

[54] STORAGE CONTROL FOR GASOLINE
INJECTION INSTALLATIONS OF
COMBUSTION ENGINES

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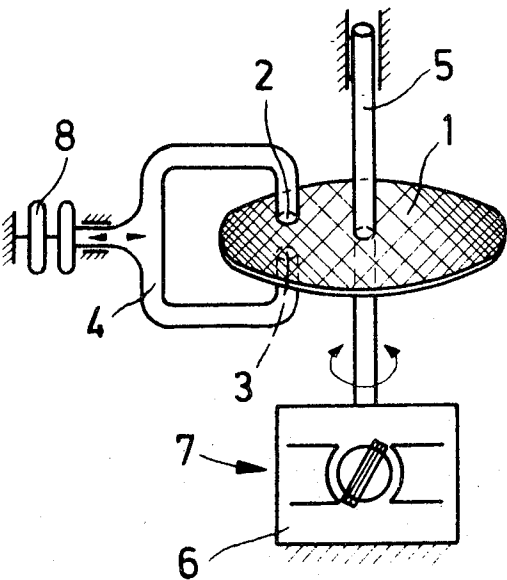
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[57] ABSTRACT

A storage control for gasoline injection installations of internal combustion engines to control the opening times of injection valves in dependence on operating conditions of the engine.

