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[54] IGNITION TIMING DEVICES FOR INTERNAL COMBUSTION ENGINES

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[52] **U.S. Cl.** ..... **123/117 A**

[51] **Int. Cl.** **F02p 5/04**

[58] **Field of Search** ..... 123/117 A, 117 R

[56] **References Cited**

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[57] **ABSTRACT**

In this device for automatically adjusting the advance and/or retard of the ignition system of internal combustion engines, a solenoid valve is interposed between the corresponding advance and/or retard control capsule connected to the engine induction manifold and to the distributor of the ignition system, a buffer capacity, an output limiting member interposed between said capacity and said manifold, and a pressure-responsive electric switch connected to said manifold and also to said buffer capacity so as to act in one or the other direction as a function of variations in a differential pressure for closing during a predetermined time period, by means of said output limiting member, and/or said buffer capacity at least one electric contact controlling said solenoid valve.

4 Claims, 2 Drawing Figures

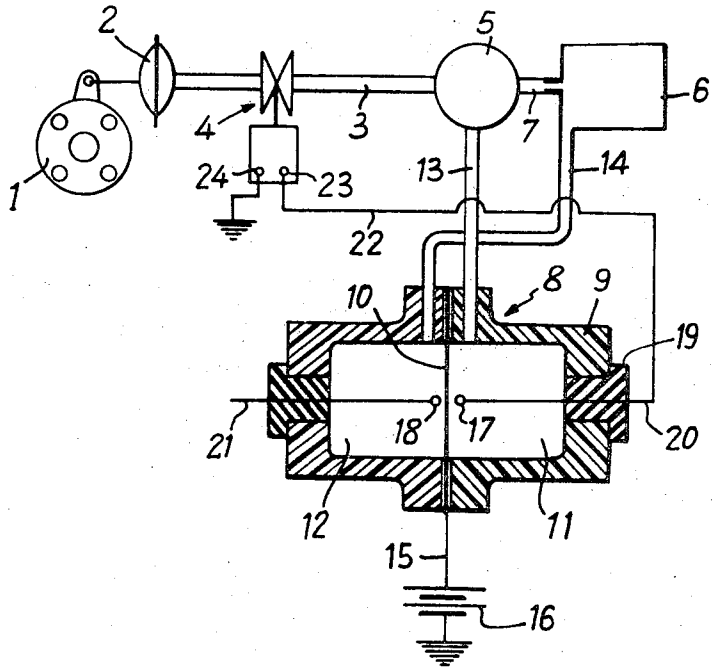


Fig: 1

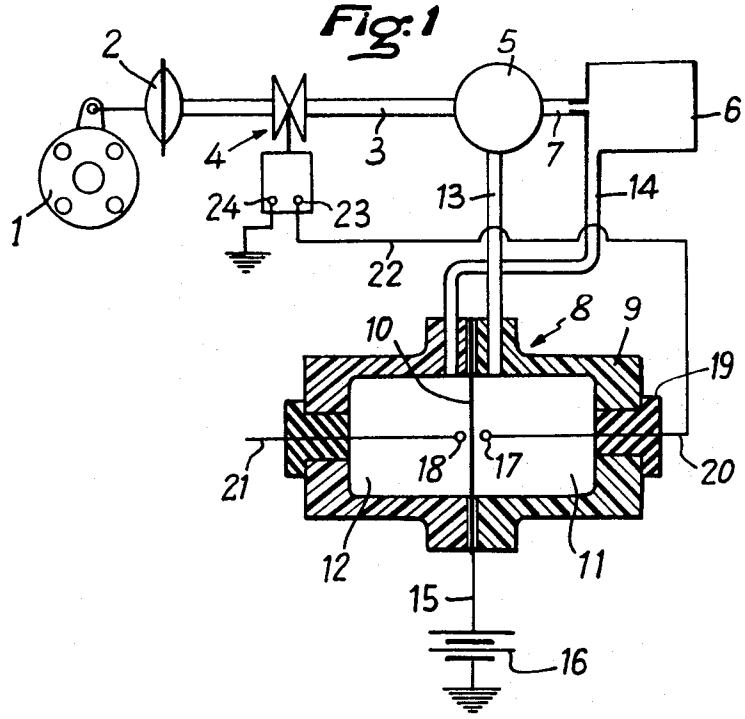
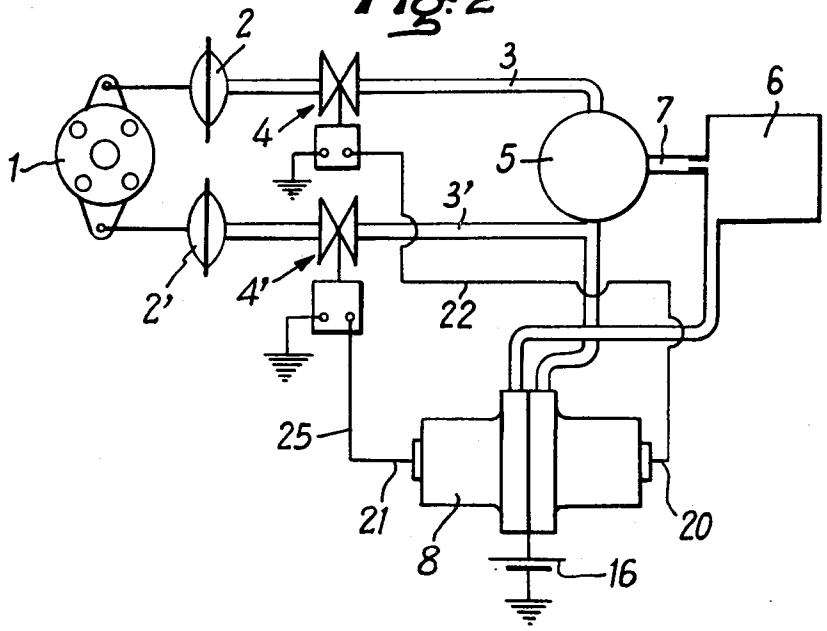

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Fig: 2


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3'
2'
4'
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8
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IGNITION TIMING DEVICES FOR INTERNAL COMBUSTION ENGINES

The present invention relates in general to ignition timing devices of internal combustion engines and has specific reference to devices of this character intended more particularly for engines wherein the ignition timing is controlled by a diaphragm responsive to the induction vacuum and connected to this end to the induction manifold, notably with a view to reduce atmospheric pollution caused by exhaust gas.

