United States Patent [19]

Lorentz

[11] **3,791,354**

[45] **Feb. 12, 1974**

[54] ENGINE CHARGE TIMING SYSTEM

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[52] **U.S. Cl.**..... **123/90.12**, 123/90.11, 123/90.15, 123/32 AE

[51] **Int. Cl.**..... **F011 9/02**, F011 1/34, F011 9/04

[58] **Field of Search**.....123/90.11, 90.12, 90.13, 123/90.14, 90.15, 97, 102, 139 E, 123/139 AW, 32 EA, 32 AE

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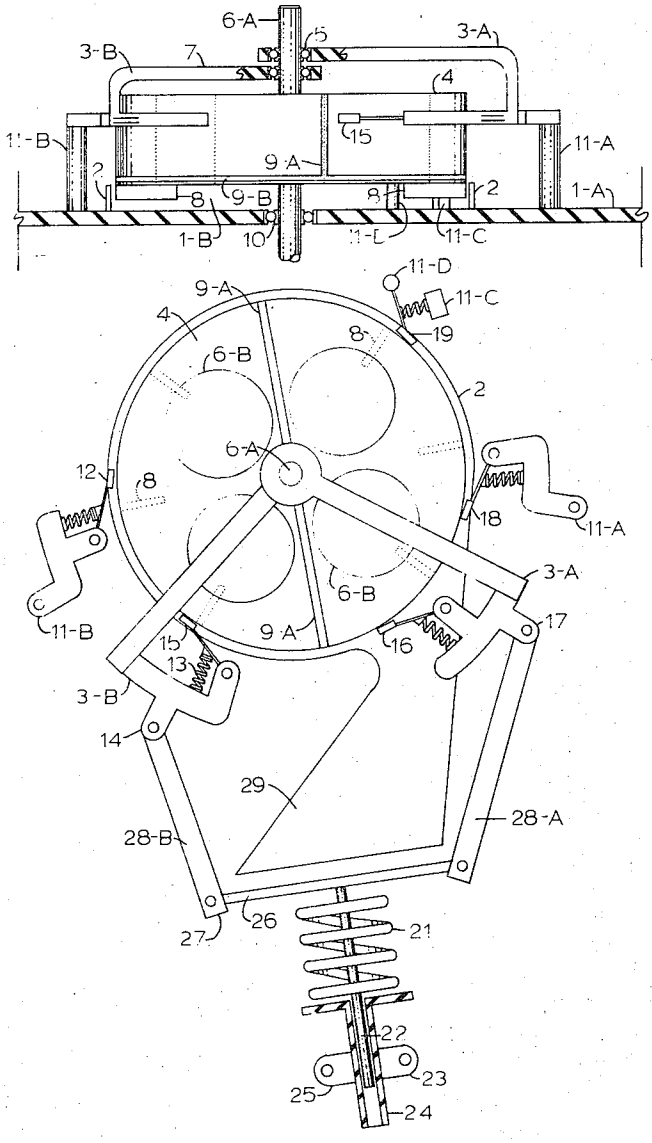
Primary Examiner—Al Lawrence Smith

Attorney, Agent, or Firm—James C. Wray; Brenner & Wray

[57] **ABSTRACT**

In a system for opening and closing poppet valves in an internal combustion engine, a pulser rotates at one-quarter engine speed to excite magnetic pickups which control the opening and closing of poppet valves through bistable multivibrators, amplifiers and solenoids which control hydraulic pilot valves to selectively open hydraulic lines for driving the poppet valve open or closed and holding the poppet valve in that condition for a predetermined time. Four pickups are associated with a pulser station for one cylinder. Two pickups control the exhaust poppet valve, and two pickups control the intake valve. The exhaust opening pickup and the intake valve closing pickup respectively are advanced and retarded with increased speed. The hydraulic pilot valve system may be cascaded to provide sufficient power to drive the poppet valves.

