United States Patent

Wisely

[15] **3,647,995**

[45] **Mar. 7, 1972**

[54] **ROTARY MULTIPLE CONTACT PERIODIC SWITCH FOR INTERNAL COMBUSTION ENGINE WITH IMPROVED DISTRIBUTOR SHAFT CONTACT COLLAR**

[72] Inventor: **Kenneth Wisely,** Mattoon, Ill.

[73] Assignee: **John J. Yelvington,** Mattoon, Ill. a part interest

[22] Filed: **Dec. 10, 1970**

[21] Appl. No.: **96,982**

Related U.S. Application Data

[63] Continuation of Ser. No. 16,273, Mar. 4, 1970, abandoned.

[52] **U.S. Cl.**.....**200/24,** 123/146.5, 200/26, 200/28, 200/166

[51] **Int. Cl.**.....**H01h 39/00,** H01h 19/00, H01h 1/00

[58] **Field of Search**.....200/19, 22, 24, 26, 28, 31, 200/166 BE, 166 BH; 123/146.5, 148

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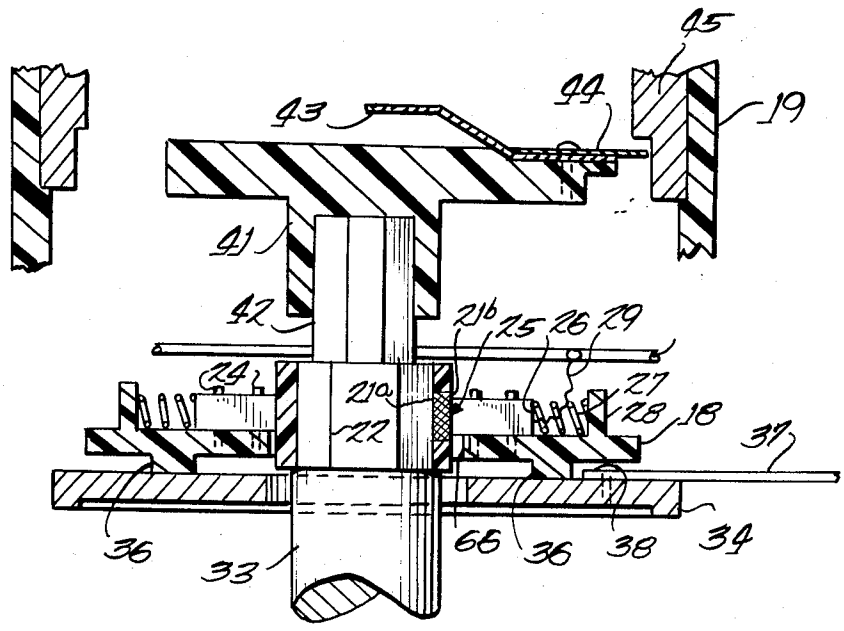
Primary Examiner—J. R. Scott

Attorney—Pendleton, Neuman, Williams & Anderson

[57] **ABSTRACT**

An ignition system for an internal combustion engine has circularly arranged stationary brushes and one or more insulated contacts rotating with the distributor shaft which replace the make-and-break contacts of an ordinary engine ignition system. The brushes and rotating contacts are adaptable to be mounted in the ordinary distributor housing. A single contact on the distributor shaft provides one ignition spark in each power stroke of a piston and more than one contact provides a corresponding number of sparks in each power stroke.

12 Claims, 11 Drawing Figures



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Fig. 1.

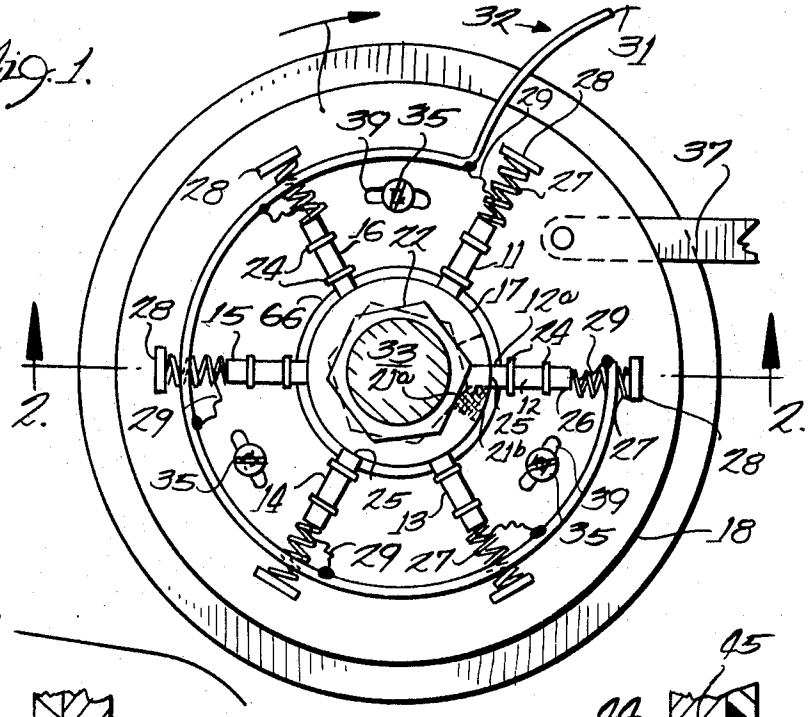


Fig. 2.

