Feb. 20, 1968 L. F. NEELY 3,370,136

IGNITION BREAKER HAVING A BREAKER ARM WITH HINGED DEFLECTION CHARACTERISTICS

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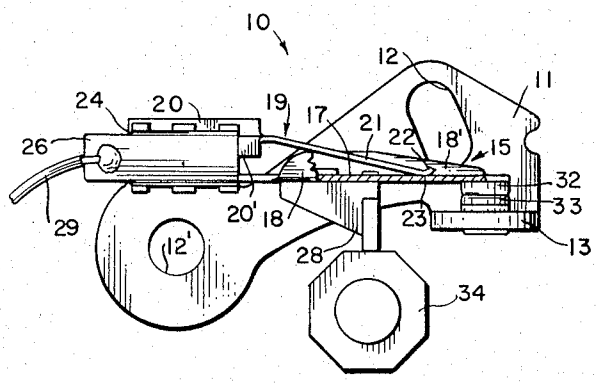


FIG. 1

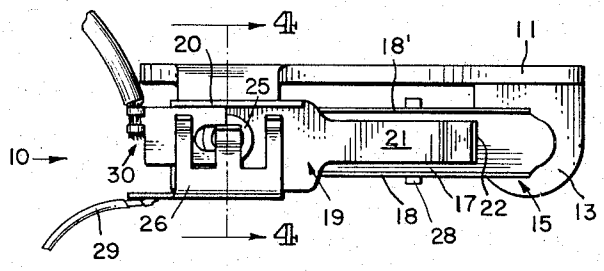


FIG. 2

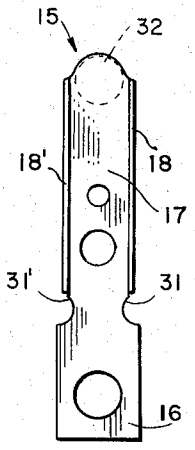


FIG. 3

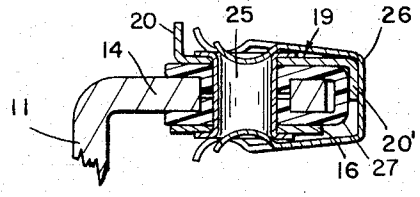


FIG. 4

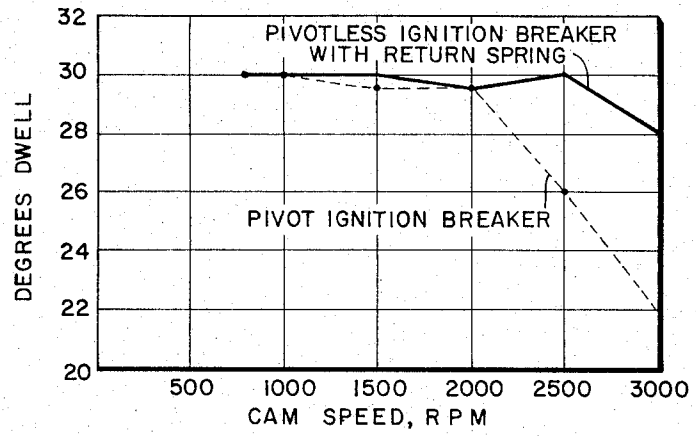


FIG. 5

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IGNITION BREAKER HAVING A BREAKER ARM WITH HINGED DEFLECTION CHARACTERISTICS

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ABSTRACT OF THE DISCLOSURE

An ignition breaker having a breaker arm with an area of reduced section to provide an ignition breaker arm having a hinged deflection. A cantilever return spring includes a free end slidably engaging the breaker arm which provides a force biasing a movable contact of the breaker arm toward a fixed contact carried by a base plate.

The present invention relates to ignition devices for multicylinder high speed internal combustion engines, and more particularly to a low inertia ignition breaker means including a contact carrying ignition breaker arm having a hinged action deflection characteristic and return spring means slidably biased against the arm to facilitate the hinged action deflection of the arm, to reduce bounce or chatter of the contacts, and to give improved dwell which will permit the ignition coil to store maximum energy. The present invention also includes a clip means termination for electrical conductors connected to the ignition breaker means thereby eliminating the conventional bolt and screw termination generally associated with ignition breaker means.