9 Claims, 10 Drawing Figures



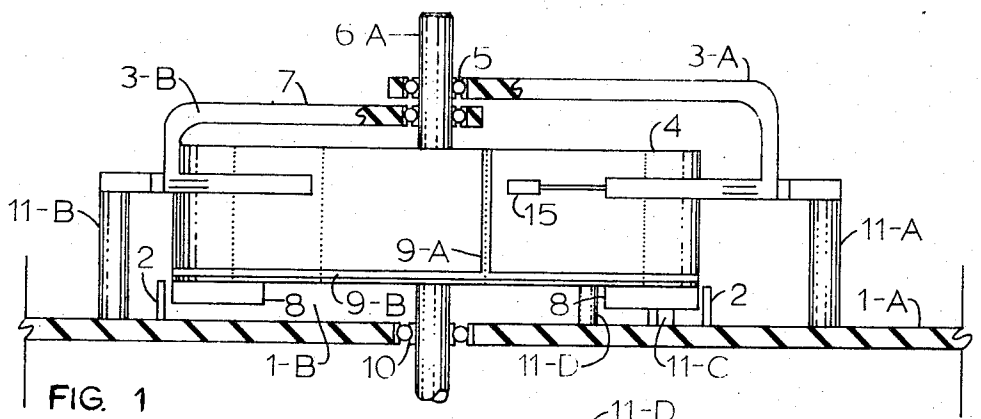

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3-A
3-B
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11-D
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FIG. 1

