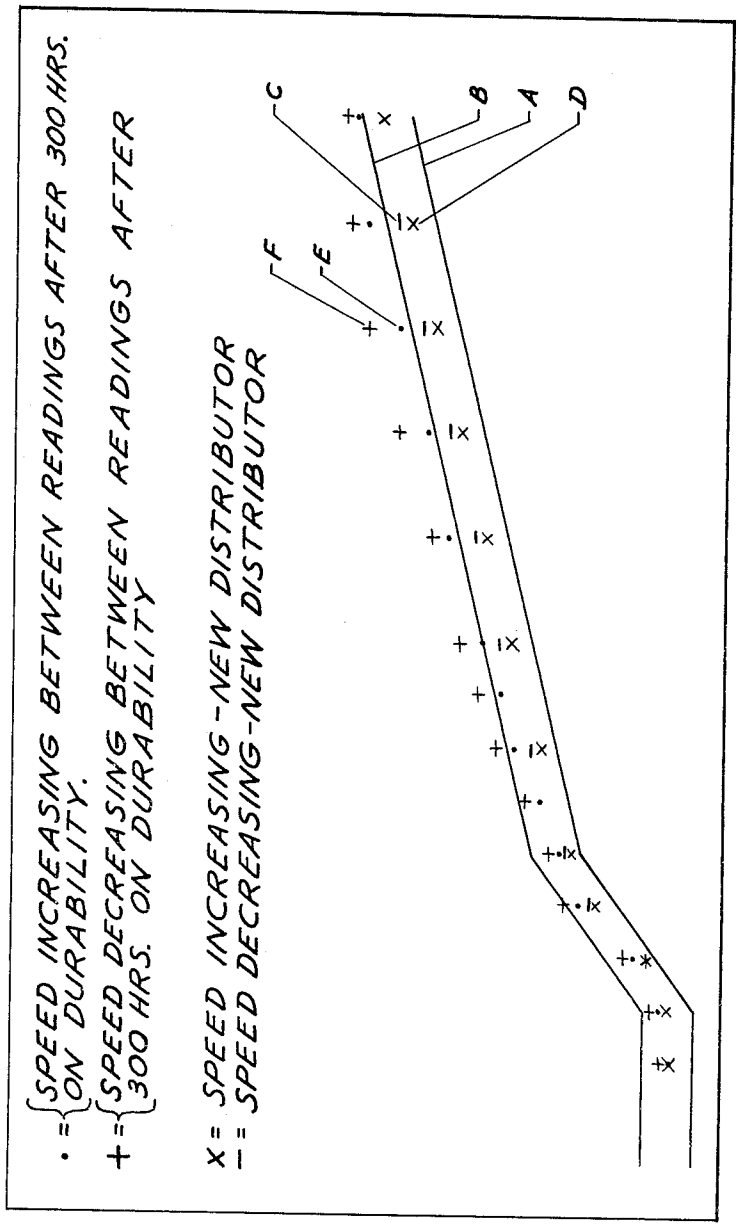
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IGNITION DISTRIBUTOR WITH FRICTION PREVENTIVE MEANS IN THE ADVANCE MECHANISM

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FIG. 8



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United States Patent Office 3,202,777 Patented Aug. 24, 1965

3,202,777

IGNITION DISTRIBUTOR WITH FRICTION PREVENTIVE MEANS IN THE ADVANCE MECHANISM

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Filed Oct. 4, 1961, Ser. No. 143,277
9 Claims. (Cl. 200—31)

This invention relates to ignition relates to ignition distributors, and more particularly to an improvement in ignition distributors of the type in which spark advance is effective in whole or in part by the action of centrifugal weights driven in accordance with engine speed.

In a number of ignition distributors commercially available today, a pin extending from each of the centrifugal weights slides in a slot formed therefor in an arm extending laterally from the distributor cam. An alternate construction employs suitably oriented slots formed in the centrifugal weights; in this case, the pins sliding in the weights are formed on or secured to each arm of the distributor cam member. In either case, the geometry of this pin and slot linkage is such that it produces the desired cam rotation to weight displacement (spark advance) characteristic.

A distributor of this kind in which the pins are formed on the distributor cam member is disclosed in U.S. application, Serial No. 84,254 filed on January 23, 1961, in the names of Eugene C. Bettoni and Ernest R. Larges.