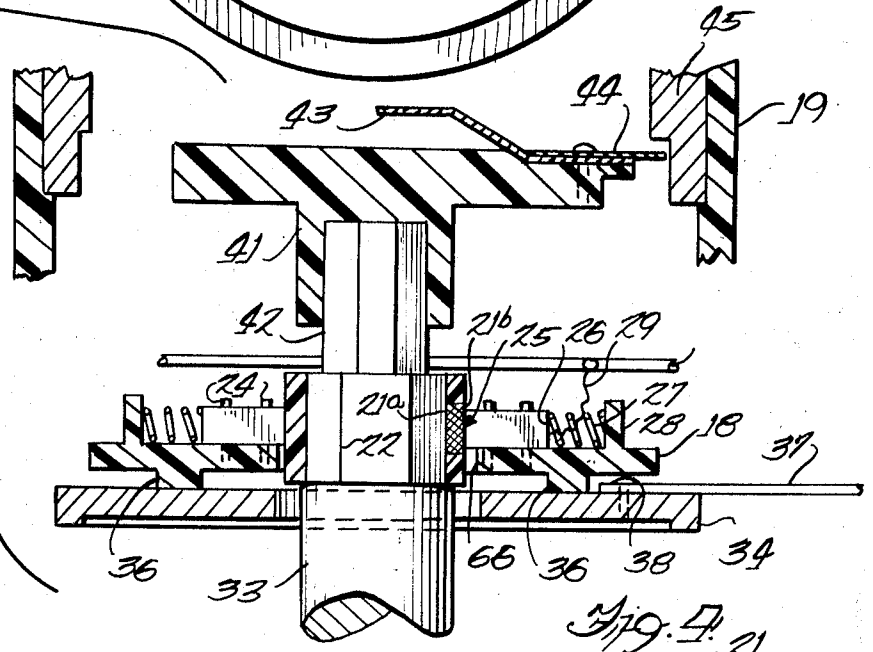


Fig. 3.

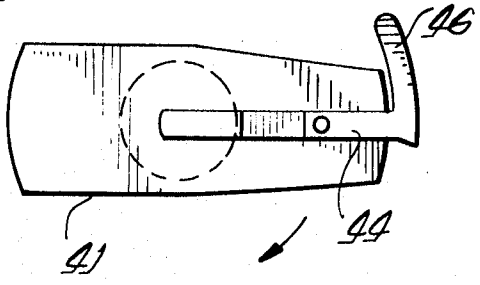
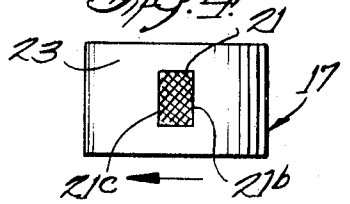


Fig. 4.



Inventor
Kenneth Wisely
by: Pendleton, Neuman, Seibold & Williams
Atty's

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Fig. 5.

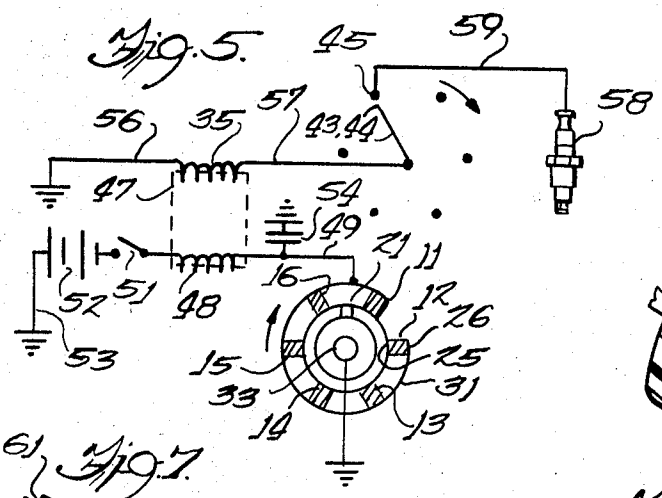


Fig. 6.

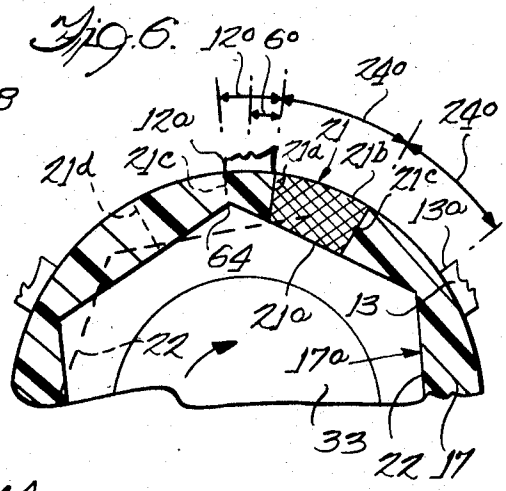


Fig. 7.