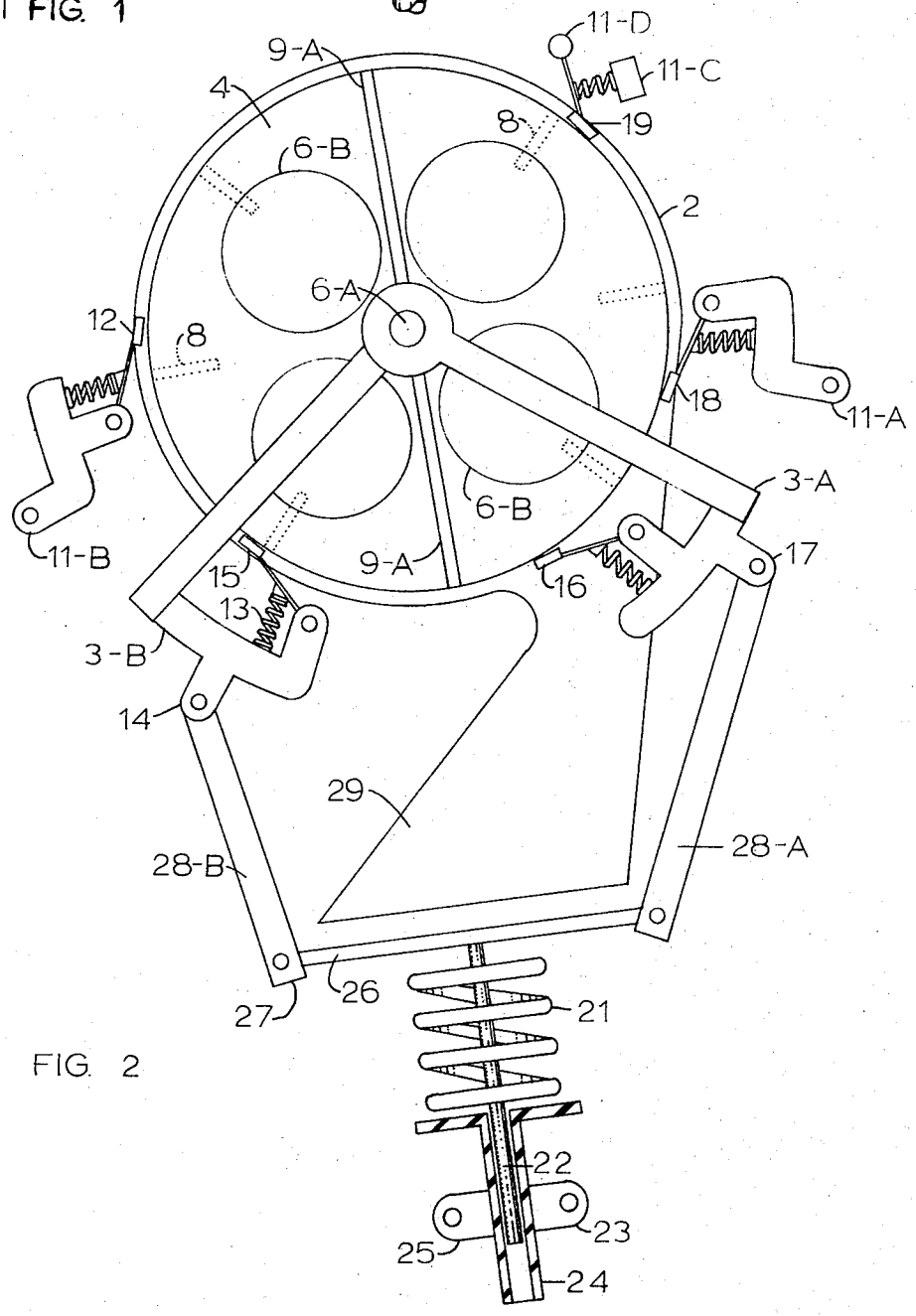

11-D
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FIG. 2

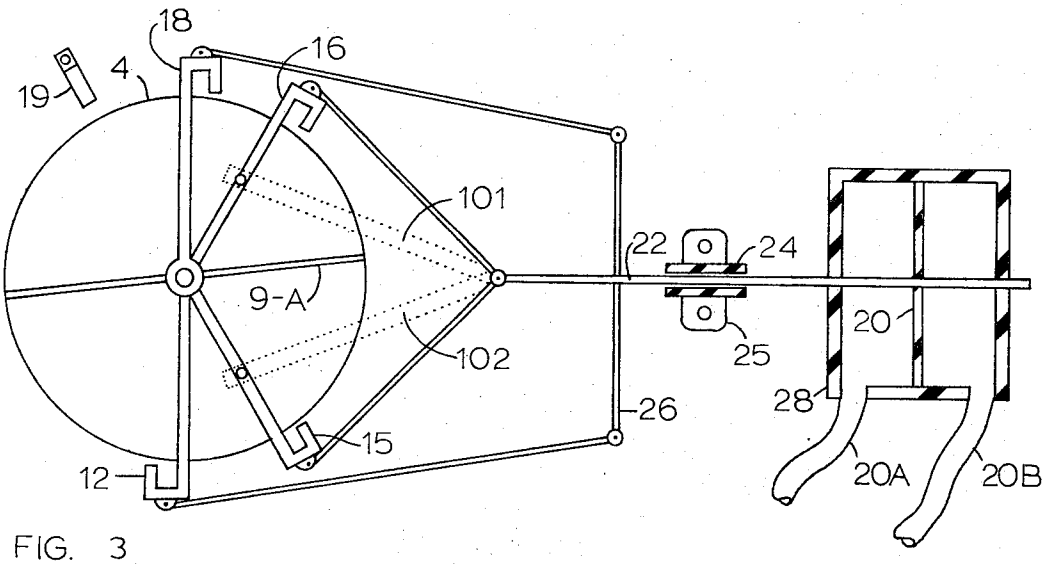


FIG. 3

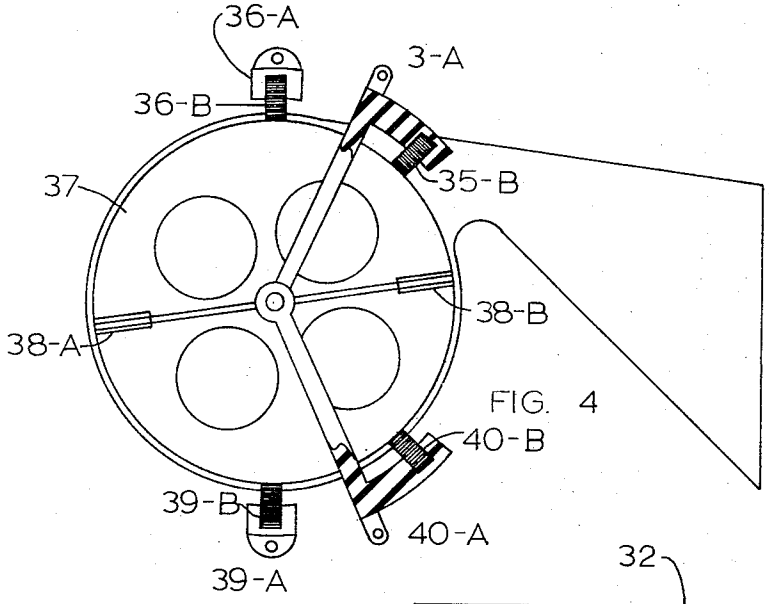


FIG. 4

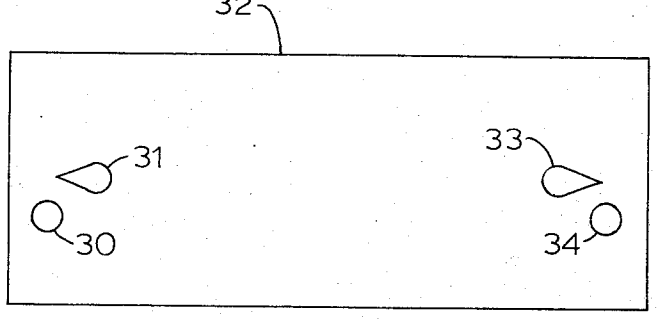


FIG. 5

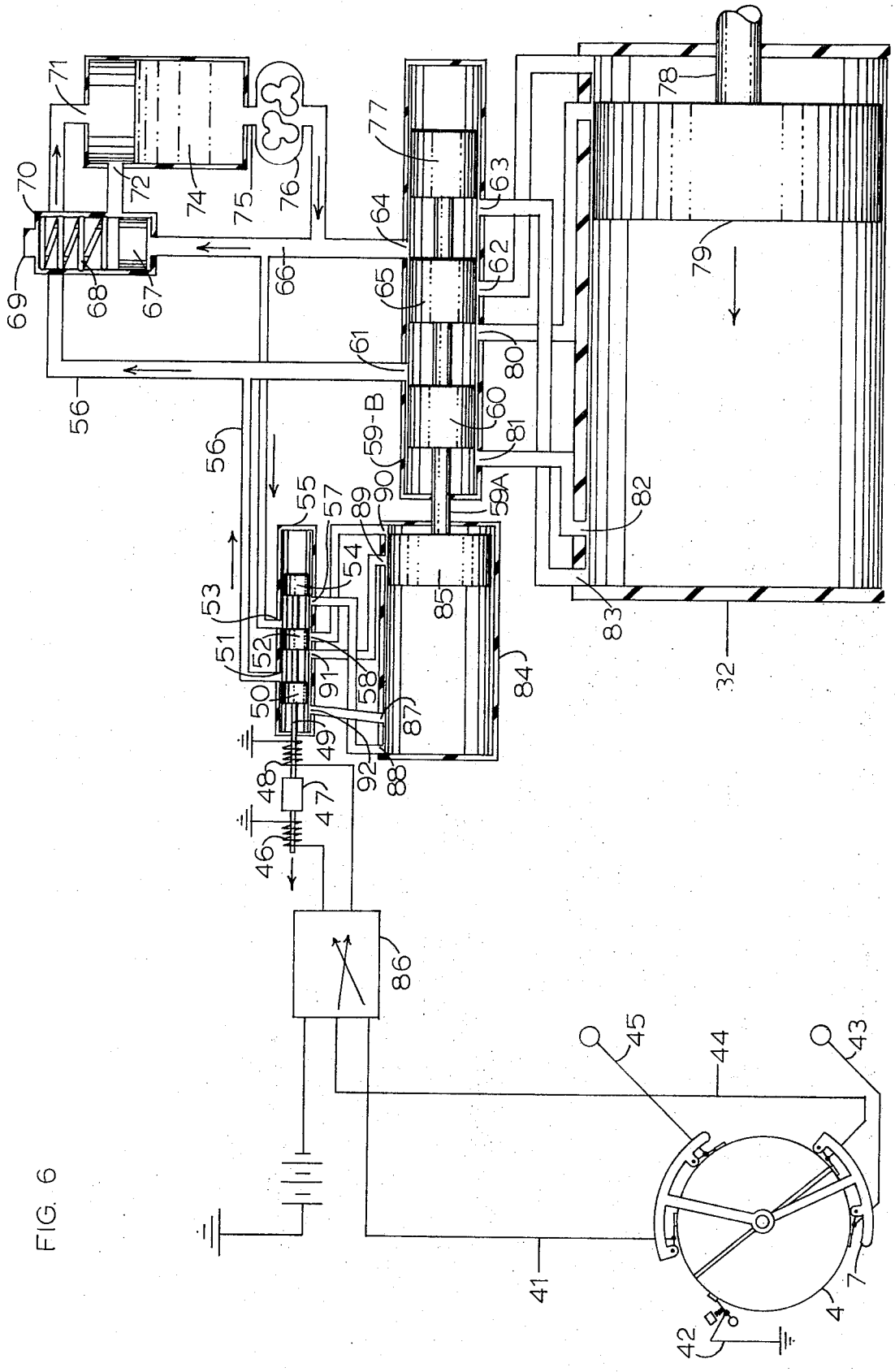

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FIG. 6

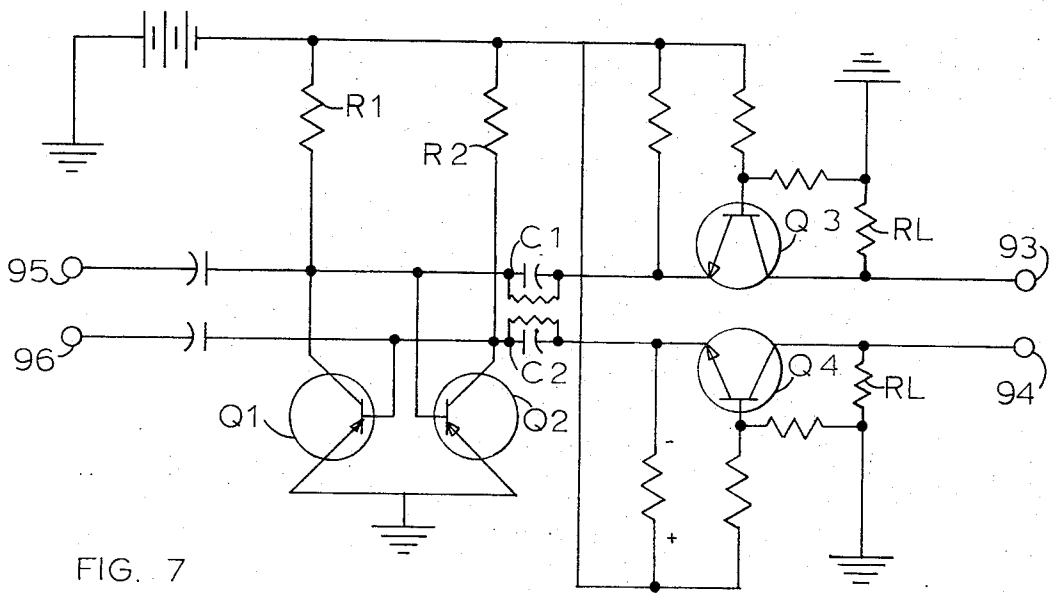


FIG. 7

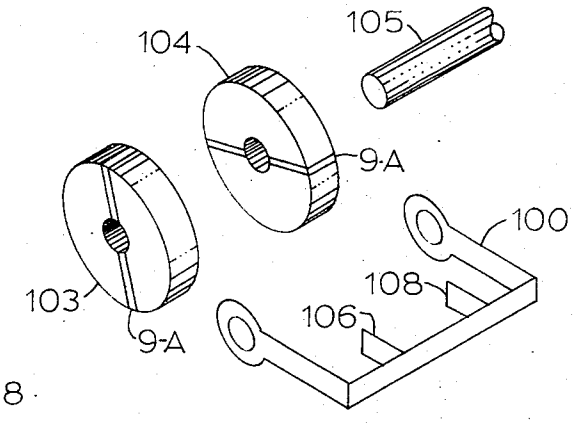


FIG. 8

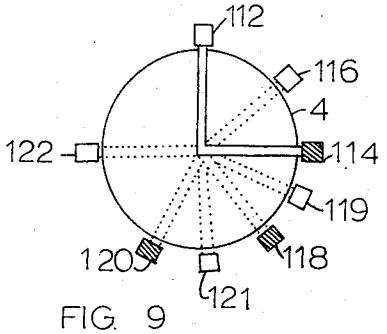


FIG. 9

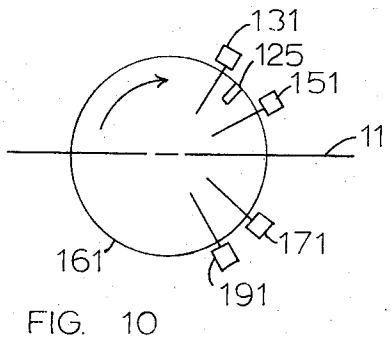


FIG. 10

ENGINE CHARGE TIMING SYSTEM

BACKGROUND OF THE INVENTION

Behavior of poppet valves in internal combustion engines affects the characteristics of the breathing of the engines. The poppet valves in conventional engines open and close corresponding to predetermined angles of crankshaft rotation. The engine valve timing is not influenced by engine speed, a variable that affects engine aspiration.

The electro-fluidic valve system of the present invention opens and closes poppet valves with variation that corresponds to engine speed. Engine breathing is improved.

Known prior art is evidenced by U.S. Pat. No. 3,548,793 which shows an optical system which controls a solenoid opening a hydraulic supply to move a poppet valve against pressure of a spring which tends to close the poppet valve. U.S. Pat. No. 3,397,681 shows commutators which supply power to solenoids, which in turn operate through levers to drive poppet valves open and closed. In U.S. Pat. No. 2,692,588, rotating hydraulic commutators supply hydraulic fluid to cylinders for driving poppet valves. The commutators are shifted longitudinally to change dwell.

U.S. Pat. No. 3,209,737 has a modification shown in FIG. 4 in which a solenoid controls a hydraulic pilot valve to supply hydraulic fluid to a cylinder for opening and closing poppet valves.