While distributors of this kind have been generally successful in their operation, the use of a cylindrical pin in a slot having parallel and straight edges results in straight line contact between the pin and the wall of the slot. This relatively small contact area results in very large bearing stresses due to vibratory conditions due to engine torsionals and the reaction of the cam to the rubbing block forces, even at light loads. These high bearing stresses often cause severe wear of both the pin and the slot.

The above-mentioned wear in turn results in a number of highly undesirable effects in the function of the spark advance mechanism, as follows:

(1) The distributor provides a different amount of spark advance for a given r.p.m., depending upon whether the engine was accelerated or decelerated to reach the given r.p.m.

(2) The distributor fails to follow the original desired relationship between spark advance and r.p.m.

It is now proposed to eliminate the above undesirable effects and to greatly increase the life of a distributor of this kind and insure its continued original proper performance. In the particular embodiment of the invention disclosed herein, this is accomplished by enlarging the above-mentioned slots and providing a so-called slider block having oppositely disposed flat outer surfaces and being made of any suitable wear-resistant and self-lubricating material, such as Delrin, between the pin and the slot. In other words, the slider block is formed in a manner so that it can be assembled over the pin and be inserted into the slot, thus increasing the contact surface are between the pin and the slot. Wear is drastically reduced and/or virtually eliminated, and the useful life of the distributor and advance mechanism is greatly prolonged.

Even in a new and properly operating prior art distributor such as that shown in the reference patent application referrred to above, there is some hysteresis between the increasing speed and the decreasing speed spark advance curves; this is so, even though both curves are within the prescribed limits. However, it has been found

that the hysteresis is greatly reduced and/or entirely eliminated with the use of the proposed invention. It is believed that this is because the edges of the slots have machine marks extending in one direction or the other, depending upon the direction of the machining; this roughness is sufficient to give a different coefficient of friction when the pin is moving along the edge of the slot in one direction than when the pin is moving in the other direction. The surface of the self-lubricating slider block appears to merely glide over the high spots of this roughened surface on the edges of the slots so as to more nearly result in a constant coefficient of friction, regardless of the direction of movement.

Also, both the pins and the weights in present day prior art distributors have to be hardened, in most cases to somewhere around R_c 55 as a minimum. This hardening is an expensive step in the manufacture of the distributor. With the use of the softer Delrin or other material for a slider block, neither of the pins nor the slots have to be hardened; rather, they can be used in their unhardened and machined condition.

The slider block member may be provided with a flange to prevent the block from being accidentally removed from the pin; also, the block many be dimensioned and formed in such a manner such that it cannot be improperly assembled in the slot.

Other objects and advantages of the invention will become more apparent when reference is made to the following description and the accompanying drawings, wherein:

FIGURE 1 is a top plan view of a prior art ignition distributor to which the invention may be applied so as to improve the operation thereof.

FIGURE 2 is a cross-sectional view taken substantially on the plane of line 2—2 of FIGURE 1 and looking in the direction of the arrows.

FIGURE 3 is a cross-sectional view taken on the plane of line 3—3 of FIGURE 2 and looking in the direction of the arrows.

FIGURE 4 is a view similar to FIGURE 3 wherein the distributor centrifugal advance mechanism has been modified to embody the invention.

FIGURE 5 is a cross-sectional view taken on the plane of line 5—5 of FIGURE 4 and looking in the direction of the arrows.

FIGURE 6 is a view similar to FIGURE 5 illustrating the application of the invention to a distributor in which certain parts are reversed.

FIGURE 7 is an enlarged perspective view of the slider block itself.

FIGURE 8 is a graph illustrating the ignition advance characteristics of an ignition distributor before and after the above-mentioned wear that use of the invention eliminates.

As already stated above, FIGURE 1–3 illustrate one of the present day-distributors to which the invention may be applied. For purposes of clearly distinguishing the invention from the prior art, this prior art distributor will first be described. Following that, the manner in which the invention may be applied to this and other prior art distributors will be described.

Referring now to the drawings, FIGURES 1–3 illustrate a carburetor 10 having an induction passage 12 and a throttle valve 14 adapted to control the flow of combustible mixtures therethrough and into the engine intake manifold 16. Port 18 communicates with the induction passage 12 and with the chamber 22 of the vacuum motor 24, as by means of a suitable conduit 26.