Sensitive and accurate adjustments are now required for the anti-pollution devices of internal combustion engines, which means an increasingly strict control of the engine ignition timing. More particularly, the communication between the vacuum chamber containing the diaphragm controlling the ignition timing and the source of vacuum to which said diaphragm is responsive must take place only a well-defined moments as a function of the changes occurring in the conditions of operation of the engine.

Timing devices of this type are already known, wherein the vacuum diaphragm chambers communicate with the induction manifold under the control of vacuum switches consisting of diaphragm distributors having a relatively long response time and which are difficult to adjust.

It is the essential object of this invention to provide a device of this general type but adapted, through relatively simple and economical means, to connect under properly timed conditions a vacuum-type ignition timing capsule or diaphragm chamber with the induction manifold as a function of the direction of variation of the induction vacuum which corresponds to the engine acceleration or idling conditions.

The device according to this invention for an engine having an induction manifold for the air/fuel gaseous mixture, an ignition distributor, at least one vacuum diaphragm capsule for controlling the ignition advance and/or retard of the distributor, each capsule being connected to the induction manifold, is characterized in that it comprises a control solenoid-valve interposed between each vacuum capsule and the engine induction manifold, a buffer capacity for the induction gas, a fluid output limiting member connecting said buffer capacity to the induction manifold, and a deferred-action, pressure-responsive electric itch connected to said induction manifold and to said buffer capacity, and adapted to act in one or the other direction as a function of the variation in a differential pressure applied to said switch in case of pressure variation in said manifold and/or in said buffer capacity so as to close during a predetermined time period, notably through said limiting member and/or said capacity, at least one electric contact controlling the corresponding solenoid-valve.