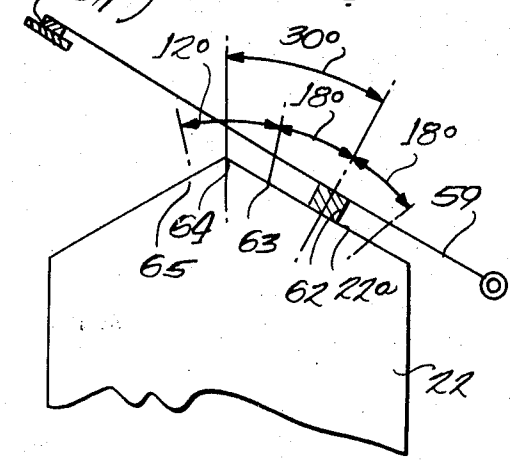


Fig. 8.

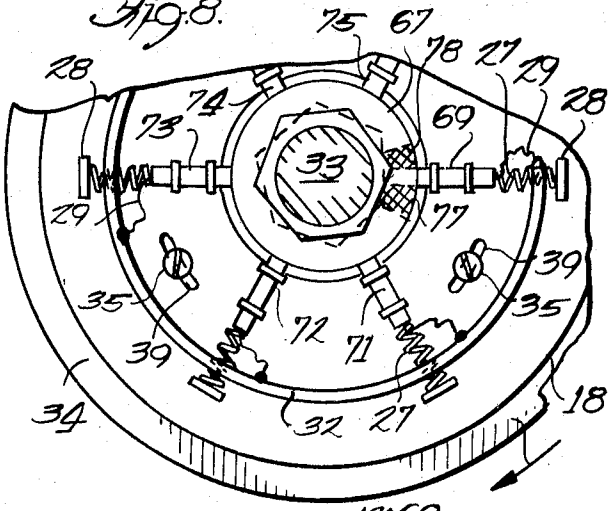


Fig. 9.

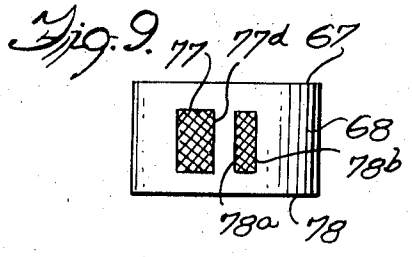


Fig. 10.

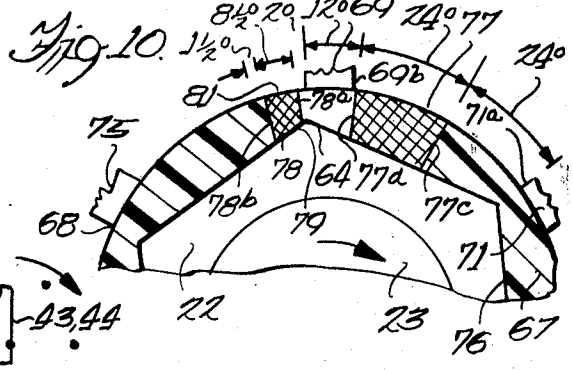
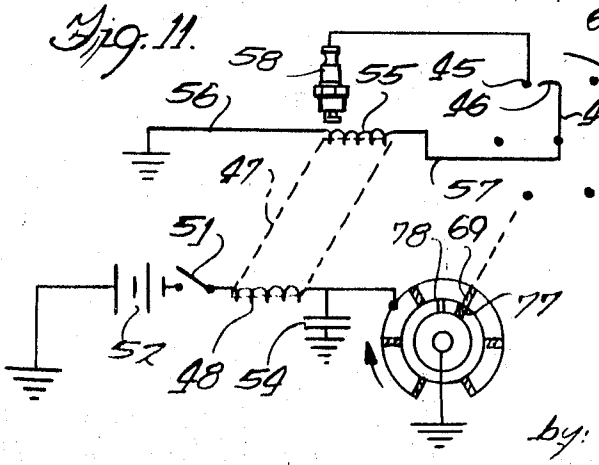


Fig. 11.



Inventor
Kenneth Wisely
Pendleton, Neuman, Seibold
by: & Williams
Atty's

ROTARY MULTIPLE CONTACT PERIODIC SWITCH FOR INTERNAL COMBUSTION ENGINE WITH IMPROVED DISTRIBUTOR SHAFT CONTACT COLLAR

This application is a continuation of application Ser. No. 16,273, filed Mar. 4, 1970, now abandoned.

BACKGROUND OF THE INVENTION

The invention relates to internal combustion engine ignition systems and apparatus of the brush and contact type, and more particularly to such systems and apparatus wherein the brushes are stationary and the contact or contacts rotate, and it is the object of the invention to provide an improved system and apparatus of this character.

It has been found that the provision of two ignition sparks for each power stroke of a piston in an automobile engine substantially improves the operation of the engine, particularly at higher speeds. The improved operation includes increased gasoline mileage, increased high speeds, and generally improved performance. It is believed that the improved performance is attributable to substantially improved combustion of the mixture in the engine cylinder.

The internal combustion engine, and particularly the automobile engine, has come in for much criticism because of its exhaust emission and the concomitant pollution of the atmosphere. Improving the fuel combustion in the cylinders of automobile engines and the like, especially where this results in substantially decreased carbon monoxide emission, is a very worthwhile objective. Accordingly, it is a further object of the invention to provide an ignition system for an automobile engine which contributes greatly to decreased atmospheric pollution.

