

[54] **IGNITION DEVICE FOR MONOROTOR
ROTARY PISTON INTERNAL
COMBUSTION ENGINES**

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[58] Field of Search.....123/148 E, 148 DC,
123/8.09, 148 DS, 148

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[57] **ABSTRACT**

The ignition device includes a rotary switch for preventing the voltage peak which is produced on the closing or opening of the breaker from appearing at the electrodes of the spark plug when the latter is in a combustion chamber of the engine at the beginning of compression. The device may include a cam driven by the engine and having an outline of sudden slope. The device has a disrupting effect sensitive to the direction of flow of the current in the secondary of the ignition coil.

10 Claims, 5 Drawing Figures

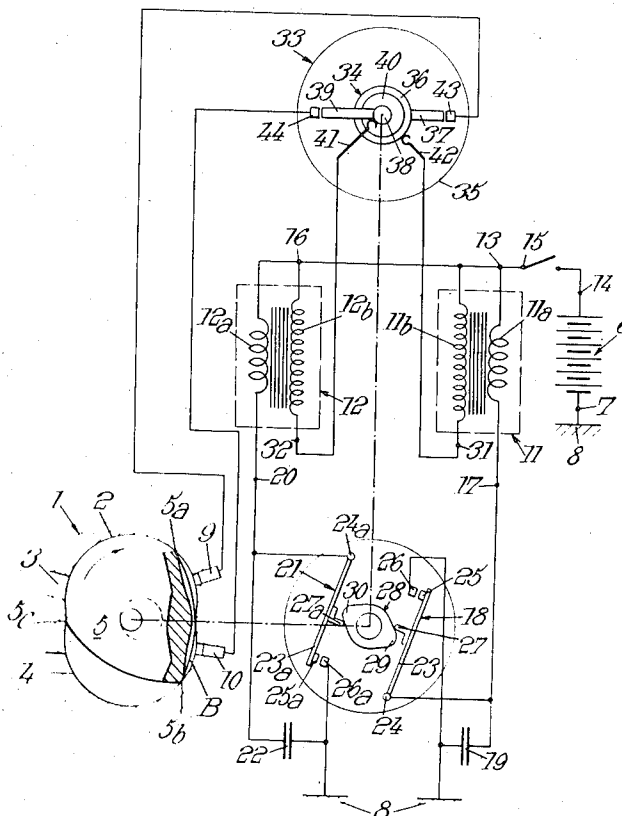


Fig. 1.

