March 2, 1937. W. B. KING 2,072,112

IGNITION SYSTEM

Filed July 28, 1932

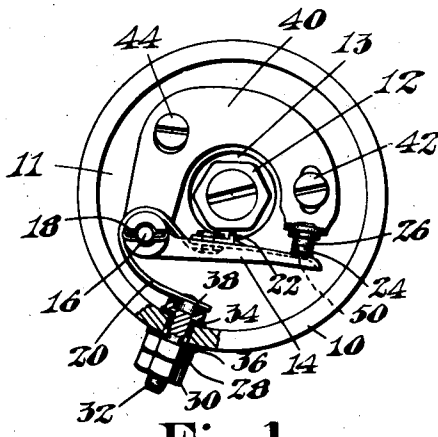


Fig.1.

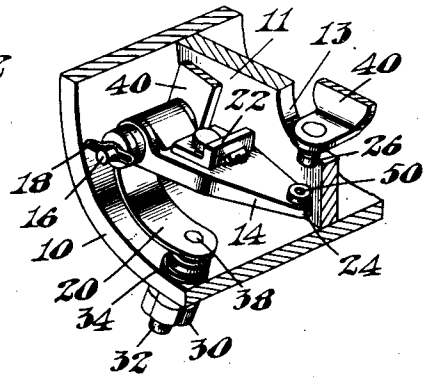


Fig.2.

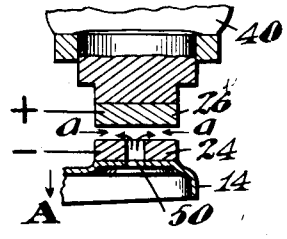


Fig.3.

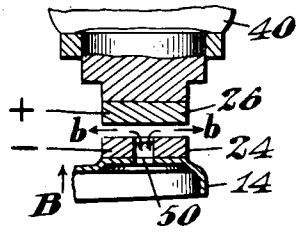


Fig.4.

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2,072,112

IGNITION SYSTEM

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Application July 28, 1933, Serial No. 625,363

8 Claims. (Cl. 200—30)

This invention relates to improvements in ignition systems for internal combustion engines and particularly to changes in the make-and-break contact members or so-called "breaker points" in the primary circuit of the usual high tension systems now used universally for automobile engines; these changes being such as to cause systems of this kind to function in an improved manner.

Although platinum and iridium were formerly used for such contact members, tungsten contact members of the general type shown in Patent No. 1,089,907, granted March 10, 1914, upon an application of William D. Coolidge, have universally superseded them for the reason that they are less expensive, wear longer and require much less attention.

With the advent of high compression engines within the last few years, more intense sparks are required at the spark plugs in the secondary circuit than formerly, so that higher voltages are required. In order to obtain the necessary energy from the usual six volt automobile storage battery, greater currents are needed in the primary circuit of the ignition system in which the breaker points are located. This has greatly increased the duty required of the tungsten points over that required when they were first introduced and for some years thereafter, because the current that must be broken is not only greater than formerly, but this greater current must be broken many more times per second because of the high speed at which such high compression engines are designed to operate. Under present average conditions, the contacts are made and broken at a rate of more than one hundred times per second, and it has been stated that this rate has been increased on occasions up to as high as four hundred times per second.

The high duty required of such present day tungsten points makes them subject, although to a lesser degree, to the troubles of the former platinum and iridium points, except that the reformation caused by the hammering action is successfully resisted by tungsten because of its extreme hardness.

Although some present day tungsten points operate without attention while the automobile in which they are used are driven for some thousands of miles, others will become almost inoperative after a few hundred miles. This variation is not fully understood but is probably caused by many variable factors such as, impurities in the tungsten metal or the use of alloys; oil and dirt on the points; varying action of the condenser bridged across the points; the resistance of the circuit; the condition of the spark coil; adjustment of the gap between the points when they are opened; number of breaks per second; and the spring tension on the breaker arm.

Regardless of the rate of deterioration, eventually the negative breaker point has built up upon it one or more sharp pointed projections, while opposite these projections craters are burned out on the positive breaker point. Apparently, the spark, which cannot be completely eliminated from between the contact members in the usual ignition systems, causes tungsten to be emitted, or vaporized, from the positive breaker point and the emitted metal moves from the positive to the negative breaker point, to which it becomes attached, and so furnishes the material from which the pointed projection becomes formed.