In the conventional ignition system, an ignition breaker means is used to interrupt an electrical current flowing in an ignition coil in synchronism with the operation of pistons of an internal combustion engine. At a predetermined time, the contacts of the ignition breaker means are biased so as to disengage with each other thereby interrupting the current that flows through the ignition coil. The interruption of the current through the ignition coil induces a high voltage in the coil. The high voltage in the ignition coil is applied across the air gap between the electrodes of a spark plug causing an electrical spark which ignites a mixture of gasoline and air in a cylinder of the internal combustion engine.

Generally, there are two basic types of ignition breaker means. The desired end result of both types of ignition breaker means is to achieve high dwell time, good cam following characteristics, and minimum contact bounce. One type of ignition breaker means is the "pivotal" ignition breaker means which generally includes a spacing and reinforcing metallic bushing located in axially aligned apertures of an ignition breaker arm means. The bushing has reduced ends forming shoulders adapted to be engaged with the inner surface of the side walls of the ignition breaker arm means. The end portions of the bushing project through the aligned openings and are swedged over the side walls in order to maintain them in the proper spaced position. The metallic bushing snugly retains an insulating bushing which serves as a pivotal insulating bearing for the arm lever about a pivotal post. A hook shaped leaf spring means is connected to the arm means to spring bias the breaker arm means into engagement with a fixed contact. Fixedly connected to the breaker arm means between the spaced parallel walls is a rubbing block. The rubbing block is generally of L-shaped configuration and is fabricated from an electrically nonconducting material. The rubbing block engages with and

follows the rise and fall contours of a cam means thereby opening and closing the contacts of the ignition breaker means. Certain disadvantages are encountered with the pivotal type of ignition breaker. For example, the pivot type of ignition breaker means by its very nature requires minimum clearances between the metallic bushing and the pivot post in order to provide substantially free rotation about the pivot post. The minimum clearances required between the metallic bushing and the pivot post are difficult to achieve and, therefore, are costly to maintain. As a result, excessive clearances are maintained in the fabrication of the pivotal ignition breaker means to facilitate adaptation of the ignition breaker means to a wide range of operating conditions. However, excessive clearances and resultant variations in clearances cause detrimental variations in timing which cannot be tolerated in high performance internal combustion engines if optimum efficiency is to be realized from the engine. In addition, excessive clearances contribute to contact misalignment during operation which in turn reduces the effective life of the ignition breaker means. To maintain the contacts in reasonable alignment is an exacting problem of design that reaches into production. Also, it has been shown that as the contacts are operated, surface irregularities develop on the contacts. Under such conditions, if the contacts do not mate properly, both the performance and the life of the contacts will be affected.

A second type of ignition breaker known as the "pivotless" ignition breaker means has been developed in an attempt to overcome the aforementioned alignment and timing problems commonly associated with the "pivot" type of ignition breaker. The ignition breaker arm means, fabricated from any suitable resilient metallic material such as hard drawn steel, has one end thereof securely fastened to a base plate by any suitable means such as by rivets or the like. Fixedly connected to the breaker arm means is an L-shaped rubbing block which rides on the contours of an actuator cam. The free end of breaker arm means carries a contact which is normally engaged with a fixed contact. As the rubbing block rides up the rise contour of the cam, the breaker arm means is flexed thereby disengaging the contact of the ignition breaker arm means and the fixed contact. The flexing of the breaker arm stores energy for release as the rubbing block falls along the fall contour of the cam. The release of the stored energy displaces the breaker arm means so that the contact of the arm and the fixed contact are engaged. The pivotless ignition breaker means experiences substantially no difficulty with the alignment of the movable and fixed contacts. However, this device does encounter serious problems due to the fact that the breaker arm means developes whip and standing waves which decrease the dwell time and contribute to excessive wear of the contacts. In several of the presently available pivotless ignition breaker devices the breaker arm means have been reinforced in an attempt to obtain a semi-rigid moving member to thereby substantially prevent the whip and standing waves developed as disclosed hereinbefore. In the devices where reinforcement of the breaker arm means has been used to limit the amount of flexing of the arm means complicated fabrication problems have developed due to the use of a relatively short resilient material having highly concentrated stresses therein thereby making contact force dependent on highly critical material and dimensional variables. In addition, the relatively short resilient material is subject to high fatigue under normal operation.