U.S. Pat. No. 2,520,537 shows a rotating pulser having electromagnetic pickups which control the operation of valves in an internal combustion engine. The device stores electrical energy and then releases electromagnetic energy to drive a poppet valve. Generally, the electrical apparatus might be considered to be similar to an amplifier with the thyratrons similar in operation to transistors. The patent does not have a hydraulic pilot valve and power system and does not have particular means for adjusting timing and dwell of the valves. U.S. Pat. No. 3,372,680 shows the use of transistors and amplifiers in controlling the timing of valves in an internal combustion engine. U.S. Pat. Nos. 3,496,918 and 3,645,241 are recent examples of electrical circuits and mechanical means for changing timing according to speed.

These and other patents are found in Class 123, Internal Combustion Engines, subclasses 90, 90.11, 90.15, 97, 102 and 139 of the United States Patent Office official classifications.

In all of the prior art, apparently there is no precise pulser pickup system in which the pulser is turned at one-quarter engine revolution, in which all of the pickups are located within 180° around the pulser and in which two of the pickups are moved together according to changing speeds. No prior art system amplifies electric signals, drives a solenoid with the amplified power, changes a state of a pilot valve with the solenoid, drives another hydraulic valve with hydraulic fluid flowing through the pilot valve, and finally drives a hydraulic motor which moves the poppet valve.

SUMMARY OF THE INVENTION

A pulser rotating at one fourth engine speed excites magnetic pickups which control the opening and closing of engine poppet valves through bistable multivibrators, amplifiers, solenoids and hydraulic pilot valves to open and close the valves of the engine. The pickups are shifted along the pulser to increase valve openings as engine speed increases.

This invention describes apparatus for controlling engine valves, particularly poppet valves, and fuel injection pumps and valves. A commutator rotates at one fourth engine speed, or at some speed related to engine speed. Pick-ups positioned adjacent the commutator complete circuits to provide pulses in timed relationship as controlled by the commutator. A bistable multivibrator or flip flop changes upon being pulsed by a pick-up. One state of the flip flop supplies power to move a solenoid armature in one direction, moving a pilot valve to supply fluid power amplified by a series of fluid amplifiers to a reciprocable fluid power cylinder motor which is connected to a stem of a poppet valve. Fluid pressure holds the poppet valve in a fixed position until the commutator pulses the next pick-up for changing the state of the flip flop, changing the direction of the solenoid armature and changing the direction of the valves in the fluid system to drive the fluid motor in its opposite direction, and changing the state of the poppet valve and holding that changed state with fluid pressure until the first pick-up is again pulsed.

One commutator is associated with one cylinder. Two pick-ups are associated with each poppet valve, i.e., two pick-ups for the exhaust valve and two pick-ups for the intake valve. In a preferred embodiment the intake closing is retarded, and the exhaust opening is advanced with increased engine speed.

The present invention concerns timing apparatus for internal combustion engines, which control valves and fluids delivered to engine cylinders and exhausted therefrom. The timing apparatus controls valves, whether of the reciprocal poppet type or of the rotary type or of any other type and controls all devices such as fuel injection systems, supercharged systems and any and all devices which control the input of air or oxygen, gaseous and liquid fuels such as liquid propane gas for gasoline operated engines, and mixtures of fuels and oxygen, and also controls the exhausting of the combustion products.

Broad objectives of the invention are met by providing a rotatable means with a first electric, magnetic, electronic or fluidic communicating means. The rotatable means rotates at some speed, preferably one-quarter, related to engine speed. Second communication means which sense the first communication means are positioned near a periphery of the rotatable means. The second communication means in turn control electronic means, which are preferably bistable multivibrators to urge the multivibrators into a predetermined stable state. The outputs of the electronic systems control valves or pumps. Amplifying devices may be added to provide increased power in the control operation. For example, a multivibrator controls a solenoid which in turn controls the pilot valve of a fluid amplification system. One communication means shifts the bistable multivibrator to a first position which controls the fluid amplifier to open an exhaust valve. Another second communication means urges the same multivibrator to a second condition, which causes the amplifier to close the exhuast valve. A separate multivibrator and amplifier are used for the intake valve in cooperation with third and fourth pick-ups around the same rotating means.

In multiple cylinder operation, separate rotatable means or disks may be employed or additional valve-controlling pick-ups may be mounted around a single disk.