It appears that the growth of the pointed projection, in the usual ignition system, is continuously accelerated because of the following actions:— As the breaker points are separated, air is drawn in from around the edges of the area of contact to fill the partial vacuum created by the separation of the points. This air all rushes across the faces of the contact members toward the space between the centers of their areas of contact, where all the paths of travel meet, and where the emitted material, with which this air is filled, is carried. Electrical action at the same time draws the emitted material to the negative breaker point, to which it becomes attached, thus starting the formation of the above-mentioned pointed projection which is usually located near the center of the initial area of contact (or at the center of the contact member, if the contact members are flat and properly set). After the projection has started to form, the current becomes localized at this place on both breaker points, and this further increases the burning action on the positive breaker point, because of the increased current density, while the total area of contact through which current can pass is also reduced. Thus the resistance of the primary circuit is gradually increased and the primary current is gradually reduced. This gradually reduces the magnetic field formed in each cycle in the spark coil core. Consequently, when this lessened field collapses, as the circuit is broken between the breaker points, a gradually weaker spark is produced at the spark plug and the efficiency of the ignition and the engine is reduced. If this is allowed to continue long enough, without remedial attention, the engine will eventually fail to operate. From the above, it will be seen

that the efficiency of the engine probably starts to deteriorate slowly as soon as the breaker points are first used, so that the average user never obtains full efficiency from his engine and the rate of deterioration increases as the current is more and more localized and the current density (and burning) is increased.

It is one of the principal objects of the invention to provide a construction in which the rate of deterioration of the breaker points will be much reduced so that, instead of deteriorating through the usual growth of a rough and pitted formation thereon at or near the center of the contact area, they will, on the contrary, actually improve with use for a considerable period, after the area of contact between the breaker points has been trued up so as to be sufficiently large and properly located, and which will then not deteriorate so as to give unsatisfactory action until they have been in use several times longer than the points in general use.

It is another object of the invention to increase the speed, certainty and regularity in timing with which the primary circuit is closed at each "make" over that heretofore obtained, even with the points in good condition, in systems operated at the high speeds now used.

A further object is to increase the speed of the "break" in the primary circuit by increasing the electrical resistance of the emitted material which remains between the contact members after they open, and which resistance is probably lowest between the centers of the areas of contact where this material is concentrated by the partial vacuum formed by the separation of the points.

In accordance with the object of reducing the rate of deterioration of the breaker points with use, a feature of the invention consists in a construction in which the material which is emitted from the breaker points is distributed to locations and in amounts such that the undesirable localized formations heretofore referred to, do not occur but in which, on the contrary, the emitted material is distributed in a manner that will usually cause the breaker points to improve with use as soon as they are properly trued up and in which the formations heretofore referred to will form much more slowly and in a larger or much less localized area.

In accordance with another object, a feature of the invention consists in means for reducing, as much as possible, the cushioning effect of the air that is partially compressed between the movable breaker arm point and the stationary breaker point as the breaker arm moves, at the high rate heretofore mentioned, to complete the "make" in the primary circuit.

In accordance with the object of increasing the electrical resistance of the emitted or volatilized material between the contacts, another feature of the invention consists in means for introducing atmospheric air into the midst of the vapor of this material, thereby diluting it and so increasing its resistance.

Preferably, and as illustrated, a single feature of construction accomplishes all of the above-described objects and embodies the features of the invention just mentioned. This feature of construction consists of a vent or passage, extending, preferably, from substantially the center of the contact surface of one of the breaker points to a location which lies in atmospheric air, whether the breaker points are open or closed. Such a vent breaks the partial vacuum heretofore created in the space between the breaker points as they separate and changes the paths of travel of the particles of emitted material so that they do not all move toward the center of such space to create a projection. It permits some of the emitted material, produced by the spark that seems impossible to eliminate completely in the usual ignition systems, to pass away from between the surfaces of contact with some of the air that travels through the vent as this air is being compressed between the points as they close. Actual tests show that this emitted or vaporized material is condensed on the walls of the vent, when this vent is in the negative contact, which is the preferred construction. Another portion of the emitted material is blown, with another portion of the air being compressed, over the surfaces of the breaker points, where it is caught, by electrical attraction, upon the negative breaker point as the points come together. The remaining, or third portion of this material is blown completely beyond the outer periphery of the breaker points and apparently most of this collects on the cylindrical faces of the breaker points. No one of the separate portions of the emitted material is concentrated in a localized area where it will cause a projection, or projections, to be built up rapidly. Therefore, the rate of formation of the projections is greatly reduced, the current is much less localized to burn rapidly any craters in the opposite breaker point and accordingly deterioration of both breaker points is retarded for a long time.