The ignition system of an ordinary automobile engine and similar engines have breaker points which are actuated by a follower engaging the surface of a breaker cam. The follower, the cam, and the breaker points are subject to wear and corrosion and require periodic adjustment, which is expensive. It is also quite inconvenient and annoying because it takes the vehicle out of service. It is an object of the invention to minimize this problem.

Prior art devices for providing more than one spark to each piston power stroke are known, as in U.S. Pat. No. 3,221,116, D. M. McAllister, and prior devices utilizing brush and rotating contact combinations are known, as in U.S. Pat. Nos. 1,494,597, W. A. Evans; 2,278,679, K. Straub; 2,593,205, B. H. Short et al.; 2,839,622, A. H. Billings; 3,004,115, J. de Rugeris; 3,022,389, V. F. Wolrab; 3,052,764, J. de Rugeris; 3,087,000, R. R. Krone; 3,270,150, R. A. Stevens; 3,342,955, W. C. Smith et al.; 3,435,161, M. A. Webster; and 3,372,249, D. D. Withem. The devices of these patents have not effectively eliminated the problems existing in the ignition system. Particularly, the problem of eliminating the effects of wear between the moving parts has not been solved. Prior devices create an unbalanced force between the brush and rotating contact or commutator members, thereby resulting in uneven wear, giving rise to eccentricities of the rotating contact member. In turn, this causes wobbling of the brush or brushes riding on the contact surface with consequent poor ignition. It is a further object of the invention to provide a combination of stationary brushes and rotating contacts which reduce wear of these parts to a minimum, if not eliminating it altogether, and wherein such wear as occurs is uniform.

Other objectives and advantages of the invention will become apparent as the description proceeds.

SUMMARY OF THE INVENTION

In carrying out the invention in one form, there is provided an ignition system for an internal combustion engine of the type including a series of cylinders, a spark plug for each cylinder, a spark coil, and distributor means including a rotor driven by a metallic distributor shaft for directing ignition sparks from such spark coil to conducting leads extending to such spark plugs and a contact supporting plate comprising an

insulating collar having an exterior cylindrical surface surrounding said metallic distributor shaft; contact means which engage said metallic distributor shaft, extend through said insulating collar and terminate on said cylindrical surface; a series of brushes insulatingly mounted on said supporting plate; said brushes being circumferentially spaced around said distributor shaft at the same angle relative to each other and each having one end bearing against said exterior cylindrical surface in a plane so as to engage said termination of said contact means during its rotation; the angular spacing between successive ones of said brushes being equal to 360° divided by the number of engine cylinders; means urging each one of said brushes into engagement with said cylindrical surface; and conductor means for connecting each one of said brushes to a source of electrical current; the angular extent, at the cylindrical surface of said collar, of said contact means being less than the angular extent between the rearward and forward edges of successive ones of said brushes.

In carrying out the invention in another form, there is provided apparatus for making and breaking the primary circuit of an automobile ignition system two times in the power stroke of each piston for providing a primary ignition spark and a secondary ignition spark to each spark plug including a distributor having a metallic distributor shaft and a peak-and-dwell circuit breaker cam thereon adapted to open and close breaker points, comprising a series of stationary equiangularly spaced brushes adapted to be mounted circumferentially in the distributor of said ignition system; a rotating insulating cylindrical collar having interior peaks and dwells to be disposed over said circuit breaker cam; a primary contact member and a secondary contact member extending through said collar and being spaced apart from each other, each of said primary and secondary contact members having an interior terminus and an exterior terminus; conductor means connecting one end of each of said brushes to a source of electrical current; the other ends of each of said brushes being adapted to ride on the cylindrical surface of said collar and to engage said exterior termini of said primary and secondary contact members; said interior termini of said primary and secondary contact members being adapted to engage the surface of said circuit breaker cam; the angular spacing, at the cylindrical surface of said collar, between the radius of the trailing edge of said exterior terminus of said primary contact member and the radius of the next rearward interior peak of said collar being essentially equal to the angular spacing between the the radius of the point on said circuit breaker cam where such breaker points would open and the radius of the next rearward peak of such breaker cam; the angular spacing, at the cylindrical surface of said collar, between the trailing edge of said exterior terminus of said primary contact member and the radius of the exterior terminus of the leading edge of said secondary contact member being greater than the angular width, at said cylindrical surface of any of said brushes; the angular spacing at the cylindrical surface of said collar, between the radius of the trailing edge of said primary contact member and the radius of the trailing edge of said secondary contact member corresponding to the predetermined time interval between such first and second sparks; the angular spacing, at the cylindrical surface of said collar, between the radius of the leading edge of said primary contact member and the radius of the trailing edge of said secondary contact member being less than the angular spacing, at the cylindrical surface of said collar, between the radii of the rearward edge of any of said brushes and the forward edge of the next rearward brush.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view, somewhat diagrammatic, of an internal combustion engine ignition system and apparatus according to the invention;

FIG. 2 is a sectional view, including additional structure, taken substantially in the direction of the arrows 2—2 of FIG. 1;

FIG. 3 is a top view of one operating component of the apparatus;