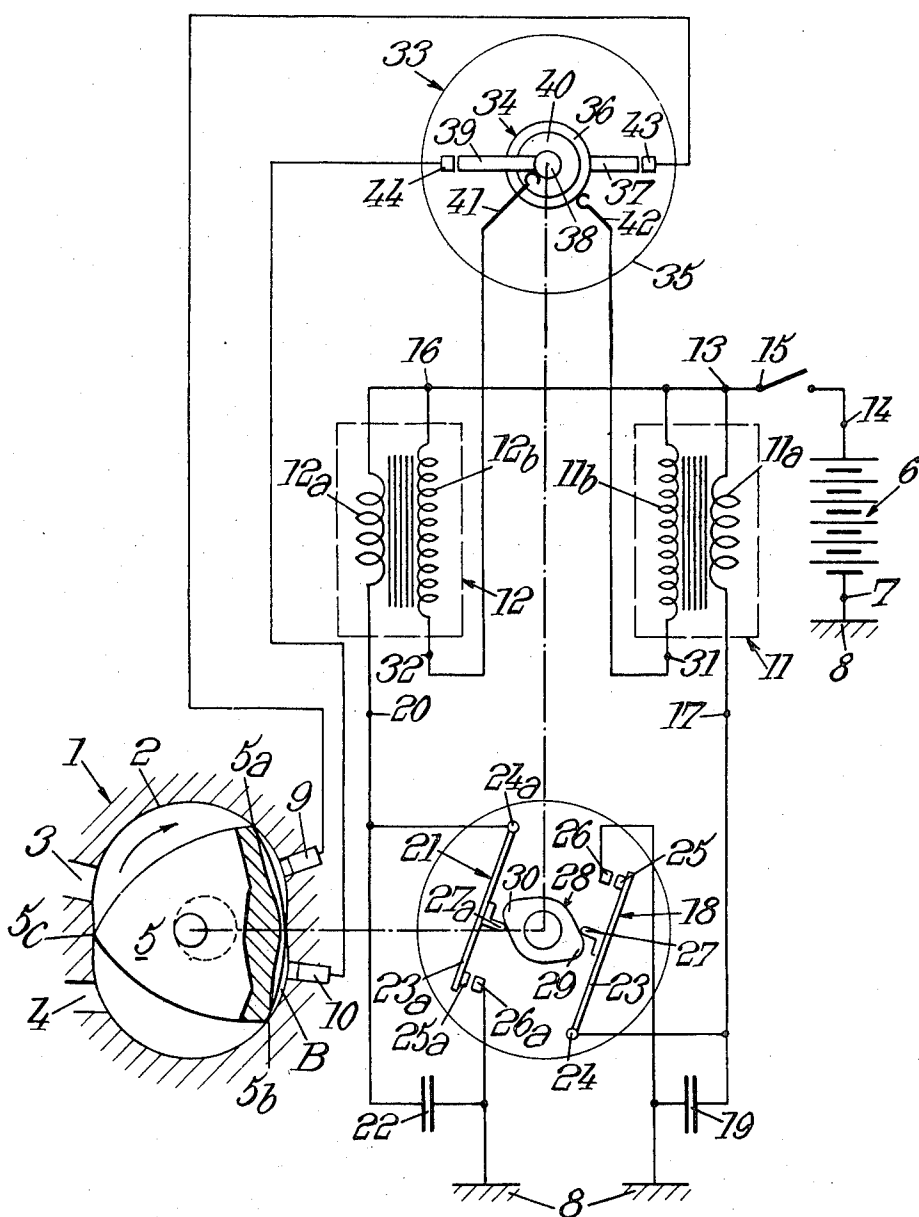


Fig. 2.

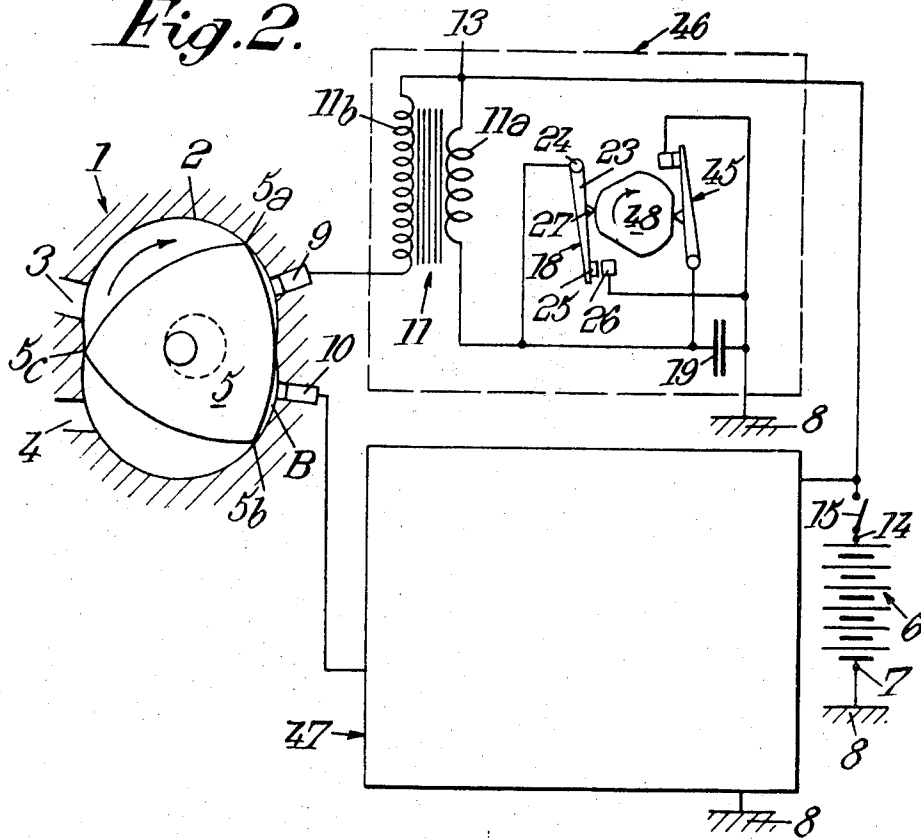


Fig. 3.