The ignition distributor 28 is comprised generally of a cup-shaped housing 30 including a depending reduced portion 32 having an opening 34 therethrough for the

reception of a driving shaft 36. A bushing-like bearing member 38 may be provided in order to reduce the degree of friction between the rotating shaft 36 and surface of opening 34.

A base plate 40, rigidly secured to the housing 30 as by means of screws 42, retains a pivot member 44 to which the breaker plate 46 is pivotally secured. The breaker plate 46 carries thereon a breaker arm assembly 48 which includes a cam engaging portion 50 engageable by the rotating cam 52 to effect make and break of the circuit at the contacts indicated at 54. The cam 52 is mounted on the shaft 36 for limited rotation with respect thereto, but so as to be rotated thereby. The shaft 36 is, of course, rotated in timed relation with the engine 56 by means of gear member 58 cooperating with some output transmission 60 of the engine.

The pressure responsive device 24 is substantially comprised of a housing 62 and cover member 64 rigidly held together in a manner so as to peripherally secure a diaphragm member 66 therebetween. A member 68, connected at its one end to the diaphragm member 66, is adapted to be operatively engaged with breaker plate 46, as by means of a hole formed therein for the reception of a connecting link 70 which pivotally secures the member 68 and breaker plate 46 to each other. Chamber 22, formed generally by cover 64 and diaphragm 66 is exposed to a source of vacuum, as communicated by conduit 26, while chamber 72 is vented to the atmosphere. A calibrating spring 74 is also located within chamber 22 in a manner so as to resiliently oppose the movement of diaphragm 66 in response to increases in vacuum. The entire pressure responsive device 24 can, of course, be secured to the housing 30 by an suitable means such as screws 76.

The speed responsive portion of the ignition advance mechanism, as illustrated generally by FIGURE 3, is substantially comprised of flyweight members 78 and 80 which are pivotally mounted, as by pivot members 82 and 84, respectively, to a base member 86. The base member is rigidly secured by any suitable means such as a collar member 88 to the shaft 36 so as to rotate therewith.

A cam plate 90, rigidly secured to the lower portion of cam member 52, has slots 92 and 94 formed therein, which are adapted to cooperate with cylindrical pin-like members 96 and 98 secured within or to flyweight members 78 and 80. Calibrating springs 100 and 102 anchored at one end to the base member 86 are provided to resist the outward movement of the flyweights 78 and 80 as engine speed increases.

The ignition distributor, as illustrated by FIGURES 1, 2 and 3, is shown in full retard, as it would be when the engine is running at curb idle.

As engine speed increases, the rotational speed of shaft 36 will correspondingly increase, and the flyweights 78 and 80 will travel arcuately outwardly about their pivots 82 and 84. As the flyweights move outwardly, the motion transmitting links or pins 96 and 98 rotate cam plate 90 and cam member 52 counterclockwise with respect to shaft 36, thereby causing an advance which is generally related to the increase in engine speed. The forces which restrict outward movement of the flyweights are, of course, due to the resistance offered by the tension springs 100 and 102.

It is to be noted that the cylindrical pins 96 and 98 have only vertical line contact with the usually straight sides or edges of the slots 92 and 94 and that it occurs on either side of the slot, depending upon the direction in which the weights are moving. This line contact between each cylindrical pin and the straight-edged slot is necessary because the pin is rigidly secured to the weight and the movement of the centrifugal advance mechanism is such that providing a pin with flat sides would cause binding and improper operation of the mechanism.

Assuming now that the flyweights have been positioned in accordance with engine speed, any part throttle position will cause vacuum to be communicated from orifice 18 to chamber 22 and accordingly move the diaphragm 66 to the left against the force of spring 74. The degree to which diaphragm 66 moves is basically a function of the manifold (engine) vacuum and the spring rate of spring 74.

As diaphragm 66 moves to the left, member 68 being secured thereto also moves an equivalent amount thereby causing breaker plate 46 to move in a generally clockwise direction about its pivot member 44. This movement results in the lobes of cam member 52 engaging the cam engaging portion 50 at ever increasing degrees of crankshaft rotation ahead of top dead center.

From the above it is evident that the ignition distributor provides speed responsive means for adjusting the position of cam member 52 with respect to the shaft 36 and separate pressure responsive means for rotating the breaker plate 46 and ignition contact arm assembly 48 in order to arrive at an ignition advance which is reflective of both engine load and speed.

