United States Patent

Takeda

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[54] CONTACT BREAKER INCORPORATING FUEL INJECTION TIMING SWITCHES

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April 2, 1970	Japan	45/31718
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[52] **U.S. Cl.** .....**200/19 M,** 123/148 DK, 123/32 AE, 123/146.5 A, 335/206

[51] **Int. Cl.** **H01h 51/28,** F02p 5/08

[58] **Field of Search** .....123/148 E, 148 DK, 32 EA, 148, 123/146.5 A; 200/19 M; 335/205, 206

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[57] **ABSTRACT**

A contact breaker unit for a fuel injection type internal combustion engine, which includes a switch mechanism having reed switches and a magnet for generating the fuel injection timing signal.

6 Claims, 6 Drawing Figures

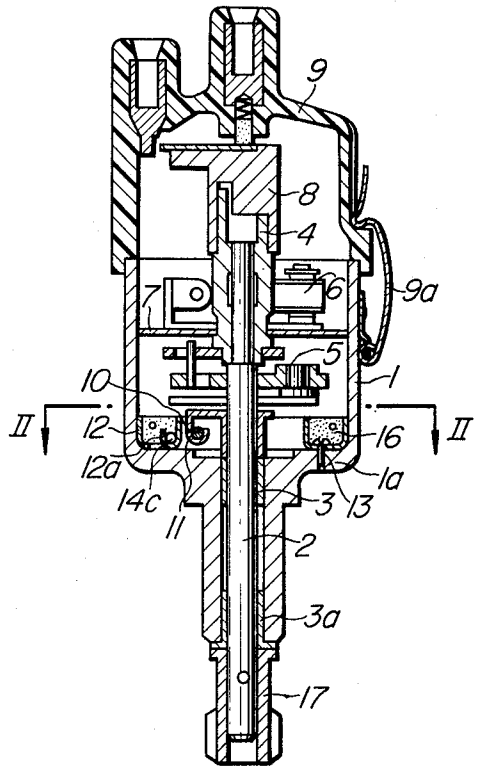


FIG. 1

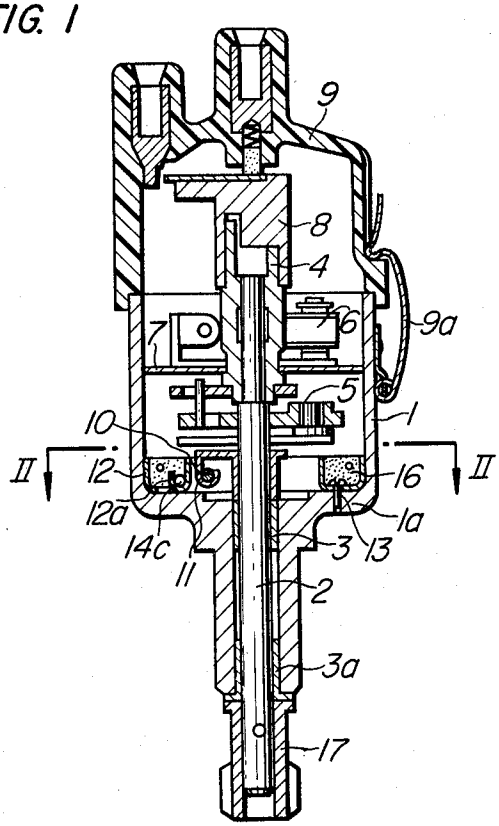


FIG. 2

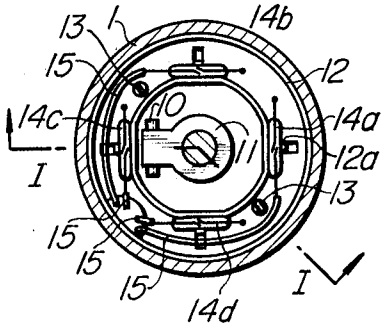


FIG. 3

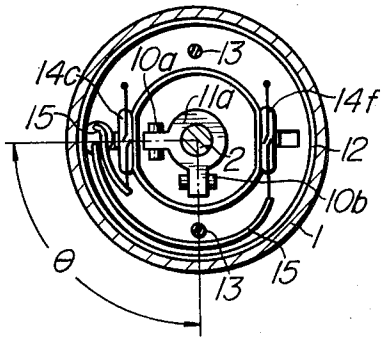


FIG. 5

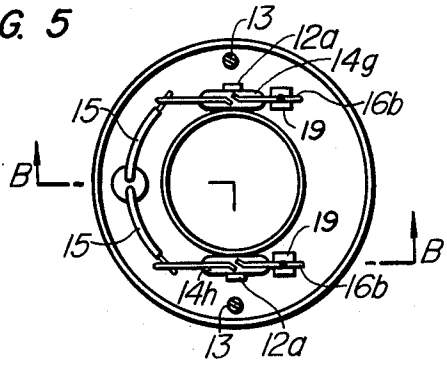


FIG. 4

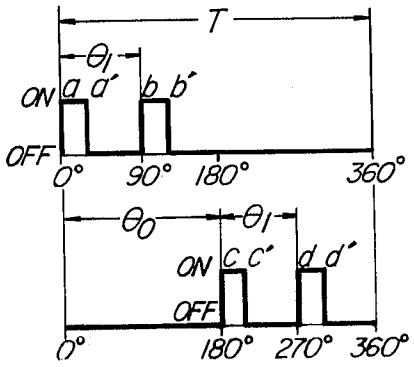
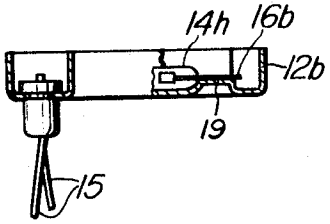


FIG. 6



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CONTACT BREAKER INCORPORATING FUEL INJECTION TIMING SWITCHES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a contact breaker unit for an internal combustion engine and more particularly a contact breaker unit incorporating a switch mechanism having reed switches and a magnet for generating a fuel injection timing signal.

2. Description of the Prior Art

In the conventional fuel injection control device, a contact breaker for producing a fuel injection timing signal, like a contact breaker for ignition, consists of contacts which are interrupted by a cam installed on a rotary shaft rotating in concert with a crank shaft of the internal combustion engine.

Said contact breaker for producing a fuel injection timing signal is installed completely separately from the contact breaker for ignition, making up a very complicated arrangement around the internal combustion engine. Further, because of a very little current flowing through its contacts and these particular contacts being exposed to the air, dust and oil which often becomes attached to the contacts, bad conductivity results. This makes it impossible to obtain a fuel injection timing signal and to run the internal combustion engine.

