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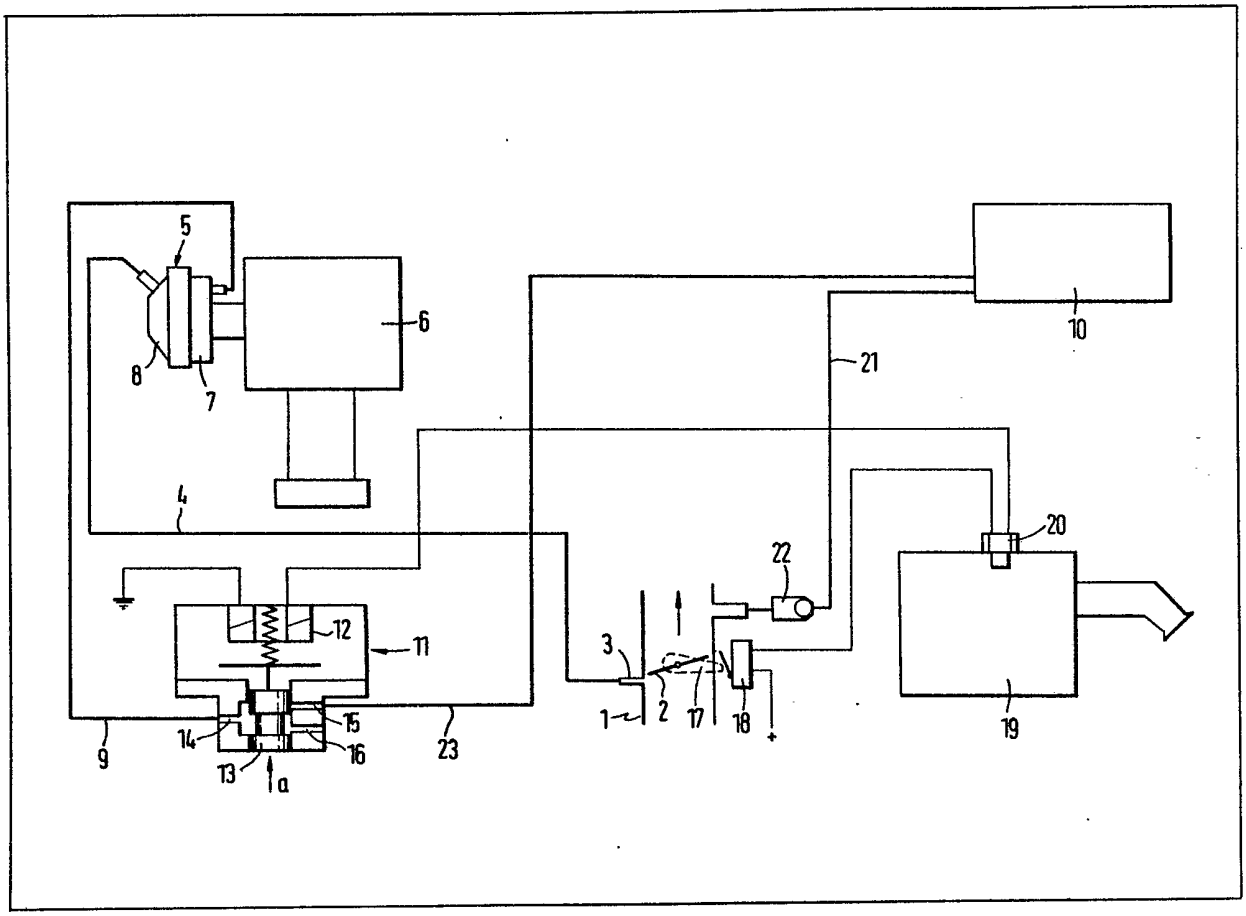
(54) An arrangement for adjusting the ignition timing in internal combustion engines

(57) The arrangement includes a distributor advance chamber 8 and a distributor retard chamber 7 for adjusting the ignition timing of the engine as a function of vacuum in an intake passage 1 having flow regulator means 2, and means 11, 18, 20 associated with the advance and retard chambers for influencing the ignition timing as a function of intake air temperature. A valve 11 connects retard chamber 7 selectively to atmosphere or to a vacuum reservoir 10 under the control of an electromagnet 12, the energising circuit of which contains a throttle valve switch 18 and a thermo-switch 20 on the air filter 19.