FIG. 4 is an elevational view of another operating component of the apparatus illustrated in FIG. 1;

FIG. 5 is a wiring diagram of an ignition system embodying the invention according to FIG. 1;

FIG. 6 is a fragmentary sectional view on a larger scale of certain components illustrating one manner of operation;

FIG. 7 is a schematic view of a portion of an ordinary automobile engine ignition system;

FIG. 8 is a top view similar to FIG. 1 of another form of the invention;

FIG. 9 is an elevational view of one operating component of the apparatus illustrated in FIG. 8;

FIG. 10 is a fragmentary sectional view on a larger scale of certain components illustrating another manner of operation; and

FIG. 11 is a wiring diagram of an ignition system embodying the invention according to FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, the ignition system and apparatus **10** are shown comprising a series of brushes **11, 12, 13, 14, 15,** and **16,** and a rotor **17.** The brushes are disposed on an insulating plate **18** which is adapted to be mounted in an ordinary distributor, the distributor cap of which is illustrated by the reference character **19** in FIG. **2.** The rotor **17** is of insulating material, such, for example, as nylon, includes a metallic contact **21,** and is adapted to be received over the peak-and-dwell cam **22** of the ignition system of an ordinary automobile engine. For this purpose, the interior surface of contact member **17** is hexagonal in form, having dwells and peaks corresponding to the dwells and peaks of the cam **22.**

The contact **21** extends through the wall of member **17** so that its interior terminus **21A** engages the surface of cam **22** for completing the electrical circuit. The exterior terminus **21B** of the contact **21** conforms to the cylindrical outer surface **23** of the member **17** and lies in a plane determined by the brushes **11–16.**

While six brushes and a hexagonal cam **22** are shown and apply to a six-cylinder engine, it will be understood that this is by way of example only, and that the invention has application to engines of any desired number of cylinders. In any case, the brushes are circumferentially spaced at equal angles relative to each other, such angles being equal to 360° divided by the number of engine cylinders. As shown, the brushes are spaced apart 60°. The ignition system is shown as applying specifically to an automobile engine, but it has equal application to other similar internal combustion engines.

Each of the brushes **11–16** is slideably mounted on the insulating member or plate **18** by a pair of U-shaped stirrups **24.** The ends of the stirrups are firmly embedded in the plate **18,** but other means for slideably holding the brushes to the plate may, of course, be used. The inner end **25** of each of the brushes is curved so as to conform to the circumference of the rotating member **17,** and the opposite end, or base, **26** of each brush is adapted to have one end of a spring **27** bear thereagainst. The other end of each spring **27** bears against a suitable abutment **28** forming part of the supporting plate **18** so that the springs **27** urge their respective brushes **11–16** against the cylindrical surface of contact collar **17.** The base **26** of each of the brushes is connected by a conductor or pigtail **29** to the conductor **31** of an insulated wire **32,** whereby electrical current may be supplied to the brushes when needed. The inner terminus **21A** of contact **21** in engaging the surface of metallic cam **22** which is driven by the distributor shaft **33** of the ordinary engine becomes part of the electrical circuit because the metal parts of the engine, including the distributor shaft, form a ground.

The brush-supporting plate **18** is attached to the make-and-break distributor points supporting member **34** of the ordinary engine by means of screws **35,** for example, plate **18** being spaced from the supporting member **34** by suitable spacers **36.** The breaker point supporting member **34** is shown as being connected to the usual spark advance-and-retard lever **37** which is pivoted to supporting plate **34** by a suitable pin **38.** Provided in brush-supporting plate **18** are arcuate slots **39** through which the shanks of screws **35** are received for permitting positional adjustment of the brush-supporting plate.

Referring to FIG. **2,** there is shown the usual distributor rotor **41** which is suitably keyed to the upper end **42** of the distributor shaft **33.** The rotor includes a spring contact finger **43,** contacting a terminal **44** which cooperates with the usual terminals **45** in the distributor cap **19.** The terminal **44** includes an arcuate tail, or extension, **46** for a purpose to be described.

Referring to FIG. **5,** the ignition circuit may be visualized. Thus, the ignition coil **47** has a primary winding **48** which has one end connected through conductor **49** to the conductor **31,** and thus through the brushes **11–16,** the rotating contact **21** and the distributor shaft **33,** to ground. The other end of primary coil **48** is connected through the ignition switch **51,** battery **52** and conductor **53,** to ground. The capacitor **54** is connected to ground and to conductor **49,** as shown, to prevent arcing at the brushes, as is well understood. The coil **47** includes a secondary winding **55** connected to ground at one end through conductor **56,** and at the other end through high-voltage conductor **57** to the metallic members **43** and **44** of rotor **41.** Contact **46** of rotor **41** completes the circuit to the engine spark plugs **58** through terminals **45** and spark plug leads **59.** In the form of the invention shown in FIG. **1,** the terminal **44** need not have the extension **46** so long as the end of terminal **44** ends closely adjacent the terminals **45.**