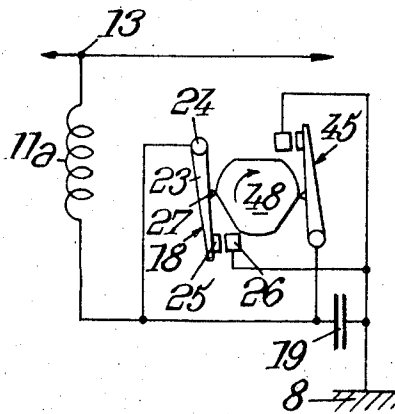


Fig. 4.

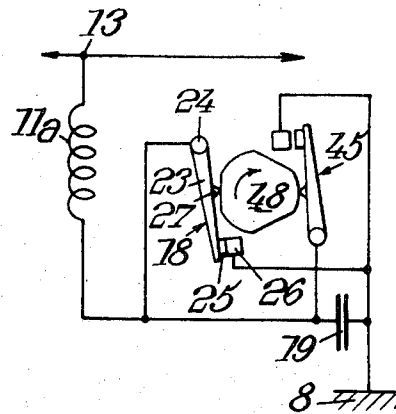
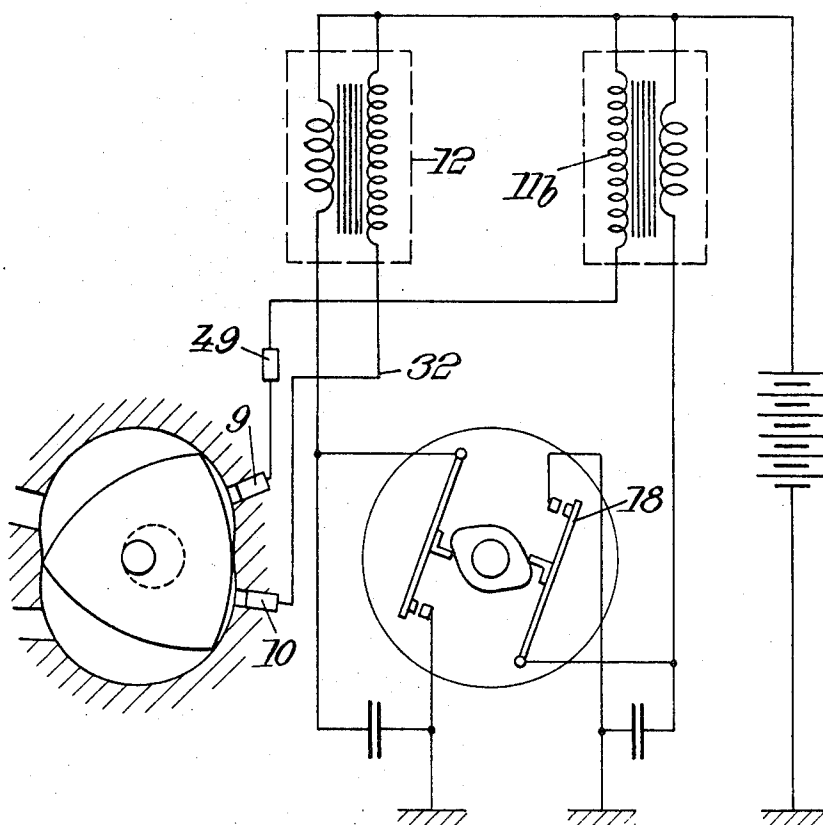


Fig. 5.