It should be noted that the above results are due mostly to the circulation of air through the vent and between the breaker points, the circulation being produced by movement through the air of the contact member on the movable breaker arm which, as it cooperates with the other member, alternately compresses and rarefies the air between the contact members. This circulation not only carries some of the undesired emitted material away from between the points but likewise carries other undesirable material away, such as particles of dirt.

Furthermore, if the breaker points come into contact over an initial area sufficiently large to provide enough compressed air to function as above described, the emitted material will either be dispersed or will be deposited on the depressed portions of the negative contact member outside of the area of contact to bring such portions slowly up to contact level while the material is being emitted from the relatively high spots of the positive contact member, so that the area of contact will, at first, gradually increase and the condition of the breaker points, or contact members, will improve with use. It is essential, therefore, for the most successful operation of the invention, to inspect new or resurfaced breaker points frequently and level off carefully the portions in contact until a considerable area is in contact, as has been the practice heretofore. After the area of contact has been made to extend completely around the vent, the breaker points will require but little attention over long periods of time, except to maintain the specified gap between the breaker points.

How the above-mentioned vent in one of the breaker points accomplishes the object of increasing the speed, certainty and regularity in timing of the "make" in the primary circuit will now be explained. It has been shown how the compressed air between the breaker points escapes through this vent, carrying with it a certain amount of emitted material. As this air escapes from the space between the contact members, the

cushioning effect of the diminishing amount of remaining air between these members is reduced by a marked degree. Accordingly, the retarding effect of the air cushion is also reduced and the contact is made sooner in each cycle of movement of the movable breaker arm and is thus maintained during a longer period in the cycle, building up a stronger magnetic field in the coil. Upon the collapse of this increased field a spark of more intensity is obtained from the ignition system than heretofore, with conditions otherwise the same. Furthermore, any tendency for the arm to rebound on the air cushion is avoided with the substantial elimination of such cushion. The "make" therefore is made, not only with greater speed, as above described, but also with greater certainty and regularity in timing than heretofore because the breaker points do not meet varying conditions upon closing.

How the above-mentioned vent serves also as a port to introduce atmospheric air into the midst of the vaporized material to increase its electrical resistance (especially at the place where heretofore it has been the lowest) and increase the speed of the "break" is obvious.

Another reason for improved operation has been found in the fact that a bright metallic surface is formed upon the contact members which apparently gives a surface having a constant and minimum contact resistance while the resistance of the frosted or matt surface of the usual contact members is higher and more variable because the number and position of the innumerable minute contact surfaces is probably never alike on successive "makes" in the circuit.

All of the factors mentioned co-operate to produce increased power and smoothness of operation of the engine and of the car driven thereby.

For a better understanding of the invention, reference is made to the following description and the accompanying drawing, in which,

Fig. 1 is a plan view of a breaker point mechanism in which the present invention is incorporated,

Fig. 2 is a perspective view of a portion of the mechanism of Fig. 1, a portion of the distributor housing being broken away,

Fig. 3 is an enlarged sectional view of the breaker points at the time the points are being separated, with the air circulation indicated by arrows, and

Fig. 4 is a view similar to Fig. 3 at the time the breaker points are approaching each other.

10 is a distributor housing in which is positioned a plate 11 upon which is mounted the usual circuit breaking mechanism for the primary circuit of a high tension ignition system. A cam 12 is driven through a gearing connection from the internal combustion engine by a shaft which extends through an opening 13 in the plate 11. The cam 12 operates a breaker arm 14 which is mounted on a fixed pivot 16, being retained thereon by the spring cotter 18. A flat spring 20 tends to move the breaker arm toward the cam 12 and the arm is moved in the opposite direction by the corners of the cam striking a fiber block 22 riveted to the breaker arm. The breaker arm 14 carries a tungsten breaker point 24 which cooperates with a fixed breaker point 26 to make and break the usual primary circuit of the spark, or induction, coil used in the usual high tension ignition system.