The ignition breaker means of the present invention overcomes the aforementioned shortcomings of the pivot and the pivotless ignition breaker means by making efficient and effective use of an ignition breaker arm having

substantially hinged deflection during displacement by the cam actuator means. The present invention relies upon an area of reduced section and of reduced reinforcement at the area reduced section on the arm to provide an ignition breaker arm having a hinged deflection. A cantilever return spring means including a free end slidably engaging the breaker arm provides a force biasing the movable contact of the breaker arm toward the fixed contact carried by a base plate. The predetermined length and deflection of the cantilever return spring permits uniform contact force with moderate control in the fabrication of the spring.

A six pronged clip means provides a means for securely connecting an electrical conductor from the capacitor and an electrical conductor from the ignition coil to the ignition breaker means. The clip means is easily removed from the ignition breaker means so as to disconnect the electrical conductors from the ignition breaker means thereby facilitating removal of the ignition breaker means, if necessary. The clip means also eliminates the bolt and screw termination for the electrical conductors commonly associated with several of the presently available ignition breaker means.

Therefore, it is an object of the present invention to provide an ignition breaker means which has an ignition breaker arm having hinged deflection characteristics.

A further object of the present invention is to provide an ignition breaker means having substantially exact contact alignment so that the ignition breaker arm may be accurately positioned thereby providing an improved high speed ignition breaker means.

Another object of the present invention is to provide an ignition breaker means having a clip means that terminates external electrical connections to the breaker means.

A further object of the present invention is to provide an ignition breaker means which is particularly characterized by its simplicity of construction.

Yet another object of the present invention is to provide an ignition breaker means having displaceable components of low mass due to the relatively thin construction of the displaceable components.

Still another object of the present invention is to provide an ignition breaker means having a cantilever return spring means which has the fixed end thereof in spaced parallel relationship with the fixed end of a cantilever breaker arm and the free end thereof slidably engaging with the free end of the breaker arm and biasing the breaker arm toward a fixed contact.

A further object of the present invention is to provide an ignition breaker means having a cantilever return spring means which substantially reduces contact "bounce" or chatter of cantilever breaker arm during make thereof with the fixed contact and reduces the length of time the contacts are disengaged or opened.

Another object of the present invention is to provide an ignition breaker means having a cantilever breaker arm means which has deflection stresses confined to a restricted area thereby giving rise to a hinged deflection when the breaker arm means is displaced.

Yet still another object of the present invention is to provide an ignition breaker means having a six pronged clip means for connecting electrical conductors to the ignition breaker means thereby eliminating expensive bolt and screw terminations.

Yet another object of the present invention is to provide an ignition breaker means having a reduced number of parts and increased efficiency over several of the presently available devices.

Still another object of the present invention is to provide an ignition breaker means having improved operating characteristics at high engine speeds.

A further object of the present invention is to provide an ignition breaker means that can be readily fabricated and formed at low cost.

A still further object of the present invention is to provide an ignition breaker means having no pivotal play thereby eliminating spurious oscillations and reducing contact bounce thus providing improved performance at high engine speeds.

The present invention, in another of its aspects, relates to the novel features of the instrumentalities of the invention described herein for teaching the principal object of the invention and to the novel principles employed in the instrumentalities whether or not these features and principles may be used in the said object and/or in the said field.

With the aforementioned objects enumerated, other objects will be apparent to those persons possessing ordinary skill in the art. Other objects will appear in the following description, appended claims, and appended drawing. The invention resides in the novel construction, combination, arrangement, and cooperation of elemets as hereinafter described and more particularly as defined in the appended claims.