IGNITION DEVICE FOR MONOROTOR ROTARY PISTON INTERNAL COMBUSTION ENGINES

The present invention relates to an ignition device for a monorotor rotary piston internal combustion engine. More particularly it relates to a device of this type which includes a breaker, a cam driven by the engine and co-operating with the breaker, an induction coil and a spark plug, said breaker causing, especially on opening, but also on closing of the primary circuit of the coil, a voltage peak of opening and of closing at the terminals of the secondary circuit of the said coil, which is connected to the spark plug.

The invention relates more particularly, because it is in this case that its application seems to offer the most advantage, but not exclusively, to those of the above-said ignition devices which include two spark plugs displaced in the peripheral direction and, in general, one induction coil and one breaker per spark plug.

As will become apparent from the following description of a conventional monorotor rotary piston engine, there can occur through the closing voltage peak, premature ignition by one of the spark plugs which disturbs the smooth operation of the engine.

It is an object of the invention, particularly, to render these devices such that their combustion cycles are practically free of such disturbance.

The ignition device for the rotary piston internal combustion engine defined above is characterized, according to the invention, by the fact that it comprises means adapted to prevent voltage peaks of closing from appearing between the electrodes of the spark plug when this latter is in a combustion chamber of the engine at the beginning of compression.

In a first embodiment, these means are arranged to, on one hand, establish an electrical connection between the spark plug and the secondary of the coil on opening or immediately before opening of the breaker, and on the other hand, to interrupt the said connection on closing or immediately before closing of the breaker.

In a second embodiment, these means are arranged so that they cause the closing of the breaker before the spark plug is in a combustion chamber at the beginning of compression.

The invention also relates to monorotor rotary piston internal combustion engines, characterized by the fact that they include an ignition device such as defined above.

In order that the invention may be more fully understood, several embodiments of ignition devices and engines according to the invention are described below purely by way of illustrative but non-limiting example, with reference to the accompanying drawings, in which:

FIG. 1 shows, diagrammatically, a first embodiment of a rotary piston internal combustion engine constructed according to the invention;

FIG. 2 shows, diagrammatically, a second embodiment of a rotary piston engine constructed according to the invention; and

FIGS. 3 and 4 show certain elements of the embodiment of FIG. 2 in other operating positions; and

FIG. 5, lastly, shows a third embodiment.

In order to construct an ignition device for a rotary piston internal combustion engine 1 comprising a casing 2 in the form of a trochoid with two lobes, provided

with an intake port 3 and an exhaust port 4, and a rotary piston 5 in the form of a curvilinear triangle with three crests 5a, 5b, 5c, rotatable inside the said envelope (in clockwise direction according to FIGS. 1 and 2), the procedure is as follows.

First of all, regarding the assembly of the ignition device, conventionally it is made to include a D.C. electrical voltage source 6 constituted, for example, by a battery provided with a positive terminal 14 and a negative terminal 7 connected to a common ground 8. It includes, preferably, two spark plugs 9 and 10 mounted in the envelope of the casing 1 and shown diagrammatically in FIGS. 1 and 2. These two spark plugs are separated from one another along the periphery of the envelope of the casing 2, so as to favor the establishment as rapidly as possible of the flame front, over the whole length of a chamber B which occurs at the end of compression and of which the shape, as seen in FIGS. 1 and 2, is very flattened and elongated. The spark plug 9 is often called the top or upper plug. The spark plug 10 is called the bottom or lower plug. Each of these plugs include two electrodes of which the first is connected to the ground 8 and of which the second is connected in the manner indicated above.

To the two plugs 9 and 10, there is made to correspond, as shown in FIG. 1, two induction coils 11 and 12 provided respectively with primary windings 11a and 12a and with secondary windings 11b and 12b. The windings 11a and 11b have a common terminal 13 connected to the positive terminal 14 of the voltage source 6 through an ignition switch 15. The windings 12a and 12b have also a common terminal 16 directly connected to the terminal 13.

The primary winding 11a includes a second terminal 17 connected to the ground 8 through a breaker 18 mounted parallel with a condenser 19. In the same way, the primary winding 12a includes a second terminal 20 connected to the ground 8 by a second breaker 21 mounted parallel with a second condenser 22.