4 Claims, 2 Drawing Figures



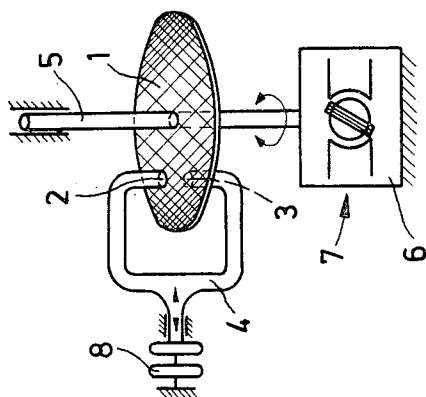


FIG. 1

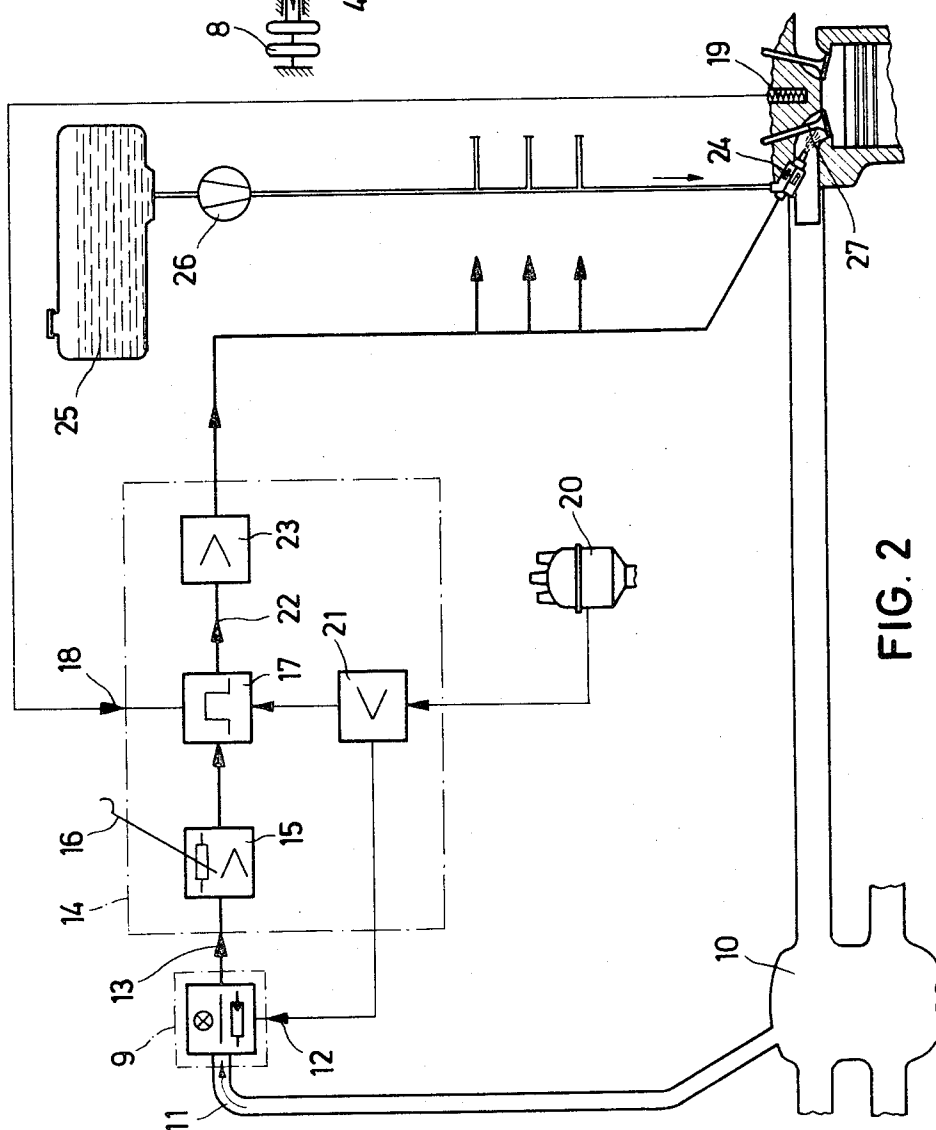


FIG. 2

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STORAGE CONTROL FOR GASOLINE INJECTION INSTALLATIONS OF COMBUSTION ENGINES

This invention relates to a storage control for gasoline injection installations of internal combustion engines, for the control of the opening times of the injection valves in dependence on the pertinent operating condition of the engine whereby for the characterization of the operating conditions two of the three possible values, suction pipe pressure, r.p.m., and throttle valve position, are adduced.

By such a control, the quantity of fuel is fed at each moment to the engine which is required for the achievement of an optimum operating behavior (specific fuel consumption, composition of the exhaust gas, etc.).

In a known electron gasoline injection installation, the pressure of the suction pipe is the main control valve, the r.p.m. having only a correcting effect. Therefore, essentially one is dealing with a control of characteristic curves and the electric values are not worked up independently of one another in the electronic control device. This means that a substantial change in the full load control is not possible without influencing the partial load control. However an independent partial load control is particularly important in view of the decontamination of exhaust gases (California test) increasing ever more in importance.

Also a mechanical gasoline injection installation has been known where a genuine performance graph control exists by the fact that the control of the injected quantity of fuel is accomplished purely mechanically with the use of a space cam. The gasoline lever will open the throttle valve and at the same time turns the space cam, and a centrifugal regulator shifts the space cam axially in dependence on the r.p.m. of the engine. The space cam is scanned by a roller which is seated on a lever, the other end of which shifts the regulator bar of the injection pump.

It is an object of the present invention to create a performance graph-storage control for an electronic gasoline injection installation.

According to the invention this object will be achieved in that a disk representing the storage and which is divided into surface elements, each of which corresponds to a certain operational state, is moved relative to an information receiver or information transmitter in dependence on the pertinent operating state, which information receiver or transmitter controls the opening times of the injection valves in correspondence with the information or operating state transmitted to it.

Advantageously the storage is developed in such a way that the surface elements of the disk have variable light transmission and that a light barrier serves as information receiver or transmitter consisting of a light source of definite intensity of illumination and of a light sensitive element, for example a photoconductive or photo-electric cell. The surface elements having variable transparency of light to correspond to the opening times of the injection valves. These injection times are found by way of a manual control instrument in dependence on the operating condition of the motor, previously on the engine test stand and is determined in the form of performance graphs. A particular advantage of this storage is that, once a sample disk is available,

other disks can be produced precisely and inexpensively with known methods of photographic techniques.

The actual control is accomplished in that the disk revolving around its own axis or axle penetrates it perpendicularly in dependence on one of the three values, r.p.m., suction pipe pressure and angle of the throttle valve, while the light barrier is shifted relative to the disk in dependence on one of the two remaining values. If therefore the revolution of the disk for example takes place in dependence on the r.p.m. of the engine, then the relative movement of the disk and light barrier can be a function either of the suction pipe pressure or of the angle of the throttle valve. Likewise the disk can be twisted directly by an adjustment of the throttle valve as a second characteristic value, for the adjustment of the light barrier effectively the r.p.m. is used. Furthermore, the disk can be rotated in dependence on the suction pipe pressure and in that case the r.p.m. being used likewise as the second independent variable.

A second possibility of achieving the invention is present by a ferromagnetic disk moving in an air gap of an iron circuit and having stored therein the information in the form of variable thicknesses. Various thicknesses of the disk signify a variable air gap and thereby change of an inductivity which is used as a time determining element of a monostable sweep stage.

A still further object of the invention resides in the fact that the storage may also be used for the electronic adjustment being dependent indeed on the same control values. For example, in the case of the above described "photo electronic storage," the entire disk is not needed for the control of the duration of the impulse, therefore for the control of the opening times of the injection valves. On the free part the ignition point adjustment field of a high voltage capacitor ignition installation may be stored with the aid of a second light barrier which is mechanically coupled with the first one: the "resistance" of the light receiver being a part of the RC element in the thyristor trigger circuit changes, and as a result the ignition point is shifted.