SUMMARY OF THE INVENTION

A primary object of the present invention is to provide a contact breaker unit with injection timing switches which is not only simple in construction and reliable, and has a very long useful life, thus obviating the disadvantages of the conventional contact breaker.

To achieve the above-mentioned object, the contact breaker with fuel injection timing switches according to the present invention comprises at least one permanent magnet fixed on a rotary shaft of the contact breaker and at least one reed switch disposed adjacent to said permanent magnet to be actuated by said permanent magnet in a housing containing said contact breaker unit.

The above and other objects, features and advantages will be made apparent by the detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a diagram showing a longitudinal section of an embodiment of the contact breaker according to the present invention.

FIG. **2** shows a cross-sectional view of the same embodiment as above.

FIG. **3** shows a cross-sectional view of another embodiment of the present invention.

FIG. **4** is a diagram for explaining the operation of the embodiment shown in FIG. **3**.

FIG. **5** is a cross-sectional view of the essential parts of a third embodiment of the present invention.

FIG. **6** is a partially exploded side view of the embodiment shown in FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **1** and **2**, the numeral **1** shows a housing for a contact breaker for ignition, the numeral **2** a vertical rotary shaft disposed in said housing and the numerals **3** and **3***a* bearing metal for supporting said rotary shaft **2**. The numeral **4** shows a cam cylinder which is loosely fitted into said rotary shaft **2** and that move symmetrically with respect to said rotary shaft **2** by the centrifugal spark advancing mechanism **5**. The numeral **6** shows a contact for ignition with the opening and closing operations driven by said cam cylinder **4** and which is installed on the fixed board **7** like a diaphragm in the housing **1**. The numeral **8** shows a distributor rotor fitted into an end of said cam cylinder **4**. The numeral **9** is a distributor