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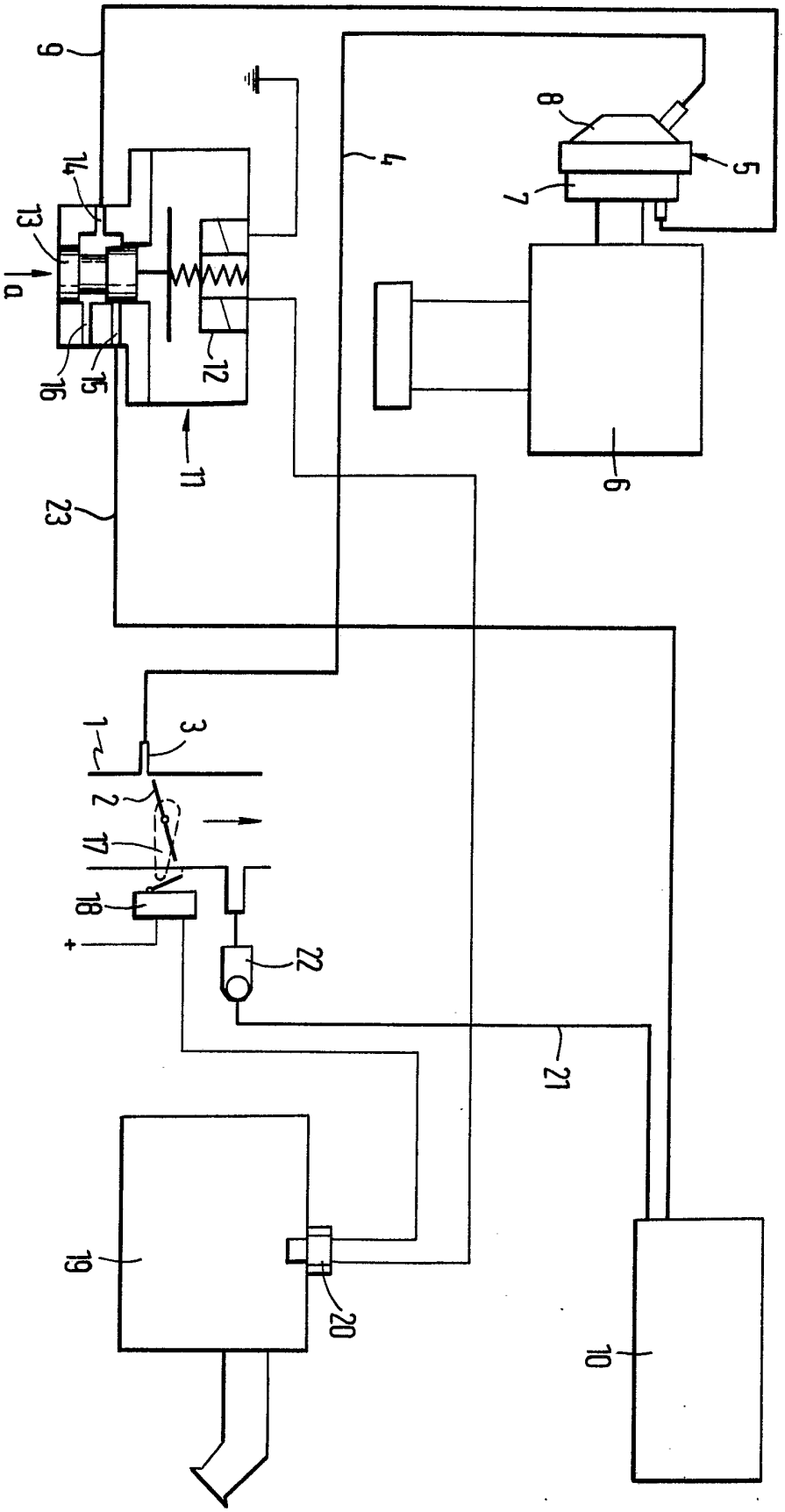