Reference will now be made to FIGURES 4–7 which illustrate how the invention is applied to the prior art distributor of FIGURES 1–3.

FIGURE 4 is, of course, a view similar to FIGURE 3, and all the identical elements are identified with the same reference numerals. Referring now to FIGURES 4 and 5, which illustrate one embodiment of the invention, it is apparent that the pins 96 and 98 are pressed in or otherwise secured to or formed on the centrifugal weights 78 and 80, respectively. However, unlike the structure of FIGURES 1–3, the pins 96 and 98 do not directly engage the edges of the slots 92 and 94; rather, the slider block 108 shown in an enlarged perspective in FIGURE 7 is positioned over each of the pins 96 and 98 so that each pin is received in the axial passage 110 extending through the block 108.

It will be noted that the slots 92 and 94 may be enlarged in both directions as compared to slots 92 and 94 of FIGURE 3, so that the pins may, if so desired, occupy the same relative positions with respect to the centerline of the shaft 36 as they do in FIGURE 3 in any condition of operation of the distributor. As already stated above, the slider block 108 may be formed of any suitable material; preferably, however, it should be formed of some wear-resistant, self-lubricating type of material.

It will be noted that an annular flange 112 may be provided, the flange having a diameter greater than the width of the slots 92 or 94, as best seen in FIGURE 4; this is so that the slider block 108, which is capable or rotational movement on its pin, cannot be raised upwardly, accidentally or otherwise, through the slot once the distributor is assembled.

It will also be noted that the slider block 108 has oppositely disposed flat surfaces 114 adapted to engage the parallel edges of the slots 92 or 94 for sliding movement therein as the weights 78 and 80 are pivoted inwardly or outwardly in response to changes in rotational velocity of the drive shaft 36. It is also to be noted that the diameter of the slider block 108 at the reduced portion 116 thereof is greater than the width of the slot so that the slider block cannot be positioned improperly in the slot.

FIGURE 6 is substantially identical to FIGURE 5, except that the pin 96′ is secured to the laterally extending arm portion 90′ of the cam member 52′ and that the slot 92′ is formed in the weight member 78′. Except for this reversal of the parts, the construction of FIGURE 6 may be identical to the structure of FIGURES 4 and 5.

The slider block of FIGURE 7 is, of course, identical in both modifications, except that the position of the slider block 108 in FIGURE 6 is reversed, as compared to FIGURES 4 and 5, in that the annular flange 112 now prevents the slider block from dropping downwardly through the slots 92′.

The overall operation of the distributors embodying the

invention, as shown in FIGURES 4–7, is exactly the same as that of the distributor shown in FIGURES 1–3. It is apparent, however, that the area of contact between pins 96 and 98 and the slots 92 and 94, respectively, has been changed from a line contact in FIGURE 3 to a sliding surface contact in FIGURES 4 and 5. The same is true in FIGURE 6.

As already stated above, line contact between the pins and the slots results in very high or concentrated stresses so that normal vibrations occuring in the advance mechanism tend to and do deform the pins and the edges of the slots to the extent that the advance mechanism cannot operate properly. This malfunction due to wear is graphically illustrated in FIGURE 8, wherein the curves A and B represent the acceptable limits of spark advance vs. engine speed, the curves C and D illustrate the performance of a new distributor and curves E and F illustrate the deviation even from the acceptable limits in a prior art distributor (FIGURES 1–3) that has been subjected to the above wear mentioned. FIGURE 8 was prepared from actual test data.

While the purpose of the invention is, of course, to maintain the operation of the distributor advance mechanism within the acceptable limits (curves A and B of FIGURE 8) throughout the distributor life, it has been found that substantially original performance (curves C and D of FIGURE 8) is achieved; in fact, the hysteresis found even in a new prior art distributor is eliminated in many instances.