The operation of the ignition system and additional structure may now be described. With the ignition switch **51** closed, electric current is supplied to the primary winding **48** when the leading edge **21C** of contact **21** engages the rearward edge **12A** of brush **12,** for example. See, particularly, FIG. **6.** In this figure, the cam **22** is in a position, shown dotted, when the leading edge **21C** of contact **21,** also in a dotted position, engages the rearward edge **12A** of brush **12.** As cam **22** rotates clockwise, it reaches the position shown by the solid lines, at which time the leading edge **21C** of contact **21** has reached the point shown by the solid lines in FIG. **6.** Correspondingly, the trailing edge **21D** of contact **21** has moved from its initial position, shown dotted, to its final position, shown solid, where the trailing edge **21D** is just about to leave the forward edge **12B** of brush **12.** Just as trailing edge **21D** leaves the forward edge **12B,** the circuit to the primary winding **48** is broken and a high-voltage spark is created by the secondary winding **55,** causing the spark plug **58** to fire. Thus, the separation of trailing edge **21D** and forward edge **12B** corresponds to the opening of the circuit breaker contacts of an ordinary engine ignition system.

Correspondingly, the length of travel from the point where the leading edge **21C** of contact **21** engages the rearward edge **12A** of brush **12** until the trailing edge **21D** of contact **21** leaves the forward edge **12B** of brush **12** corresponds to the cam-dwell period of an ordinary engine ignition system.

In FIG. **6,** the angular extent of contact **21** at the radius of engagement with brush **12** is shown as about equal to twice the angular extent of brush **12,** and brush **12** is shown as being about 12° in angular extent. This combination of angular dimensions results in a dwell or primary circuit closed of about 36° (brush width plus contact width). As shown in FIG. **6,** the leading edge **21C** of contact **21** on continued rotation will engage the rearward edge **13A** of brush **13** preparatory to firing the next cylinder. This travel of contact **21** corresponds to 24° of distributor shaft rotation, indicating that the open circuit portion of the cam interval is 24°. Thus, as shown, the dwell of the circuit is 36° and the open portion is 24°, as is typical of a six-cylinder automobile engine.

It will be apparent that other combinations of angular extents of the brushes and contacts may be selected to achieve particular conditions of operation.

Substantial flexibility of operation accrues from the rotating contact apparatus as described in that the angular extend of the contact **21** can be of any dimension so long as it is slightly less than the angular distance between the forward edge **12B** of brush **12** and rearward edge **13A** of brush **13**. In this way, the dwell, or energization portion of the primary coil may be increased, resulting in a better spark and consequently better combustion of the mixture in the engine cylinder.

The rotating member **17** may be termed a collar inasmuch as it fits relatively tightly over the make-and-break cam **22**.

For use in an already existing automobile engine, for example, the interior hexagonal surface **17A** of the collar must fit appropriately relative to the cam **22** of the existing engine. Referring to FIG. **7**, there is shown, schematically, a hexagonal cam **22**, a breaker arm **60** and points **61**, a follower **62** being disposed to bear on the cam surface for actuating the points **61**. In the position shown, the follower **62** is in the middle of the dwell period of cam surface **22A**. About 18° of rotation later of cam **22**, when point **63** reaches follower **62**, the points **61** open. Thus point **63** corresponds to the separation of trailing edge **21D** and forward edge **12B**, as described. For the particular conditions indicated, then, the peak **64** of cam **22** must be about 12° of rotation behind the opening point of the contacts. Twelve degrees of rotation after this, when point **65** reaches the center of follower **62** (a total travel of 24°), the contacts **61** again close, and this closing point corresponds to the time when the leading edge **21A** reaches the rearward edge **13A**, as shown in FIG. **6**, to begin a new dwell period.

To permit adjustments in relative location of the brush assembly **11–16**, **18** and rotating contact **21**, the arcuate slots **29** have been provided as described. After the appropriate adjustment has been made, the automatic spark mechanism of the engine by means of lever **37** operates the mechanism in the customary manner.

The circumferential or angular extent of contact **21** may be chosen along with the circumferential or angular dimensions of the brushes to achieve the desired dwell and open periods, and the axial dimension of the contact **21** may be selected to be larger than the axial brush dimension as shown in order to achieve decreased resistance.

The symmetrical arrangement of the brushes brings equal wear forces to bear on the collar **17** whereby this member will wear uniformly without creating any eccentricities. Accordingly, necessary spark adjustments are reduced to a minimum. Moreover, material such as nylon, of which the collar **17** may be made, does not wear significantly and, accordingly, the collar and contact will last a long time. The contact **21** may be made of any suitable conducting material, such as copper or compressed carbon, for example.

The brush combination supported by plate **18** can be attached to an existing ignition system, for which purpose the supporting plate **18** has a circular opening **66** large enough to easily slip over the collar **17**. The collar **17**, instead of being a separate unit adaptable to be attached to the cam **22** of an existing engine, may be formed as part of the distributor shaft in the first instance by the engine manufacturer.

It will be understood that the rotor **41** is located in the usual manner so that contact **44** is opposite the appropriate terminal **45** when the spark is to occur. The brush-supporting plate **18** may be located to cause the trailing edge **21D** and forward edge **12B** to separate, that is, to create a spark at the desired point in the engine cycle, usually somewhat ahead of the top dead center position of the particular piston. While the operation has been described with respect to a particular brush **12**, it will be evident that the same type of operation occurs at every other brush.