SPECIFICATION

An arrangement for adjusting the ignition timing in internal combustion engines

The present invention relates to an arrangement for adjustment of the ignition timing in internal combustion engines as a function of the vacuum in the intake passage which has a flow regulator such as, for example, a throttle valve and further including a vacuum device comprising a distributor spark chamber and a distributor spark retarding chamber.

In current automobile ignition systems, it is conventional to delay the ignition timing in order to reduce harmful exhaust substances, such as hydrocarbons and NO_x. However, a delay in the ignition timing results in both lower thermal efficiency and lower engine output, with a consequent impairment of engine performance. This impairment of engine performance is particularly evident with cold ambient conditions and during engine warm-up.

It is already known, German Patent No. 596,918, that better combustion with a cold engine can be obtained by advancing the ignition. Ignition advance can be adjusted as a function of a predetermined engine temperature, but an internal combustion engine provided with such an ignition timing arrangement cannot be driven at maximum power due to the detonation that is encountered early.

In a warmed-up internal combustion engine, the detonation threshold depends upon ambient conditions, particularly the temperature of the air intake and air pressure. The margin of safety between full-load ignition and the detonation threshold must be adapted to the most unfavourable ambient conditions that can be expected to occur as a whole in the operation of the internal combustion engine. Thus, in the average set of ambient conditions, the maximally useable output of the internal combustion engine is less than desired.

It is an object of the present invention to provide a means for adjustment of internal combustion engine ignition timing which optimizes timing adjustment. The problems encountered in the prior art have been solved by providing means whereby adjustment of the ignition timing is influenced by intake air temperature.

By the adjustment of the ignition timing as a function of intake air temperature, it has been found possible to come closer to the detonation threshold with full-load ignition characteristics than was possible previously so that the maximum useful output of the internal combustion engine is increased without changing the ignition timing in the partial load or idling range.

We have found it to be particularly advantageous if the adjustment means includes a thermo-switch that is influenced by intake air temperature, a throttle switch which is actuatable as a function of the flow regulator position, and a control valve that influences the vacuum means.

The accompanying sole figure shows an arrangement for adjusting the ignition timing of an internal combustion engine according to the present invention.

Referring to the drawing in which the internal combustion engine is not illustrated, there is shown a section of an intake passage 1 having a flow regulator, e.g. a throttle vale 2, rotatably disposed therein and actuatable as desired. Intake air flows through the intake passage 1 in the direction indicated by the arrow. The intake passage 1 is connected to a vacuum device 5 through a port 3 just upstream the illustrated idling position of the throttle valve 2 and a control pressure line 4 connected to the port 3.

The vacuum device 5 controls the ignition timing of a distributor 6 and includes a spark retard chamber 7 and a spark advance chamber 8 into which control line 4 opens. The retard chamber 7 is connected through vacuum lines 9 and 23 to a vacuum ballast 10. The line 9 is regulated by a control valve 11 which comprises an electromagnet 12, a control piston 13, and throughput ports 14, 15 and 16. A throttle valve switch 18 is arranged in the circuit of the electromagnet 12 and is actuatable by a control cam 17 which is pivotable with the throttle valve 2. A thermo-switch 20 is also arranged in the circuit of the electromagnet 12 and is fixed on the air filter 19 and influenced by the intake air.

The vacuum ballast chamber 10 is connected with another port (unnumbered) in the intake line in the region of the throttle valve 2 *via* a vacuum line 21. A control valve 22 is arranged in the vacuum line 21 in order to maintain the pressure in the vacuum ballast chamber 10 in a known manner.