The appended drawings illustrate an embodiment of the present invention constructed to function in the most advantageous modes devised for the practical application of the basic principals involved in the hereinafter described invention.

In the drawing:

FIGURE 1 is a top view of the ignition breaker means of the present invention with a portion thereof removed illustrating the various components of the breaker means and the position of each with respect to the other when the breaker lever arm is engaged with the fixed contact.

FIGURE 2 is a side view of the ignition breaker means of the present invention.

FIGURE 3 is a side view of the cantilever ignition breaker arm illustrating the restricted or necked in portions of the arm which locate a line across the arm which serves as the articulate line where the arm turns or swings.

FIGURE 4 is a cross-sectional view of the present invention taken across the lines 4—4 of FIGURE 2.

FIGURE 5 is a graphical illustration comparing the performance of a pivot type of ignition breaker with the pivotless ignition breaker with the cantilever ignition breaker arm and the cantilever return spring means of the present invention.

Generally speaking, the means and methods of the present invention relates to an ignition breaker means for an internal combustion engine. The breaker means includes a base plate means having a plurality of ears extending therefrom and integrally formed therewith. Each of the ears are spaced from the other ears. A resilient breaker arm has one end thereof fixedly connected to a first one of the ears and has a free contact carrying end having a smaller width than the width of the fixedly connected end. The arm also includes oppositely formed necked in portions which join the free end to the end fixedly connected to the ear. The necked in portions define a line across the arm about which the arm swings with a hinged-like action. Flanges extend along the lateral sides of the arm from the necked in portions to the contact for preventing flexing along the flanged length of the arm. A rubbing block is used for displacing the breaker arm and is fixedly connected to one side of the free end of the ignition breaker arm. A cantilever return spring means has one end fixedly connected to the first ear and is in spaced relationship with respect to the ignition breaker arm. The other end of the return spring means is slidably biased against the free end of the ignition breaker arm. A means electrically insulates the breaker arm and the return spring means from the ear. A fixed contact is carried by a second ear and is normally engaged with the movable contact carried by the ignition breaker arm. A clip means frictionally engages with the breaker arm and with the spring means so as to provide termination for conductions connected to the ignition breaker means.

Referring now to FIGURES 1–3 of the drawing and more particularly to FIGURE 1, the ignition breaker means is generally indicated by the reference numeral **10**. The ignition breaker means includes a base plate **11** which is housed in a distributor housing (not shown). The base plate is retained in the housing by fastening means (not shown) such as screws or the like inserted through apertures **12** and **12'** in the base plate. Aperture **12** is illustrated as being oblong and aperture **12'** is shown as being circular. It will be understood that both apertures may be circular or both apertures may be oblong or as illustrated in FIGURE 1. Oblong apertures in the base plate facilitate adjustment of the base plate and hence adjustment of the ignition breaker means with respect to an eight lobe cam means (not shown) which actuates the ignition breaker means. The oblong configuration of the apertures permits adjustment of the arcuate spacing between the contacts.

The base plate is fabricated from any suitable metal such as cold-rolled steel or the like. The base plate includes an integral ear **13** that projects therefrom at substantially a right angle. The integral ear **13** has fixedly connected thereto by any suitable means such as welding, soldering, pressure welding and the like a fixed contact **33** fabricated from any suitable contact material such as tungsten or the like. A second ear **14** which is integral with the base plate and projects therefrom at substantially a right angle serves as a seat for an ignition breaker arm **15** fabricated from any suitable resilient metallic material such as steel or the like.