The breaker 18 comprises a rigid conductor arm 23, hinged at one of its ends on a fixed axle 24 and bearing, at its other end, a conductive pastille 25, which pastille can come into contact with another fixed pastille 26 connected electrically to the ground 8. The pastille 25 is connected electrically to the terminal 17 of the coil 11 through the arm 23. The latter bears, substantially at its center, an insulating follower 27. The breaker 21 is identical with the breaker 18 and the parts of this breaker analogous to those of the breaker 18 bear the same reference numerals followed by the letter a. The pastille 25a is connected electrically to the terminal 20 of the coil 12.

The two breakers 18 and 21 are arranged substantially symmetrically with respect to the axis of rotation of a cam 28 with two diametrically opposite bosses 29 and 30. The said cam is driven in rotation at a speed proportional to that of the engine and co-operates with the followers 27 and 27a of the breakers so as to allow to come into contact and to separate alternately, on one hand, the pastilles 25 and 26, and on the other hand, the pastilles 25a and 26a. Flexible return means, not shown, act on the two arms 18 and 23. In the same way, adjusting means for the advance of the spark (not shown) may act on the angular adjustment of the cam 28 with respect to the shaft of the engine which is moved by the piston 5.

The secondary windings 11b and 12b include, respectively, output terminals 31 and 32. Up to the present, these terminals were, in the case of monorotor rotary piston engines, connected directly and permanently to the second electrode of the plugs 9 and 10, respectively. It will be recalled that the first electrode of the said plugs is connected to the ground 8.

The operation of such a conventional device was as follows.

When the rotary piston 5 arrives in a predetermined position to which there corresponds a volume also predetermined of the chamber B, the cam 28 separates from one another, simultaneously or with a slight displacement in time, on one hand, the pastilles 25 and 26, and on the other hand, the pastilles 25a and 26a. There is hence a brusque opening of the electrical circuit of each primary winding 11a and 12a which generates a considerable variation of magnetic flux in the said primary windings. This magnetic flux variation induces in the secondary windings 11b and 12b a high electrical voltage. The terminals 31 and 32 are thus brought to a high potential with respect to the ground and it is the same for the electrodes of plugs 9 and 10 respectively connected to the terminals 31 and 32. The assembly is constructed in such a way that the difference of potential which appears between the electrodes of the plugs 9 and 10 is sufficient to produce a spark suitable for igniting the compressed mixture in the chamber B.

By reason of the rotation of the cam 28, the bosses 29 and 30 therefore separate from the followers 27 and 27a and the pastilles 25 and 26, 25a and 26a again come into contact with one another. There is closing of the primary circuit of each coil 11 and 12 and the intensity of the current flowing in the coils 11a and 12a passes from a null value to a non-null value. Hence, on the closing of the primary circuit, a variation of magnetic flux is again produced in the primary windings 11a and 12a and a high difference of potential of the order of 1,500 to 2,500 volts appears between the electrodes of the plugs 9 and 10. At the moment when the closing of the primary circuit of the coil 12 occurs, the lower plug 10, connected to this coil, is in the presence of gas under high pressure and the dielectric strength of these gases is high enough for a spark not to flash generally between the electrodes of the plug 10. Even though a spark should flash, it would not be troublesome since it would be produced in a mixture of burnt gases.

On the other hand, at the moment when the closing of the primary circuit of the coil 11 is produced, that is to say at the same time or substantially at the same time as the closing of the primary circuit of the coil 12, the crest 5a of the piston, which bounds the rear zone of the chamber B, has generally passed by the plug 9. The latter occurs then in a chamber containing a mixture of fresh gas at the beginning of compression. Most of the time, the difference of potential which appears between the electrodes of the plug 9 is sufficient to generate a spark and an untimely pre-ignition of a mixture which has not yet reached the desired level of compression. The spark flashes fairly easily since the mixture is little compressed and possesses hence a relatively low dielectric strength. But such a preignition is troublesome to the good operation of the engine and is accompanied by a noise similar to a loud clicking and a loss of power.