The operation of the above-described embodiment is as follows. When the internal combustion engine is driven and the temperature of the intake air is above the nominal switching point of thermo-switch 20 (for example at 20° to 25°C.), then the thermo-switch closes. Due to the continued movement of throttle valve 2, the vacuum increases in the vicinity of the port 3. As a result, the ignition timing will advance, *via* the control pressure line 4 and the distributor advance chamber 8, while the retard chamber 7 will be vented *via* the vacuum line 9 and throughput ports 14 and 16.

If the throttle valve 2 is turned from a position constituting the partial load range of the internal combustion engine first, the vacuum in the advance chamber 8 will be reduced by the pressure rise in the suction line. The throttle valve switch 18 will be actuated by the control cam 17 and the circuit for the electromagnet 12 will become a closed circuit. As a result, the electromagnet 12 will pull the control piston 13 in the direction of arrow *a* until the throughput port 16, through which the retard chamber 7 is vented, closes and the throughput port 15 is opened. The distributor retard chamber 7 will then be connected with the vacuum ballast chamber 10 *via* vacuum line 9, ports 14 and 15, and vacuum

line 23, The ignition advance is thereby reduced by a value given in the retard chamber without, however, leaving the range of advanced ignition.

If the throttle valve 2 is again turned toward the range constituting partial load or beyond the partial load range in the direction of idling, the electromagnet circuit will be interrupted and the control piston 13 will move in the direction opposite to arrow *a* back into the position illustrated. Then, the throughput port 15 will close and the connection between the vacuum ballast chamber 10 and the retard chamber 7 will be interrupted. The retard chamber 7 will again be vented through vacuum line 9 and ports 14 and 16, and the distributor 6 will again move towards the advance ignition position through the control pressure line 4 and the port 3 as a function of the vacuum in the intake passage 1.

When the internal combustion engine is driven and the temperature of the intake air is below the nominal switching point of the thermo-switch 20 (for example 20° to 25°C.), the thermo-switch 20 remains open and the circuit of the electromagnet 12 is interrupted by the thermo-switch 20 and the throttle valve switch 18. With continued movement of the throttle valve 2, the vacuum is increased in the vicinity of the port 3 and the distributor advance chamber 8, and the distributor 6 is set on advance ignition. If, then the throttle valve switch 18 is closed by the control cam 17, the circuit of the electromagnet 12 remains interrupted because of the open thermo-switch 20. Thus, with an air intake temperature below the switching point of the thermo-switch 20, there is no lessening or retardation of the ignition advance by the movement of the control piston 13 even if the throttle valve 2 has been turned beyond the setting that constitutes the partial load range of the engine.

While we have shown and described one preferred embodiment in accordance with the present invention, it is to be understood that modifications and changes may be made without departing from the scope of the present invention. For instance, the full load ignition timing can be influenced as a function of air pressure by means of a pressure chamber height regulator or in conjunction with the thermoswitch.

CLAIMS

1. An internal combustion engine having an arrangement for adjusting the ignition timing of the engine as a function of vacuum in an intake passage having a flow regulator means, including a distributor spark advance chamber and a distributor spark retard chamber, and means associated with the advance and retard chambers for influencing the ignition timing as a function of intake air temperature.

2. An engine according to claim 1, wherein said last-mentioned means includes a thermo-switch which is influenced by intake air temperature, a throttle valve switch which is actuatable as a function of the position of the flow regulator means, and a control valve.

3. An engine according to claim 2, wherein the control valve includes a control piston, and an electromagnetic means for actuating the control piston, said thermo-switch and said throttle valve switch being operatively associated with said electromagnetic means.

4. An engine according to claim 2 or 3, wherein the control valve is provided with ports cooperating with the position of said control piston selectively to vent said distributor retard chamber or to connect said retard chamber with a vacuum ballast chamber.

5. An engine according to any of claims 2 to 4, wherein a control cam is provided operatively associated with said flow regulator means for actuating said throttle valve switch.

6. An engine according to any of claims 2 to 5, wherein the said thermo-switch is provided in an air filter of the engine.

7. An internal combustion engine having an arrangement for adjusting the ignition timing of the engine, substantially as described with reference to, and as illustrated in the accompanying drawing.

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