In summary, the structure of this invention eliminates direct line contact between the pins and the edges of the slots, as employed in prior art ignition distributor centrifugal advance mechanisms. This is accomplished by employing the above described slider block, which is fitted over each pin and which has oppositely disposed flat sides engaging the parallel straight edges of the slots. The slider block is preferably made of a wear-resistant, self lubricating material so that the slider block itself does not wear to any noticeable extent; also, the slider block is free to rotate on the pin and to move along the slot with substantially no noticeable friction. Where the slider block is made of a soft material, as compared to the steel pins and weights, the pins and weights need not be hardened, thus eliminating an expensive step in their manufacture. The use of the invention not only prolongs the useful life of the centrifugal spark advance mechanism, but it can be shown that it actually improves the operation of a new prior art distributor in that the hysteresis usually found in even a new distributor is often eliminated.

While but two modifications of the invention have been shown and described, it is apparent that other modifications may be made within the scope of the appended claims.

What I claim as my invention is:

1. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support member secured to rotate with said shaft, a pair of centrifugal weights pivotally secured to said support member in a manner to move outwardly under the influence of centrifugal force to the extent dependent upon the rotational speed of said shaft, a pin extending upwardly from each of said weights, an arm member extending from each side of said cam member, said arm members being positioned parallel to said support members and each of said arm members having a suitable angularly disposed slot therein receiving said pins extending from one of said centrifugal weights, the geometry of said pins and said slots being such as to produce the desired cam rotation to weight displacement characteristics when said shaft is rotated, and a sleeve member disposed over each of said pins in a manner so that direct engagement of the edges of the slots by said pins is prevented, said sleeve member being formed to provide area rather than line sliding contact with the edges of the slots.

2. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon engaging said pin, the geometry of said pin and said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, and a sleeve member disposed over said pin in a manner so that direct engagement of said edge by said pin is prevented, said sleeve member being formed to provide area rather than line sliding contact with said edge.

3. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon engaging said pin, the geometry of said pin and said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, and a sleeve member disposed over said pin in a manner so that direct engagement of said edge by said pin is prevented, said sleeve member having a flat surface formed on the outer periphery thereof for engagement with said edge.

4. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon cooperating with said pin, the geometry of said pin and said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, and means for increasing the effective contact area between said pin and said edge.

5. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon cooperating with said pin, the geometry of said pin and

said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, and means for preventing sliding line contact between said pin and said edge.

6. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon cooperating with said pin, the geometry of said pin and said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, and a sleeve member fitted over said pin so as to have freedom of rotation with respect to said pin, said sleeve member having a surface slidably engaging said edge.

7. An ignition distributor for an internal combustion engine, comprising a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed slot thereon receiving said pin, the geometry of said pin and said slot being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, and a sleeve member made of a wear-resistant, self-lubricating material and fitted over said pin so as to have freedom of rotation with respect to said pin, said sleeve having a surface slidably engaging an edge of said slot, said sleeve member also having a radially extending flange thereon having a diameter greater than the width of said slot so as to prevent passage of said sleeve member through said slot.

8. As a replacement item, a sleeve member for use in an internal combustion engine ignition distributor assembly including a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a cylindrical pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon for cooperation with said pin, the geometry of said pin and said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, said sleeve member comprising a body having a single diameter axial passage therethrough adapting the same to be rotatably mounted on said pin, said body having means adapted to prevent accidental removal of said sleeve from said pin and means adapted to provide sliding area rather than sliding line contact with said edge, said sleeve member being constructed from a wear-resistant, self-lubricating material.

9. As a replacement item, a sleeve member for use in an internal combustion engine ignition distributor assembly including a housing, a shaft journalled in said housing and adapted to be driven in accordance with engine speed, a distributor cam member mounted on the end of said shaft disposed within said housing in a manner to permit rotation of said cam with respect to said shaft, a support secured to rotate with said shaft, a centrifugal weight member pivotally secured to said support in a manner to move outwardly under the influence of centrifugal force to an extent dependent upon the rotational speed of said shaft, one of said members having a pin extending therefrom and the other of said members having a suitable angularly disposed edge thereon for cooperation with said pin, the geometry of said pin and said edge being such as to produce the desired cam rotation to weight displacement characteristic when said shaft is rotated, said sleeve member comprising a body having a single diameter axial passage therethrough adapting the same to be rotatably mounted on said pin, said body having a radially extending annular flange portion at one end thereof adapted to project beyond said edge to prevent accidental removal of said sleeve from said pin, the entire portion of said body adjacent said flange being formed with a surface adapted to provide sliding area rather than sliding line contact with said edge, said sleeve member being constructed from a material having wear-resistant and self-lubricating properties.

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