To overcome this drawback, according to the main feature of the invention, there is made to include in the ignition device of the rotary piston internal combustion engine 1, means to prevent the voltage peak of closing from appearing between the electrodes of each plug, when the latter is in a combustion chamber at the beginning of compression.

In a first embodiment, the said means are constituted by a rotary commutator 33 (FIG. 1) rotated by the engine 1 and which, on one hand, establishes an electrical connection between the plug 9 and the coil 11 and between the plug 10 and the coil 12, slightly before and during the opening of the breakers 18 and 21, and on the other hand, interrupts the said connection slightly before and during the closing of the said breakers 18 and 21.

The rotary commutator 33 comprises a rotor 34 and a stator 35. The rotor 34 is composed, on one hand, of a cylindrical crown of revolution 36, conductive at least over its periphery and provided with a radial conductor arm 37 extending towards the outside, on the other hand, of a cylinder 38 conductive at least over its periphery, coaxial with the crown 36 and provided with a radial conductor arm 39 diametrically opposite the arm 37, a part of the cylinder 38 being situated on the inside of the said crown, and finally on the other hand, of an insulator 40 arranged between the crown 36 and the cylinder 38. The position of the arm 39 along the axis of the rotor is such that said arm is insulated electrically from the crown 36. The rotor 34 is driven around its axis at a speed proportional to that of the engine.

The stator 35, shown diagrammatically, bears the rotor 34 and comprises two brushes 41, 42 and two conductive terminals 43, 44 diametrically opposite with respect to the center of the rotor. The brush 41 bears on the outer surface of the cylinder 38 and permits electrical connection to be ensured between the arm 39 and the terminal 32 to which this brush is connected. The brush 42 bears on the outer surface of the crown 36 and ensures the passage of electrical current between the terminal 31, to which it is connected, and the arm 37. The terminals 43 and 44 are arranged so that the arms 37 and 39 come to their contact or a slight distance from the latter on each turn of the rotor. These terminals are connected respectively to the second electrodes of the plugs 9 and 10.

Finally, it must be specified that the angular displacement of the rotor 34, the angular amplitude of the phase during which there is electrical connection between the arms 37, 39 and the terminals 43, 44 and the profile of the cam 28 are determined so that the said connection is established slightly before and during the opening of the breakers 18 and 21, but is interrupted before the closing of the breakers.

The operation of such a device is as follows.

When the pastilles 25, 26 and 25a, 26a are separated from one another by the action of the cam 28, the arms 37 and 39 are respectively in electrical connection with the terminals 43, 44 (FIG. 1) as has been explained and the voltage peak of opening is applied to the electrodes of the plugs 9 and 10, which causes the production of a spark, as previously explained.

When the pastilles 25, 26 and 25a, 26a come again into contact with one another, that is to say on the closing of the breakers 18 and 21, the arms 37 and 39 have turned and are no longer in electrical connection with

the terminals 43 and 44. The voltage peak of closing is not transmitted to the electrodes of the plugs 9 and 10 but appears between the arms and the terminals. The distance separating the arms from the terminals 43,44 at this moment is sufficient so that a spark is not produced between these elements.

With the rotary commutator 33, there is therefore eliminated any possibility of a production of a spark at the plugs on the opening of the breakers 18 and 21 and pre-ignition is thus eliminated.

In another embodiment, the rotary commutator 33 can include only a single arm 37 and be arranged only in the circuit of the upper plug 9, whilst the low plug 10 is directly connected to the terminal of the output 32 of the coil 12. In this case, the spark due to the closing of the breaker 21 is not systematically suppressed on the plug 10, but this is not troublesome since this spark can only be produced in a mixture of burnt gases. According to the rotary speed given to the rotor 34, there may be provided one or two diametrically opposite terminals and connected electrically between themselves, to come into contact with the single arm 37.

According to a second embodiment, the abovesaid means to prevent the voltage peak of closing from appearing at the electrodes of each plug, when the latter is in a chamber at the beginning of compression, may be constituted by a cam outline 28 such that the closing of the breakers 18 and 21 is produced before the spark plug 9, and all the more so, the plug 10, are in a chamber at the beginning of compression.