The ignition breaker arm includes an end portion **16** that is wider than the contact carrying blade portion or free end **17**. The contact carrying blade portion includes integral flanges **18** and **18'** that are in substantially spaced parallel relationship and extend therealong from the contact **32** carried by the blade portion **17** to the necked in portions **31** and **31'**. The flanges **18** and **18'** prevent the blade from experiencing detrimental flexing when displaced. The necked in portions **31** and **31'** of the blade **17** locate the line across the blade which serves as the articulate line where the arm turns or swings with a hinged action when displaced by the cam means **34**. The end portion **16** includes a substantially centrally located aperture used to fixedly connect the end portion **16** and hence the ignition breaker arm to the ear **14**. The free end of the ignition breaker arm carries the contact **32** fabricated from any suitable hard metallic material such as tungsten or the like. As shown in FIGURE 4, the ignition breaker arm is connected to the underside of the ear **14** and is electrically insulated therefrom by insulating means **27**. Fixedly connected to one side of the ignition breaker arm is an L-shaped rubbing block **28** which rides on the contours of the cam means **34**. The rubbing block is fabricated from any suitable material having a low coefficient of dry friction such as nylon or the like. The cantilever return spring means **19** is apertured at its first end **24** as shown in FIGURE 2. The first end **24** includes a wall **20** projecting upwardly and a wall **20'** projecting downwardly therefrom. The purpose of the walls **20** and **20'** is to prevent detrimental flexing of the first end **24** as the blade of the return spring means is displaced. The blade **21** of the return spring means is at an obtuse angle with respect to the major plane of the first end **24** of the return spring means and is used to spring bias the ignition breaker arm toward the fixed contact. The extremity **22** of the blade includes a slightly angulated portion that prevents the blade from digging into and gouging the ignition breaker arm as it slidably engages the arm. The cooperative relationship between the cantilever return spring means and the contact carrying blade deserves analysis. It is seen that at location **23** on the contact carrying blade, the extremity **22** of the return spring engages with and bias the blade toward the fixed contact. As the contact carrying blade is displaced from its initial position of engaged with the fixed contact carried by ear **13**, the deflection of the ignition breaker arm is hinge-like due to the bias force exerted by the return spring and the necked in or reduced sections of the breaker arm. The displacement of the cantilever return spring generates kinetic energy. However, a significant amount of the kinetic energy is dissipated due to the sliding action between the extremity **22** of the return spring means and the contact carrying blade substantially at point **23**. The dissipation of significant amounts of kinetic energy reduces the kinetic energy available to cause overthrow of the contact carrying blade and hence reduces the chance for bouncing of the contact carrying blade on the fixed contact and reduces the length of time the contacts are open.

FIGURE 4 shows the means by which the cantilever spring means and the contact carrying blade are fixedly attached to ear **14**. An insulating means **27**, fabricated from any suitable insulating material such as nylon or the like, is used to electrically insulate the ear **14** from other electrically conductive parts of the breaker means carried by ear **14**. The insulating means is substantially double grommet shaped. It will be noted that the insulating means has a portion thereof folded over so as to electrically insulate wall **20'** of the return spring means from the ear **14** of the base plate. The insulating means also serves to electrically insulate the ignition breaker arm from the base plate and from the return spring means. FIGURE 4 also shows that with respect to the ear **14** of the base plate, the first end **24** of the return spring means and the ignition breaker arm are in substantially spaced parallel relationship. A fastening means **25** fixedly seats the insulating means, the return spring and the ignition breaker arm on the ear **14**. As shown in FIGURE 4, the fastening means may be an eyelet device fabricated from any suitable metallic material such as brass and the like. The eyelet is swedged over and electrically connects the return spring means to the ignition breaker arm yet is electrically insulated from the base plate by the double grommet shaped insulating means.

A six pronged clip means **26** used to provide a means for connecting electrical conductors **29** and **30** to the ignition breaker means. The clip means includes three sets of legs having the respective legs of each set in substantially spaced parallel relationship. When the clip means engages the ignition breaker means as illustrated in FIGURES 1, 2 and 4 the respective legs of the clip means are displaced outwardly thereby storing energy and frictionally engaging with the return spring means and the ignition breaker arm. The frictional engagement serves to retain the clip means in engagement with the ignition breaker means hence connecting electrical conductors **29** and **30** to the ignition breaker means.