A speed responsive apparatus changes the positions of the second communication means with respect to the disk. As engine speed increases, the exhaust valve opening is advanced, and the intake valve closing is retarded. Preferably, the speed responsive means works on two pick-ups to concurrently change their position. In a preferred embodiment, the speed responsive means is a blower connected to the rotating disk and air directing means and a fin or blade against which the air from the blower is applied. Increased pressure on the blade moves the blade against spring pressure and urges two communication means into new angular positions with respect to the disk. Preferably, the communication means in one pair, which is attached to a blade, are mounted on one side of the rotating means within a 180° arc, so that the communications means in the pair may be concurrently moved by a single blade.

One object of the invention is the provision of internal combustion engine charge timing systems having a disk rotating at engine speed, a communicator on the disk, and several cooperating communicators positioned around the disk for operating a response mechanism to control engine charge and speed responsive means for shifting the second communicators angularly with respect to the disk.

Another object of the invention is the provision of internal combustion engine charge timing apparatus with rotating means for pulsing valve controllers to operate flip flops and amplifiers for opening and closing valves and for charging and discharging engine cylinders.

These and other objects and features of the invention are apparent from the disclosure, which includes the drawings and the foregoing and ongoing specification of which the claims are a part.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevation of a commutator pulser of the present invention.

FIG. 2 is a side view of the commutator pulser and advance retard mechanism.

FIG. 3 is a modification of the pulser of FIG. 2.

FIG. 4 is a side view of an induction pulser.

FIG. 5 is a cylinder.

FIG. 6 is a schematic representation of a complete system with commutator pulser minus the bracket advance retard mechanism and showing the bistable multivibrator and amplifiers is block diagram.

FIG. 7 is a schematic diagram of a bistable vibrator and amplifiers used in another embodiment of the invention.

FIGS. 8 and 9 show two cylinder operations.

FIG. 10 illustrates a two stroke cycle timing pulser which is driven at engine speed.

DETAILED DESCRIPTION OF THE DRAWINGS

The pulsers in FIGS. 1, 2, 3 and 4 produce the motive effort that excites the remaining portion of the system to properly operate poppet valves. Either pulser may be used in a setup. The pulser may take a different form, depending upon whether the engine used is one of a multicylinder design or of a single cylinder design. The pulsers shown in the drawings are for a single cylinder in either a single or multiple cylinder installation.

The commutator pulser of FIGS. 1 and 2 consists of a nonconductor solid in the shape of a disk 4, with a commutator bar 9-A, and terminal strip 9-B attached so that brush 19 riding on said terminal strip will provide a ground for brush 12, 15, 16 and 18 through said commutator bar, as said disk, commutator bar and terminal strip rotate on shaft 6-A. The brushes other than 19 are attached mechanically to brackets 3-A, 3-B, 11-A and 11-B and electrically to transistorized circuits of FIG. 7. Disk 4 and respective components will rotate at one fourth the speed of the engine crankshaft.

Brush 18 is grounded at a time desirable for exhaust poppet valve closing. Brush 16 is grounded at a time desirable for inlet poppet valve closing. Brush 15 is grounded at a time desirable for exhaust poppet valve opening. Brush 12 is grounded at a time desirable for inlet poppet valve opening.

FIG. 3 depicts a timing pulser and advance retard mechanism that is influenced by engine speed and engine load. Generally, the exhaust closing and inlet opening should vary at about 55% of the rate at which the inlet closing and exhaust opening vary, hence 101 and 102 of FIG. 3.

The induction pulser in FIG. 4 affords less wear because of less contacting parts. Said pulser is similar to the commutator pulser because it provides a timed interruption for the transistorized circuits of FIG. 7. Instead of merely grounding the said circuit, the induction pulser induces a positive pulse to the circuit. Disk 37 with magnets 38-A and 38-B rotate at one quarter the speed of the engine crankshaft so that the said magnets induce current in the respective coils. Coil 36-B is activated at a time desirable for exhaust poppet valve closing. 35-B is energized at a time desirable for inlet poppet valve closing. 40-B is energized at a time desirable for exhaust poppet valve opening. Coil 39-B is activated at a time desirable for inlet poppet valve opening.

In one example of changing timing as shown in FIGS. 1, 2, 3 and 4, ambient air is pushed through opening 6-B to cavity 1-B by atmospheric pressure, acted upon by centrifugal force at said cavity as disk 4, blades 8, commutator bar 9-A and terminal strip 9-B rotate on shaft 6-A, and directed to plate 26 by shroud 2 and spout 29. Said air exerts pressure on plate 26 with magnitude as the speed of shaft 6-A increases, moving brush 16 in a clockwise direction via mechanical linkage 28-A and brush 15 in a counterclockwise direction via mechanical linkage 28-B, thus providing varied engine valve timing that is affected by engine speed. Rod 22 riding in cylinder 24 being firmly attached to plate 26 aligns plate 26 with spout 29, and spring 21 resists movement of said plate and rod. Tabs 23 and 25 fasten cylinder 24 to engine casting 1-A with screws. The above-described mechanism is designed for use on pulsers of FIGS. 1, 2, 3 and 4.