For the sake of clarity it is desired to mention that it will not cause any kind of difficulty to include also in the storage such points of the state which characterize the sliding drive. This state is characterized in that on the one hand the throttle valve is closed and, on the other hand the r.p.m. of the engine is considerably higher than the idling r.p.m. No fuel should be fed to the engine during this time, that is to say the injection valves must remain closed.

The storage control according to the invention combines within itself the advantages of the space cam control (advantage: performance graph control) known in the case of mechanical injection installations, as well as those of the known electronic injection installations (advantage: less constructional expenditure for fewer movable parts, greater operating reliability). The storage can be reproduced by simple means and is therefore particularly suitable for large scale serial production of such injection installations. The adjustment of the electronic circuit is possible without difficulty despite maintenance of small tolerances. Simple electronic construction units, (sweep stages, differential amplifiers), can be used which make possible an extensive integration of the circuit. Further, it is desired to again point out once more the possibility al-

ready mentioned of a simultaneous adjustment of the ignition point.

The invention, which is not limited by the schematically shown embodiment, will be explained in detail in the following when considered in connection with the accompanying drawing in which,

FIG. 1 is a diagrammatic view of the basic structure of a photoelectronic storage means according to the invention, and

FIG. 2 is a block diagram of the electronic injection installation with electronic storage and connected to an engine.

Referring to FIG. 1a, disk 1 with variable transparency may be moved or rotated between a light barrier 4 formed by a point shaped light source 2 of definite intensity of illumination and a light sensitive element 3, (for example a photoconductive or electric cell). The shaft 5 of the disk 1 is driven by a torque pickup 6 which operates according to the principle of the moving coil instrument. The value of the torsion is determined by the r.p.m. 7 which is injected in the form of an electronic voltage by the electronic r.p.m. transmitter of the control instrument (compare FIG. 2).

The light barrier 4 can be shifted in the direction of the arrow in dependence on the suction pipe pressure and the latter acts on a bellows 8, which as a result thereof, is more or less compressed or pulled apart. The "pulse time" assigned to every operational state, that is to say, the time which is available for the injection of the fuels on the valves is available as a unit of density of or on the disk 1 and is transformed by the light receiver 3 into a proportional voltage and is further processed in the control instrument. The storage value transmitted in dependence on the degree of density determines the duration of the impulse of a pulse transmitter stage, that is, the degree of density therefore is a measure for the injection time.

In FIG. 2, the pulse time is selected from the storage 9 with the aid of the pressure in the suction pipe 11 taken from the suction distributor 10 and the r.p.m. 12 and is transmitted to a control instrument 14, and from there is fed to a pulse generator 17, monostable sweep stage, by means of an amplifier stage 15 with a balancing potentiometer 16, for adjustment of the sensitivity or tolerances. Additionally a temperature requirement 18 of the temperature sensor 19, will have an influence on the heating up phase. Upon arrival of releasing impulses of the ignition distributor 20 by means of an amplifier stage 21 of the electronic tachometer, the impulses with the corrected final impulse duration 22 will reach the injection valves 24 by means of the terminal

stage 23, which valves inject or spray the fuel sucked in from the tank 25 with a pump 26, in front of the inlet valves 27 with a constant pressure achieved by way of pressure regulators.

WE CLAIM:

1. In a storage control apparatus for internal combustion engine fuel injection systems wherein the opening times of the injection valves are controlled in accordance with a combination of at least two engine operating conditions selected from the group of operating conditions consisting of the pressure of the intake pipe, the engine r.p.m., and the position of the throttle valve, said storage control apparatus having a storage member with a surface divided into individual elements each of which represents an injection valve opening time associated with the said combination of at least two engine operating conditions, and means for extracting information recorded on each of said surface elements by relative movement between said storage member and said means for extracting, the improvement in said storage control apparatus comprising:

said storage member is a disc and said individual surface elements are blackened areas of various degrees of transparency on said surface, said means for extracting comprises a light transmitter and light receiver which are responsive to the various degrees of transparency, said light transmitter and said light receiver are respectively mounted in fixed relationship to one another on opposite sides of said surface, means for relatively moving said light transmitter and said light receiver with respect to said surface in accordance with the changes in one of said two engine operating conditions, means for moving said disc with respect to said light transmitter and said light receiver in accordance with the other of said two operating conditions, and control means responsive to signals from said light receiver for generating signals for controlling said opening times of the injection valves.

2. A storage control apparatus as in claim 1 wherein said means for moving rotates said disc around an axis through its center.

3. A storage control apparatus as in claim 1 wherein said disc is a photographic material.

4. A storage control apparatus as in claim 1 wherein said means for extracting further comprises an additional light transmitter and receiver, said disc further includes additional storage elements representing information for adjusting the ignition times of said engine.

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