The breaker arm 14 is, of course, insulated from the grounded distributor housing 10, the live wire of the primary circuit being connected by the nut 28 and checknut 30 to a stud 32 which is insulated from the housing 10 by the insulating bushing 34 and insulating washer 36. The stud 32 carries the current to the breaker arm 14 by means of a metallic button 38 riveted to the breaker arm spring 20, the tension of the spring maintaining the button 38 in electrical contact with a recess in the stud 32.

Adjustment of the breaker gap is accomplished by swinging an arm 40, which carries the fixed breaker point 26, about the same stud 16 upon which the insulated breaker arm 14 is pivoted. To make the adjustment, a clamping screw 42 is loosened and the arm 40 swung about the pivot stud 16 by turning an eccentric member 44 in the proper direction, after which the clamp screw 42 is tightened.

The above-described mechanism is all of usual construction and, except where its parts form an element or elements of the combination claimed, forms no other part of my invention.

To accomplish the previously-stated objects of my invention, a vent is located in one of the breaker points, preferably the negative one. This vent is shown, in its preferred form, at 50, and consists of an axial hole passing from the center of the contact surface of the movable breaker point, because this is the negative one in this instance, completely through that breaker point and through its support to the atmosphere beyond. When the fixed breaker point is the negative one, the vent would preferably be located in that one. The diameter of this vent is shown exaggerated in the drawing for clearness but it should actually be about .040'' to .050'' in diameter, according to the results of tests already made.

The operation of the invention has already been discussed but its operation may be more fully understood by a consideration of Figs. 3 and 4.

Referring first to Fig. 3. After the breaker points 24 and 26 have been in contact with each other, the breaker arm 14 moves in the direction of the arrow A to separate the points. As they separate, atmospheric air passes through the vent 50 in the direction of the small arrows, breaking the central portion of the partial vacuum which forms between the breaker points as they separate. This air meets, or collides with, the air that rushes in radially in the direction of the arrows *a*, *a*, to break the peripheral portion of the partial vacuum. The air between the breaker points contains some tungsten which has been emitted or vaporized from the positive breaker point 26 and the two colliding currents of air distribute this material. Thus, the air flowing through the vent 50 prevents this emitted material from being concentrated in the central area between the breaker points, where it would otherwise be attracted electrically by the negative breaker point 24 to form slowly, in the usual breaker point construction without the vent 50, a projection on the negative breaker point. The vapor being diluted by the air passing through the vent has its electrical resistance increased to cause a quicker and more complete break in the primary circuit and furthermore, as the vapor is now of more uniform density between the points, the emitted tungsten, as just stated, is more evenly distributed over the entire area of the negative contact member 24, where it adheres by electrical attraction.

Referring now to Fig. 4. On the return stroke of the breaker arm 14, it starts to move in the direction of the arrow B. This tends to com-

press the air between the breaker points 24 and 26. This air still contains emitted material because the break was probably made less than 1/100 of a second previously. Some of the partially compressed air containing this emitted material passes through the vent 50 in the direction of the small arrows, where the emitted material is deposited on the inside walls of the vent, as shown by actual tests (provided the vent is in the negative contact member as it should be). Another portion of this partially compressed air passes radially in the direction of the arrows *b*, *b*. A portion of the emitted material in this air is caught on the negative breaker point 24 where it is compacted by the blow as the points finally make contact and the remaining portion passes beyond the edges of the contact members and collects on the cylindrical surfaces of these members. It will be seen that the partially compressed air is allowed to pass freely from between the breaker points as they close so that the cushioning effect of the compressed air is greatly reduced, allowing the points to come together more quickly and without rebound.

In the above explanation it has been assumed, for clearness, that the breaker points are flat and in contact throughout their entire area. This ideal condition is rarely attained in actual practice when the breaker points are first installed and accordingly, after new breaker points are installed they should be inspected a few times and trued up until an area of contact is obtained that completely encircles the vent 50 and is of sufficient area to produce the above-described air circulation. This requires no more than the attention which should be given to any newly installed breaker points. After this sufficiently extended area of contact completely around the vent 50 has been attained, the breaker points require no further attention for a long period of time. The emitted tungsten collects at the edges of the area of contact on the negative breaker point until it is thick enough to make contact with the opposite portions of the positive breaker point. This results in the area of contact gradually increasing until substantially the entire area is in contact, unless too much emitted material is dispersed, which causes the negative contact member to become slightly concave, in which case the outer edge only of the area of contact connects with the positive breaker point.