cap which is supported in the housing **1** by the clip **9***a*. The numeral **10** shows a permanent magnet supported between the centrifugal spark advancing mechanism **5** and the step **1***a* of the housing **1** by the metal plate **11** attached to the rotary shaft **2** in the housing **1**. The numeral **12** shows a ring groove having a U-shaped section which is fastened to the step **1***a* with the screw **13** on the inside of the housing **1** nearly outside of the rotating circle of said permanent magnet **10**. **14***a*, **14***b*, **14***c*, and **14***d* show reed switches which are supported horizontally at equal distance from each other by a supporter **12***a* which is a portion of said ring groove **12** bent towards the inside thereof. The sequence of their arrangement depends on the order of fuel injection by the cylinders. Said reed switches **14***a*, **14***b*, **14***c* and **14***d* correspond to the four cylinders of the four-cylinder internal combustion engine (not shown in the drawing) and each end thereof is soldered to the ring grove **12**, the other end being connected to the lead wire **15** and further to a fuel injection control device (not shown in the drawing). In the ring groove **12** is molded the non-magnetic resin **16** whereby the reed switches **14***a*, **14***b*, **14***c* and **14***d* as well as the lead wire **15** and the screw **13** are fixed inside of the ring groove **12**. FIG. **2** does not include the resin **16**. The numeral **17** shows a gear which is mounted on the rotary shaft **2** and in mesh with a gear at the side of the internal combustion engine in such a manner as to rotate said rotary shaft **2** in a certain relationship with the internal combustion engine.

Explanation will now be made of the operation of the fuel injection timing switches of the contact breaker according to the present invention. As the rotary shaft **2** rotates, the permanent magnet **10** also rotates, approaching one of the reed switches. When they come to face each other, the contact of said reed switch is closed, and it is opened as the permanent magnet moves away from said reed switch. And a signal caused by the opening and closing action of these reed switches is applied to the fuel injection device as a fuel injection signal. This fuel injection device injects the required amount of fuel into an appropriate cylinder according to the fuel injection signal supplied.

The reed switches **14***a*, **14***b*, **14***c* and **14***d* disposed inside the ring groove **12** are supported by the supporter **12***a* and molded with resin inside of said groove. Therefore, these switches as well as the lead wire **15** never change their positions even if some vibrations are applied to them from outside. Also, the fastening screw **13**, which is fixed in position by resin, does not become loose.

In addition, in the embodiment mentioned above, since the permanent magnet **10** installed on the rotary shaft and the reed switches **14***a*, **14***b*, **14***c* and **14***d* are disposed near the step **1***a* or the bottom of the housing **1**, the assembly work of the device is simpler and the centrifugal spark advancing mechanism **5** is easily lubricated.

Instead of resin as used in the above-mentioned embodiment, other non-magnetic material, such as rubber may be molded in the ring groove **12**.

Although in the above embodiment the four reed switches were used to match a four-cylinder internal combustion engine, two reed switches may suffice for the four-cylinder internal combustion engine if a single fuel injection signal obtained from a reed switch is employed to inject fuel into two cylinders simultaneously. The contact breaker according to the present invention can be used with a multiple-cylinder internal combustion engine with more than four cylinders, in which case the number of reed switches needed is determined by the total number of cylinders and by the number of cylinders into which fuel is simultaneously injected.

By additionally installing a plurality of permanent magnets to actuate the reed switches, it is possible to reduce the number of reed switches needed. In the embodiment shown in FIG. **3**, for example, the two permanent magnets **10***a* and **10***b* are supported by the metal plate **11***a*. In FIG. **3**, the same components as those shown in FIG. **2** are marked with the same reference numerals, and the insulating filling material for fixing the reed switches, lead wires and screws are not depicted.

The embodiment in FIG. 3 shows a contact breaker for a 4-cylinder internal combustion engine with the angular distance of 180° between the reed switches **14***e* and **14***f* and an angular distance (θ) of 90° between the permanent magnets **10***a* and **10***b*. The angle θ depends on the position where the reed switches are installed. Since the drive gear ratio between the combustion engine and the rotary shaft of the distributor is 2 to 1, the angle θ is a multiple of 90° in the case of a 4-cylinder internal combustion engine, and a multiple of 60° in the case of a 6-cylinder internal combustion engine.

As the result of the rotation of the permanent magnets **10***a* and **10***b*, the opening and closing operation of the reed switch **14***c* is shown in the upper portion of FIG. 4 and that of the reed switch **14***f* in the lower portion thereof. Under the condition shown in FIG. 3, assume that the permanent magnet **10***a* causes the contact of the reed switch **14***c* to be closed at the point *a*. Then the same contact is opened at the point *a'* as the rotary shaft **2** rotates. After the rotary shaft **2** rotates by 90°, another permanent magnet **10***b* causes the reed switch **14***e* to be closed at the point *b* and to be opened at the point *b'*. In like manner, after a 180° rotation the reed switch **14***f* is closed at the points *c* and *d* and opened at the points c' and d'. That is to say, the circuit is closed at the point a, θ_1 (90°), θ_o (180°) in that order and then after a further rotation of 90°. Hence four interrupting signals can be obtained during a single rotation T (360°) of the rotary shaft **2**. These signals are applied to the fuel injection control device through the lead wire **15** as fuel injection signals.