In this embodiment, the terminals 31 and 32 of the secondary windings of the coils are directly connected to the electrodes of the plugs 9 and 10, as in known ignition devices for rotary piston engine. But, by reason of the outline of the cam, when the breakers close, the crest 5a bounding the rear zone of the chamber B has not yet passed by the upper plug 9. The voltage peak of closing is hence applied to the plugs before the peak 5a has passed by the plug 9, and a fortiori, the plug 10. The two plugs are again in the chamber B in the presence of burnt gases under high pressure, hence at high dielectric strength, little favorable to the flashing of a spark on closing, as explained above. In any case, the flashing of such a spark would not be troublesome since it would be produced in burnt gases.

However, it is possible that a cam outline satisfactory for the conditions described is too angular to enable completely satisfactory operation.

In order to preserve a cam profile which is little angular and to obtain, however, an opening followed very nearly by the closing of the breakers, in another embodiment, the abovesaid means are constituted, for each induction coil, by a second breaker (45 for coil 11, see FIG. 2) mounted in parallel with the first breaker (18 for the coil 11) and cooperating with the same cam, the assembly being such that any period during which two breakers arranged in a same primary circuit of a coil are open simultaneously is followed by the closing of one of these breakers before the spark plug connected on this coil occurs in a chamber at the beginning of compression.

In FIG. 2, there is shown very diagrammatically the ignition device. There is provided, for the upper plug 9, an assembly 46 comprising two breakers 18,45 mounted in parallel. There may be provided, for the lower plug 10, an assembly 47 identical with 46. How-

ever only a single breaker could be used for the plug 10 since the latter, by reason of its position on the envelope of the casing 2, occurs practically always in the presence of burnt gases when the voltage peak of closing is produced, even if there is only a single breaker in the primary circuit of the coil 12 and if the profile of the cam is not particularly abrupt. The two breakers 18 and 45 can cooperate with a same cam 48 with three bosses for example.

The operation of such a device is as follows.

The explanation only bears on the operation of the ignition device of the plug 9 since the operation of the device of the plug 10 is either identical or conventional.

When the cam 48 occupies the position shown in FIG. 2, the breaker 18 is open but the breaker 45 is closed. The primary circuit of the coil 11 is closed and the magnetic flux produced by the primary winding is substantially constant. No voltage peak is therefore induced between the terminals of the secondary winding 11b.

When the cam 48 arrives in the position shown in FIG. 3, the breaker 18 still open is at the point of closing at the moment when the breaker 45 is opened. The opening of the breaker 45 causes the opening of the primary circuit 11a and the appearance of the voltage peak of opening at the secondary circuit 11b and at the plug 9. At the moment when this opening is produced, the level of compression in the chamber B has reached a predetermined value, the spark flashes and normal ignition takes place.

Shortly after, when the cam 48 arrives in the position shown in FIG. 4 and before the crest 5a has passed by the plug 9, the breaker 18 is closed as well as the primary winding circuit 11a. The peak voltage of closing is hence produced before the plug 9 occurs in a combustion chamber at the beginning of compression and containing a mixture of fresh gas.

With such a device, the outline of the cam can be normal since the interval of time separating the opening and the closing of a same breaker can be relatively great, whilst the interval of time separating the opening and the closing of the primary circuit is very slight.

As a result of which, and whatever the embodiment adopted, there is obtained an ignition device for a rotary piston engine which responds well to the purpose for which it is proposed, namely to obtain undisturbed combustion cycles and to eliminate the pre-ignition of mixtures of fresh gases at the beginning of compression. In the case of the first embodiment where there is introduced a rotary commutator in the ignition device, pre-ignition is eliminated by eliminating the spark of closing. In the case of the second and third embodiments, pre-ignition is eliminated by establishing the closing of the breaker before the upper plug 9 has been passed by the crest 5a and occurs in a chamber at the beginning of compression.

The operation of the rotary piston engine provided with such a device is improved and the power of the said engine is held substantially constant in the course of operation.