It has been found that more efficient operation, higher speeds, better combustion and improved operation generally can be obtained in an ordinary engine by firing the spark plug of each cylinder more than once during the same piston power stroke. For example, the first or primary spark, at some speed, may occur approximately 8° ahead of the top dead center position of a particular piston, and the second or secondary spark, at the same spark plug, may occur about 45° later in rotation of the engine crankshaft, which is to say about 22½° later in rotation of the distributor shaft. The reason for the improved engine performance, due to the second spark, is not fully understood because, after the first spark, the fuel mixture in the cylinder is burning, but it has been found that a second spark causes improved performance, as stated. At the present time, with the constant and heavy emphasis on minimizing, if not eliminating, atmospheric pollution from any source, including automobile engines, it is a worthwhile effort to improve the fuel combustion in such an engine.

Referring to FIGS. **8–11**, there is shown a form of ignition system wherein two sparks are provided during each power stroke of a piston. Thus, there is shown a rotating insulating collar **67** having an exterior cylindrical surface **68** for cooperation with the inner ends of the brushes **69**, **71**, **72**, **73**, **74** and **75**, as described for brushes **11–16**, and having an interior hexagonal surface **76** to be tightly received over the ordinary make-and-break cam **22**. Insulating collar **67** includes a conducting contact **77** of the same dimensions, termini and location as contact **21** of collar **17**. Accordingly, the primary ignition spark will occur, in this form of the invention, at the same time as the spark occurs in the form shown in FIG. **6**, that is, when the trailing edge **77D** of contact **77** leaves the forward edge **69B** of brush **69**. The operation of the coil **47** and the circuit for creating the spark are the same as shown in and described in connection with FIG. **5**.

Collar **67** includes a second contact **78** which has an interior terminus **79** for engaging the surface of cam **22** and an exterior terminus **81** for engaging the inner ends of the brushes. The leading edge **78A** of contact **78** is angularly, or circumferentially, disposed behind the trailing edge **77D** by an angular extent slightly greater (for example, 2°) than the angular extent of brush **69**. In this manner, the first or primary spark occurs before the dwell period begins for the next or secondary spark, and no short circuit of the coil during the first spark takes place. The trailing edge **78B** of contact **78** extends angularly 8½°, for example, behind leading edge **78A**, so that this trailing edge **78B** moves away from the forward edge **69B** of brush **69** before the leading edge **77C** of contact **77** reaches the rearward edge **71A** of brush **71**. In this manner, again, no short circuit of the ignition coil during the secondary spark takes place, and the separation between trailing edge **78B** and the forward edge **69B** (22½°) takes place to create the secondary spark at the spark plug at the desired time interval. In the form shown in FIG. **10** a 1½° interval has been allowed for trailing edge **78B** to leave forward edge **69B** before leading edge **77C** reaches the rearward edge **71A**. That is to say, the overall angular or circumferential extent of the two contacts **77** and **78** is slightly less than the angular extent between the forward edge **69B** of brush **69** (or any brush) and the rearward edge **71A** of the next forward brush **71** (or any next forward brush).

In the example shown in FIG. **10**, the dwell period for the first spark is 36°, as is typical with six-cylinder engines, and the dwell period of the second spark is about 20½°, that is, equal to the angular width of the brush **69** (12°) plus the angular width of contact **78** (8½°).

The location of the cam peak **64** for the structure shown in FIG. **10** is the same as that shown for the structure in FIG. **6** inasmuch as the first, or primary, spark should occur at the same relative point in the engine cycle.

Referring to FIG. **11**, it will be evident that the circuit diagram is essentially the same as that of FIG. **5**. However, in order to produce two sparks at each spark plug, it is necessary that the distributor rotor **41** include the arcuate extension **46** so that when the second contact **78** breaks its circuit to create the second spark, the tail of extension **46** is still adjacent the distributor terminal **45**, thereby to cause the voltage impulse to travel along the spark plug wire to the spark plug **58**. The length of the extension **46** is selected to correspond to the angular travel of the distributor shaft, that is, the travel of collar **67**, between the first and second sparks. In the particular ex-

ample, the extension **46** must be about 22½° long or somewhat longer.

In the form of the invention shown in FIGS. **6–11**, the angular extent of the brushes and the angular extent of the contacts may be selected to give the desired amounts of dwell and open in the primary circuit of the coil. The ignition adjustments as described for the first form of the invention also apply with respect to the second form. Likewise, the advantages of the invention also apply.

It will be clear that more than two contacts may be disposed in the collar **67**. As many as six may be advantageous.

In the second form of the invention, while the collar **68** may be constructed to be utilized in an existing engine along with an appropriate assembly of brushes, it will be clear that the structural components of collar **68** may be part of the distributor in the first instance.