Other features and advantages of this invention will appear as the following description proceeds with reference to the accompanying drawing illustrating diagrammatically by way of example two typical forms of embodiment of the invention. In the drawing :

FIG. 1 is a diagram illustrating a device comprising a single vacuum diaphragm capsule operating only as an ignition advance control, and

FIG. 2 is similar diagram showing a device comprising two vacuum diaphragm capsules for controlling the one the advance and the other the retard of the engine ignition timing.

Referring to FIG. 1, the distributor 1 of the engine ignition system is controlled by a vacuum capsule 2 of known type. A pipe line 3 connects this capsule through a solenoid valve 4 to the induction manifold 5 of the engine which is considered as constituting, or acting as, a gas reservoir under variable pressure. A gauged buffer reservoir or capacity 6 communicates with the manifold 5 via a gauged passage 7 having a throttle cross-sectional area at its inlet connected to of said reservoir 6.

The solenoid valve 4 is controlled by means of a pressure-responsive switch 8 comprising a case 9 made of two symmetrical assembled halves or shells of insulating plastic material, divided into two chambers 11 and 12 by a resilient diaphragm 10 clamped between said case halves. One of these chambers, for example chamber 11, is connected via a pipe line 13 to the induction manifold 5, and the other chamber 12 is connected via another pipe line 14 to the buffer reservoir 6.

The diaphragm 10 serving the purpose of adjusting the sensitivity of the device is of the variable-stiffness type and consists either of a thin metal disk having a good electrical conductivity, or of a disk of plastic material either metal-coated (or metallized), or provided with a conductive strip and a central contact on either side. The metal diaphragm or the metal strip carried by the plastic disk 10 is connected via a conductor 15 to a source 16 of electric current having its positive terminal earthed, as shown.

A fixed contact 17 is disposed in chamber 11 in the vicinity of the central portion of diaphragm 10, and another fixed contact 18 is disposed symmetrically to the diaphragm in the other chamber 12. These contacts are connected through insulating grommets 19 to connecting terminals 20 and 21, respectively. In the example of FIG. 1 only contact 17 is utilized and its terminal 20 is connected via another conductor 22 to the energizing terminal 23 of solenoid-valve 4 having its other terminal 24 earthed, as shown.

In the modified form of embodiment illustrated in FIG. 2 the ignition system comprises an additional vacuum capsule 2' for controlling also the ignition retard; this capsule is connected via a pipe line 3' and another solenoid-valve 4' to the induction manifold 5. In this case while the advance control capsule 2 has its solenoid valve still connected to the terminal 20 of switch 8, this retard control capsule 2' has its solenoid valve 4' connected through a conductor 25 to the terminal 21 of said switch.

This device operates as follows :

Under stabilized engine speed conditions the same pressure p_o prevails in the induction manifold 5 of the engine and in the buffer capacity 6. If a pressure variation occurs either in the manifold or in the buffer capacity, a gas circulation is produced in passage 7 interconnecting these two chambers. Now the length and gauge section of this passage 7 are calculated to produce variable transfer times of the gas from manifold 5 to capacity 6, or vice-versa, as required.

When as a consequence of changes in the engine speed a vacuum is created in manifold 5, the pressure value therein will vary from p_o to $p_p - \Delta_p$, wherein Δ_p is

the known vacuum or suction value. Under these conditions, the chamber **11** of switch **8** will receive this pressure $po - \Delta_p$ while chamber **12** remains at pressure p_o. The diaphragm **10** will undergo a distortion proportional to the suction force Δ_p so as to engage the fixed contact **17** and thus close the energizing circuit of solenoid valve **4**, and this valve will cause the vacuum capsule **2** to communicate with the induction manifold **5** and introduce a certain advance in the engine ignition.