FIGURE 5 is a graphic representation illustrating the performance of the pivotless ignition breaker means of the present invention as compared to the performance of the common type of pivot ignition breaker means. It will be noted that the performance of the two different types of ignition breaker means using an eight lobe cam is substantially the same until the eight lobe cam attains a cam speed of about 2000 revolutions per minute. At the aforementioned cam speed, the dwell time of the pivot type of ignition breaker means drops to about 26 degrees at 2500 revolutions per minute and further drops to about 22 degrees at 3000 revolutions per minute. The ignition breaker means of the present invention remains at substantially a constant dwell time of 30 degrees at 2500 revolutions per minute and drops only slightly to 28 degrees at 3000 revolutions per minute. A significant improvement is seen in the present invention over the pivot type of ignition breaker.

While the invention is illustrated and described in an embodiment, it will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of this invention and as set forth in the appended claims.

Having thus described my invention, I claim:

1. An ignition breaker means for an internal combustion engine comprising, base means having a plurality of ears extending therefrom and integrally formed therewith, each of said ears spaced from the other, a displaceable breaker arm having one end thereof fixedly connected to first one of said ears and a free contact carrying end, said arm including restricted portions joining said free end to said end connected to said one ear, said restricted portions being oppositely formed necked-in portions defining a line across said arm about which said arm swings as said arm is displaced, means extending along the sides of said arm from said restricted portions to said contact for preventing flexing along said length of said arm, a rubbing block for displacing said breaker arm fixedly connected to said arm, return spring means have one end fixedly connected to said first ear and the other end thereof biased against said free end of said ignition breaker arm, and a fixed contact carried by a second ear of said plurality of ears and normally engaged with a movable contact carried by said ignition breaker arm.

2. An ignition breaker means for an internal combustion engine as claimed in claim 1, wherein said means extending along the sides of said breaker arm are flanges that extend along the lateral sides of said arm.

3. An ignition breaker means for an internal combustion engine as claimed in claim 1, wherein a means electrically insulates said breaker arm and return spring means from said one ear.

4. An ignition breaker means for an internal combustion engine as claimed in claim 1, wherein the other end of said return spring means is slidably biased against said free end of said breaker arm.

5. An ignition breaker means for an internal combustion engine as claimed in claim 1, wherein said fixed ends of said breaker arm and said return spring means are retained on said first ear in spaced relationship.

6. An ignition breaker means for an internal combustion engine as claimed in claim 1, including a clip means frictionally engaging with said breaker arm and said spring means so as to provide termination for conductors connected to said ignition breaker means.

7. An ignition breaker means for an internal combustion engine as claimed in claim 1, wherein said breaker arm is substantially flat and said free end of said return spring means is at an angle with respect to said breaker arm.

8. An ignition breaker means for an internal combustion engine as claimed in claim 1, wherein said fixed end of said return spring means includes oppositely extending walls which substantially prevent flexing of said fixed end of said spring.

9. An ignition breaker means for an internal combustion engine comprising, a base plate means having a plurality of ears extending therefrom and integrally formed therewith, each of said ears spaced from the other, a displaceable resilient breaker arm having one end thereof fixedly connected to first one of said ears and a free contact carrying end having a smaller width than the width of said one end, said arm including oppositely formed necked-in portions joining said free end of said end connected to said one ear, said necked-in portions defining a line across said arm about which said arm swings as said arm is displaced, flanges extending along the lateral sides of said arm from said necked-in portions to said contact for preventing flexing along said flanged length of said arm, a rubbing block for displacing said breaker arm fixedly connected to one side of said free end of said ignition breaker arm cantilever return spring means have one end fixedly connected to said first ear in spaced relationship with respect to said ignition breaker arm and the other end thereof slidably biased against said free end of said ignition breaker arm, means for electrically insulating said breaker arm and said return spring means from said one ear, a fixed contact carried by a second ear of said plurality of ears and normally engaged with a movable contact carried by said ignition breaker arm, and a clip means frictionally engaging with said breaker arm and said spring means so as to provide termination for conductors connected to said ignition breaker means.

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