Although practically no material is emitted from the central portion of the positive contact member, (as it is opposite the vent where it can make no contact), the projection which is left after the surrounding portions have been vaporized will not interfere with the operation of the device for an exceedingly long time. It is necessary, however, that the gauge by which the gap is adjusted be so cut away as to clear this portion of the positive breaker point.

Experiment has shown that, when the vent is in the positive breaker point, no vaporized tungsten is deposited on the walls of the vent and that projections are still formed on the negative point. It is believed, however, that their growth is less rapid than would be the case without the vent. Therefore, as previously stated, it is preferred to locate the vent in the negative breaker point (whether it is the fixed or the movable one) where the emitted material otherwise tends to collect at its center. As the portion of material traveling toward the center has no place to collect at the center, with a vent at that location, it passes through the vent where it can cause no trouble. The travel through the vent is aided by the electrical attraction in this case.

In view of the facts just stated, certain of the appended claims define the vent as located in the negative contact member or breaker point but, unless thus specified, the claims should be construed to protect constructions in which the vent is located in either breaker point, because some retardation in the formation of the projection on the negative contact member is obtained with the vent in the positive contact member and the reduction of the air cushion between the points, and consequent improved spark at the spark plugs, is obtained with the vent in either contact member.

Instead of providing an axial vent 50, the vent may consist of one or more grooves cut in the face of one of the breaker points, or of any other suitable construction. Such constructions are intended to be covered by such of the appended claims as can be construed to cover them, although the construction preferred at present is that illustrated in the attached drawing.

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

1. In a high tension ignition system for internal combustion engines, a pair of relatively movable contact members with substantially flat opposed contact surfaces of substantial area, one of said contact members having a vent through which atmospheric air may pass to and from the space between the contact surfaces upon each separating and each approaching movement, respectively, of the contact members and means to move said contact members relatively to and from each other a plurality of times per second.

2. In a high tension ignition system for internal combustion engines, a pair of relatively movable contact members with substantially flat opposed contact surfaces of substantial area, the negative contact member having a vent through which atmospheric air may pass to and from the space between the contact surfaces upon each separating and each approaching movement, respectively, of the contact members and means to cause said movements to occur alternately in rapidly recurring sequence.

3. In a high tension ignition system for internal combustion engines, a pair of relatively movable contact members with opposed contact surfaces and a vent in the negative contact member for carrying a portion of the material emitted from the positive contact surface away from between the contact members and acting to cause distribution of another portion of the emitted material over the negative contact surface, whereby any tendency to form a projection of material on either contact surface will be greatly retarded and means to move said contact members relatively to each other a plurality of times per second.

4. The combination, with a pair of relatively movable contact members operating in repeated cycles to make and break an electrical circuit with such rapidity that an air cushion is formed between the contact members upon each "make" in the circuit, of a vent to permit the cushioned air to escape whereby contact is made earlier in each cycle of motion and thus maintained during a longer period in the cycle.

5. The combination, with a pair of relatively movable contact members operating to make and break an electrical circuit with such rapidity that

volatilized material remains in the space between the contact members at all times while they are separated, of a port for conducting atmospheric air into the mass of said material to separate the particles thereof and increase the electrical resistance of said space, whereby a more effective and quicker "break" is made in the circuit.

6. In an electrical circuit provided with contact members having opposed contact surfaces which move rapidly relatively to each other to "make" and "break" the circuit, the method of increasing both the speed and certainty of the "make", and also the time of its duration, which consists in expelling a portion of the entrapped air cushion, formed during the approach of the members, from within the peripheries of the contact surfaces through a vent while another portion escapes between and beyond the outer peripheries of the contact surfaces.

7. In an electrical circuit provided with contact members having opposed contact surfaces which move rapidly relatively to each other to "make" and "break" the circuit, the method of reducing the tendency to form projections on either contact surface from volatilized material of said members which consists in breaking through a vent the partial vacuum formed between and within the outer peripheries of the contact surfaces upon the separation of the members so as to prevent concentration of said material between the surfaces and to permit a portion of the material, during approach of said members, to pass from between said surfaces through said vent while another portion passes between and beyond the outer peripheries of the contact surfaces.

8. In an electrical circuit provided with contact members having opposed contact surfaces one of which has a vent, which contact surfaces move rapidly relatively to each other to "make" and "break" the circuit, the method which consists in distributing volatilized material of said members by colliding currents of air during each separation of said members for reducing the tendency to form projections on either contact surface from said volatilized material.

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