In the embodiment mentioned above, a single reed switch serves the purpose if the number of permanent magnets is increased to, say, four at an angular distance of 90° in FIG. **3** in accordance with the number of cylinders. In addition, by installing reed switches equal in number to the cylinders so that a plurality of permanent magnets may operate each of said reed switch, interrupted injections into a single cylinder in such a number as determined by the number of the magnets can be obtained. Said interrupted injections improves the combustion efficiency.

FIGS. **5** and **6** show an improvement on the ring groove **12** with a U-shaped section as shown in FIGS. **1** to **3**. The same or corresponding parts in all of the above figures are marked with the same reference numerals. The glass tube covering the switching elements of a reed switch is so brittle that when a switch terminal, especially one at the earthside, is bent to be soldered to a foundation metal plate, the glass tube is liable to be broken, or the joint between the glass tube and the switching element often comes off with the result that said terminal moves separately from the glass tube, causing an unsatisfactory switching operation.

To obviate these disadvantages, the ring groove **12**b of the embodiment shown in FIGS. **5** and **6** is equipped with a trapezoidal projection **19** which is formed by embossing or other methods, which makes possible a soldering operation on the ring groove **12***b* without bending the terminal **16***b* of the reed switches **14***g* and **14***h*. As a consequence, not only is the assembly made easier but the reed switches are rarely damaged. Incidentally, like the embodiment mentioned earlier, insulating material is filled into the ring groove.

I claim:

1. A contact breaker for internal combustion engine having a housing, rotary shaft disposed in said housing, a bearing metal for supporting said rotary shaft, a centrifugal spark advancing mechanism, a cam cylinder loosely fitted into said rotary shaft and mounted on said spark advancing mechanism, a contact for ignition with the opening and closing operations driven by said cam cylinder, a distributor rotor fitted into an end of said cam cylinder, a clip and a distributor cap supported in said housing by said clip, wherein at least a permanent magnet is fixed on a rotary shaft of said contact breaker, and at least a reed switch is disposed adjacent to the rotational base of said permanent magnet so as to be actuated by said permanent magnet;

said reed switch being installed inside of a U-sectioned non-magnetic ring groove fixed in said housing, said ring groove being filled with insulating material in which said reed switch is embedded;

said ring groove being made of a non-magnetic metal with at least one projection for supporting a terminal of said reed switch, said projection being trapezoidal in elevation.

2. A contact breaker according to claim **1**, wherein said permanent magnet and said reed switch are located under said centrifugal spark advancing mechanism in said housing.

3. A contact breaker according to claim **1**, wherein said contact breaker is provided with a single permanent magnet and a plurality of reed switches disposed at regular intervals of space.

4. A contact breaker according to claim **1**, wherein said contact breaker is provided with two permanent magnets and a plurality of said reed switches disposed at regular intervals of space.

5. A contact breaker according to claim **1**, wherein said ring groove is equipped is equipped with a means for fixing on said housing said ring groove and a lead wire leading to said reed switch, said fixing means being embedded in an insulating material.

6. A contact breaker unit for producing a fuel injection signal for an internal combustion engine mounted in a housing in combination with a distributor mechanism, said distributor mechanism comprising a rotary shaft extending longitudinally in said housing and having an elongated end portion extending outwards through a closed end wall of said housing, said elongated end portion being adapted to be driven for rotation in synchronism with rotation of the engine, a cam cylinder mounted on the opposite end portion of said rotary shaft, a contact means mounted in said housing so as to be operated by said cam cylinder and a distributor cap mounted at an open end of said housing; wherein said contact breaker unit comprises:

at least one permanent magnet mounted on said rotary shaft for rotation in synchronism with rotation of the engine;

a U-sectioned annular member made of a non-magnetic material and fixed on an innerside of said closed end wall of said housing concentrically with said rotary shaft;

at least one reed switch having two terminals extending outwardly and moulded with an insulating material in said U-sectioned annular member at a predetermined position so as to be periodically in close proximity to said magnet with the rotation thereof thereby being magnetically actuated;

one of said two terminals being directly fixed to a projection formed on said annular member and moulded in said insulating material.

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