When as a consequence of the gas flow produced in passage **7** in the direction from capacity **6** to manifold **5** the pressure in the buffer capacity **6** has dropped sufficiently, this pressure reduction in chamber **12** of switch **8** will enable the diaphragm **10** to resume its initial shape, thus opening the circuit at contact **17** after a predetermined response time. The solenoid valve **4** is thus re-closed and the vacuum capsule **2** will again be isolated from manifold **5**. Therefore, the contact established as a consequence of the distortion of diaphragm **10** will last one fraction of the time during which gas is being transferred through passage **7**.

When, on the other hand, the pressure in manifold **5** increases, for example from p_o to $p_o + \Delta_p$, the pressure will also increase in chamber **11** in relation to chamber **12**. Thus, diaphragm **10** will be distorted in the opposite direction and caused to engage the other fixed contact **18** in chamber **12** so as to close the energizing circuit of solenoid valve **4'** (FIG. **2**). Thus, this valve **4'** will cause the vacuum capsule **2'** to communicate with induction manifold **5** and introduce a retard in the ignition timing.

During this time the gas flows from manifold **5** via passage **7** to buffer capacity **6**. When the pressure in chamber **12** has increased sufficiently to enable the diaphragm to resume by inherent elasticity its initial shape, so as to open contact **18–10** after a predetermined response time greater than that of contact **17–10**, the solenoid valve **4'** will be reclosed to isolate the vacuum capsule **2'** from manifold **5**.

The chambers **11** and **12** of pressure-actuated switch **8** may be connected indifferently to manifold **5** or chamber **6**, or to the inlet ends of passage **7**, on either side thereof, in order to improve the sensitivity of the device.

The volumes of manifold **5** and chamber **6** are adjustable to permit the proper setting or control of the ignition timing. To this end, the gauged diameter of passage **7** may also be modified accordingly.

The buffer capacity **6** may also, if desired, receive other pressure variation connections and thus operate differentially.

The advance or retard vacuum capsules are particularly advantageous in that they produce an ignition timing retard or advance only when accelerating or decelerating.

Of course, various modifications and variations may be brought to the device of this invention when embodying it in actual practice, without however departing from the basic principle thereof as set forth in the appended claims.

What is claimed as new is :

1. Ignition timing device for internal combustion engines comprising an induction manifold for the air/fuel gaseous mixture, an ignition distributor, at least one vacuum diaphragm capsule for controlling the ignition timing of the distributor, each capsule being connected to the reduction manifold, characterized in that it comprises a control solenoid-valve interposed between each vacuum capsule and the engine induction manifold, a buffer capacity for the induction gas, a fluid output limiting member connecting said buffer capacity to the induction manifold, and a deferred-action, pressure-responsive electric switch connected to said induction manifold and to said buffer capacity, and adapted to act in one or the other direction as a function of the variation in a differential pressure applied to said switch in case of pressure variation between said manifold and said buffer capacity so as to close during a predetermined time period, at least one electric contact controlling the corresponding solenoid-valve.

2. Device according to claim **1**, characterized in that said output limiting member comprises a gauged tubular passage interconnecting the buffer capacity and the engine induction manifold, said passage having a reduced cross-sectional passage area at its inlet corresponding to said buffer capacity, the dimensions of said passage being determined as a function of the desired fluid transfer time through said passage.

3. Device according to claim **2**, characterized in that said buffer capacity is of the variable-volume type.

4. Device according to claim **1**, characterized in that said electric switch comprises an insulating case divided by a flexible resilient diaphragm of variable stiffness into two chambers connected to said induction manifold and to said buffer capacity, respectively, said diaphragm being electrically conductive and connected to one terminal of a source of current, and a fixed contact in at least one of said switch chambers which registers with the central portion of said diaphragm and is adapted to co-act therewith for energizing the corresponding solenoid valve.

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