As is self-evident, and as results besides already from the preceding description, the invention is in no way limited to those of its methods of application, nor to those of its methods of production of its various parts, which have been more particularly described; it embraces, on the contrary, all variations.

In another embodiment, for example, the means of connection and of disconnection to prevent the voltage peak of closing from appearing between the electrodes of the spark plug, when the latter occurs in a chamber at the beginning of compression, can be electronic.

In a further embodiment, illustrated in FIG. 5 (wherein corresponding elements to those in FIG. 1 are identified by the same reference numbers), the lower spark plug 10 can be directly connected to the terminal 32 of the plug 12, whilst, in the circuit of the upper plug 9, the rotary commutator 33 is replaced by a device with a disruptive effect 49 constructed, on one hand, so as to allow an electrical current to pass when the voltage at its terminals is of the order of the voltage produced by the secondary 11b at the opening of the breaker 18, that is to say of the order of 15,000 to 20,000 volts, and on the other hand, so as to oppose the passage of an electrical current when the voltage at its terminals is of the order of 1,500 to 2,500 volts, an order of magnitude of the voltage obtained on the closing of the breaker 18. This device 49 with disruptive effect can, also, be incorporated in the plug.

What we claim is:

1. A monorotor rotary piston internal combustion engine comprising, a single housing having a multilobed inner peripheral surface, a single multilobed rotor mounted for rotation within said housing, said housing comprising an intake port and an exhaust port; in combination with an ignition system comprising, a breaker, a cam driven by the engine and cooperating with the breaker, an induction coil having a primary circuit and a secondary circuit and at least two spark plugs on said peripheral surface and connected to said secondary circuit operating together, the second said spark plug being located between the first said spark plug and said exhaust port, said breaker causing, particularly on opening but also on closing of the primary circuit of the coil, a voltage peak of opening and of closing respectively at the terminals of said secondary circuit, and interrupting means in said secondary circuit adapted to prevent the voltage peak only of closing of the breaker from appearing at the electrodes of at least said first spark plug when the latter is in a combustion chamber of the engine at the beginning of compression.

2. An engine according to claim 1, wherein said interrupting means are constituted by a second breaker mounted in parallel with the first and cooperating with a cam, the assembly being such that any period during which the two breakers are opened simultaneously is

followed by the closing of one of the breakers by-passing the voltage surge to the spark plug before the spark plug is in a combustion chamber at the beginning of compression.

3. An engine according to claim 2, wherein said two breakers are arranged to cooperate with the same cam having three bosses.

4. An engine according to claim 1, wherein said interrupting means only act on said first spark plug, the second spark plug which on closing is in the burnt gases being directly connected to the secondary circuit.

5. An engine according to claim 1, wherein said interrupting means are arranged, on one hand, to establish an electrical connection between the spark plug and the secondary of the coil on opening or immediately before opening of the breaker, and on the other hand, to interrupt said connection on closing or immediately before closing of the breaker.

6. An engine according to claim 1, wherein said interrupting means are arranged so that they cause the closing of the breaker before the spark plug is in a combustion chamber at the beginning of compression.

7. An engine according to claim 1, wherein said interrupting means are constituted by a rotary commutator rotated by the engine and have contacts arranged to establish electrical connection between the spark plug and the coil, slightly before and during the opening of the breaker, and to interrupt said connection slightly before and during the closing of the breaker.

8. An engine according to claim 1, wherein said interrupting means are sensitive to the voltage at the terminals of the secondary and are constituted by a device with a disrupting effect allowing an electrical current to pass when the voltage at its terminals is of the order of the voltage which appears at the terminals of the secondary of the coil on the opening of the breaker, that is to say of the order of 15,000 to 20,000 volts, and opposing the passage of an electrical current when the voltage at its terminals is of the order of the voltage at the terminals of the secondary on the closing of the breaker, that is to say of the order of 1,500 to 2,500 volts.

9. An engine according to claim 8, wherein said device with a disrupting effect is incorporated in said first spark plug.

10. An engine according to claim 1, wherein said interrupting means are constituted by a portion of said cam having an outline of sudden slope.

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