It is to be understood that the present disclosures have been made only by way of example and that many additional modifications, changes, and various details may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An ignition system for an internal combustion engine of the type including a series of cylinders, a spark plug for each cylinder, a spark coil, and distributor means including a rotor driven by a metallic distributor shaft for directing ignition sparks from such spark coil to conducting leads extending to such spark plugs and a contact supporting plate, comprising; an insulating collar having an exterior cylindrical surface surrounding said metallic distributor shaft; contact means in electrical contact with said metallic distributor shaft, extend through said insulating collar and terminate on said cylindrical surface; a series of brushes insulatingly mounted on said supporting plate; said brushes being circumferentially spaced around said distributor shaft at the same angle relative to each other and each having one end bearing against said exterior cylindrical surface in a plane so as to engage said termination of said contact means during its rotation; the angular spacing between successive ones of said brushes being equal to 360° divided by the number of engine cylinders; means urging each one of said brushes into engagement with said cylindrical surface; and conductor means for connecting each one of said brushes to a source of electrical current; the angular extent, at the cylindrical surface of said collar, of said contact means being less than the angular extend between the rearward and forward edges of successive ones of said brushes.

2. The invention according to claim **1** wherein said contact means comprises a single contact member.

3. The invention according to claim **1** wherein the series of brushes and the urging means are mounted on an insulating plate which is attached to the contact supporting plate.

4. The invention according to claim **1** wherein the insulating collar has an interior surface conforming to the primary circuit breaker cam of a regular automobile distributor.

5. The invention according to claim **4** wherein the series of brushes and the urging means are mounted on said insulating plate which includes a central opening to be received over said insulating collar when said insulating plate is attached to the contact supporting plate.

6. The invention according to claim **5** wherein the insulating plate includes arcuate slots for enabling adjustment of said insulating plate.

7. The invention according to claim **5** wherein the urging means comprises an individual spring bearing against the base of each of said brushes.

8. Apparatus for making and breaking the primary circuit of an automobile engine ignition system including a distributor having a distributor shaft and a peak-and-dwell circuit breaker cam thereon adapted to open and close breaker points comprising a series of stationary equiangularly spaced brushes adapted to be mounted circumferentially in the distributor of said ignition system; a rotating insulating cylindrical collar having interior peaks and dwells to be disposed over said circuit breaker cam; and a contact member extending through said collar and having an interior terminus and an exterior terminus; conductor means connecting one end of each one of said brushes to a source of electrical current; the other ends of each of said brushes being adapted to ride on the cylindrical surface of said collar and to engage said exterior terminus of said contact member; said interior terminus of said contact member being in electrical contact with the surface of said circuit breaker cam; the angular spacing, at the cylindrical surface of said collar, between the radius of the trailing edge of said exterior terminus of said contact member and the radius of the next rearward interior peak of said collar being essentially equal to the angular spacing between the radius of the point on said circuit breaker cam where the breaker points of an automobile ignition system open and the radius of the next rearward peak of such breaker cam; and the angular spacing, at the cylindrical surface of said collar, between the radii of leading and trailing edges of said contact member being less than the angular spacing, at the same cylindrical surface, between the radii of the rearward edge of any of said brushes and the forward edge of the next rearward brush.

9. The invention according to claim **1** wherein said contact means comprises more than one contact member, adjacent ones of which are spaced apart by an angular extent greater than the cooperating angular extent of any of said brushes, and the angular spacing between the trailing edges of adjacent contact members correspond to the predetermined interval between two successive firing sparks to a spark plug.

10. The invention according to claim **9** wherein said contact means comprises two contact members.

11. Apparatus for making and breaking the primary circuit of an automobile ignition system two times in the power stroke of each piston for providing a primary ignition spark and a secondary ignition spark to each spark plug including a distributor having a distributor shaft and a peak-and-dwell circuit breaker cam thereon adapted to open and close breaker points comprising a series of stationary equiangularly spaced brushes adapted to be mounted circumferentially in the distributor of said ignition system; a rotating insulating cylindrical collar having interior peaks and dwells to be disposed over said circuit breaker cam, a primary contact member and a secondary contact member extending through said collar and being spaced apart from each other, each of said primary and secondary contact members having an interior terminus and an exterior terminus; conductor means connecting one end of each of said brushes to a source of electrical current; the other ends of each of said brushes being adapted to ride on the cylindrical surface of said collar and to engage said exterior termini of said primary and secondary contact members; said interior termini of said primary and secondary contact members being in electrical contact with the surface of said circuit breaker cam; the angular spacing, at the cylindrical surface of said collar, between the radius of the trailing edge of said exterior terminus of said primary contact member and the radius of the next rearward interior peak of said collar being essentially equal to the angular spacing between the radius of the point on said circuit breaker cam where such breaker points would open and the radius of the next rearward peak of such breaker cam; the angular spacing, at the cylindrical surface of said collar, between the trailing edge of said exterior terminus of said primary contact member and the radius of the exterior terminus of the leading edge of said secondary contact member being greater than the angular width, at said cylindrical surface of any of said brushes; the angular spacing at the cylindrical surface of said collar, between the radius of the trailing edge of said primary contact member and the radius of the trailing edge of said secondary contact member corresponding to the predetermined time interval between such first and second sparks; the angular spacing, at the cylindrical surface of said collar, between the radius of the leading edge of said primary contact member and the radius of the trailing edge of said secondary contact member being less than the angular spacing, at the cylindrical surface of said collar, between the

radii of the rearward edge of any of said brushes and the forward edge of the next rearward brush.

12. The invention according to claim 11 wherein a distributor rotor is provided and includes a terminal of an arcuate extent corresponding to the time interval between the successive sparks.

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