In operation, brush 15 or coil 40-B pulses the bistable multivibrator of FIG. 7 at terminal 95 to trigger the vibrator. Q-1 conducts; Q-2 is driven to cutoff; and Q-4 amplifies. The resulting output at terminal 94 excites coil 48 in FIG. 6, drives iron core 47 toward said coil, slug 50 covers port 92, slug 52 uncovers port 91 and covers port 58 and slug 54 uncovers port 57. Pressure from line 66 caused by pump 76 in conjunction with regulator valve 70 causes fluid to flow from said line through port 53 to port 57, port 88 and cylinder 84. Piston 85 is driven toward port 89, and fluid on the

same side of piston 85 flows as port 89 exhausts through ports 89, 91, 51 and line 56 to container 74. Slug 60 covers port 81; slug 65 uncovers port 80 and covers port 62; slug 77 uncovers port 63; and fluid flows from line 66 through port 64 to port 63, port 83 and cylinder 32. Piston 79 drives exhaust poppet valve stem 78 in a direction away from cylinder 32 to open the poppet valve.

To close the exhaust port, brush 18 or coil 36-B pulses the bistable multivibrator of FIG. 7 at terminal 96 to trigger said vibrator. Q-2 conducts, Q-1 is driven to cutoff, Q-3 amplifies, and output is from terminal 93 which is applied to coil 46 of FIG. 6. Slug 50 uncovers port 92, slug 52 uncovers port 58 and covers port 91, slug 54 covers port 57 and fluid flows from line 66 through ports 53, 58 and 90 to push piston 85 toward port 87. Fluid flows from cylinder 84 through ports 87, 92, 51 and line 56 to container 74. Similar valve and piston action takes place at valve 59-B and piston cylinder 79–32 to close exhaust poppet valve stem 78.

Cylinders 84 and 32 have their ports arranged as in FIG. 5 so the respective pistons will be slowed as they reach the end of their strokes at the exhausting ports 31 and 33. As the pistons cover the exhaust ports, the said port becomes more and more closed off. Thus, the pistons become decelerated by the port restrictions.

The purpose for two power cylinders (84 and 32) is to amplify the power input at rod 49.

FIG. 8 illustrates how timing disks 103 and 104 can be coupled to control more than one cylinder. One advance retard mechanism can be used to control all the pulses to a multicylinder setup. 106 and 108 control one part of valve timing such as exhaust opening. The timing difference between the two cylinders is controlled by the offset of the terminal strips 9-A.

FIG. 9 shows how a second cylinder can be supported by rigidly fixing duplicate pick-ups 114, 118, 120 and 122 respectively to each of the four pick-ups 112, 116, 119 and 121 already fixed around the periphery of the timing disk.

FIG. 10 is the configuration for a two stroke cycle pulser. Disk 161 is to be driven at the same speed as the crankshaft in the direction of the arrow. Magnetic insert 125 excites pick-up coils in a 180° peripheral area of the disk. In the scavenging two cycle, coil 131 causes the exhaust valve to open. 151 causes the intake valve to open. Coil 171 closes the exhaust valve, and coil 191 closes the intake valve.

The disk timing mechanism can be used to control the timing of injection when applied to fuel injection systems.

Although this invention has been described in part by specific embodiment, it will be obvious to those skilled in the art that modifications may be made without departing from the scope of the invention, which is precisely defined in the following claims.

I claim:

1. Internal combustion engine charge timing apparatus comprising an axle, a rotary support for the axle, rotatable means mounted for unidirectional rotation on the axle, drive means connected to the rotatable means and to an engine, whereby a definite rotational relationship is established between the engine and the rotatable means, first communication means mounted in the rotatable means, a first pair of second communication means positioned with a 180° arc with respect to the rotatable means and positioned adjacent the rotatable means for communicating upon cyclic juxtaposition of the first communication means with the second communication means, mounting means connected to the rotary support and connected to the second communication means, whereby the second communication means may be moved with respect to each other and may be arcuately moved within the 180° arc, speed responsive means operatively connected to the engine and to the second communication means for moving the second communication means in the arc upon variation of engine speed, and charge controlling means operatively connected to the second communication means for controlling engine charge upon the communicating of the second communication means.

2. The apparatus of claim 1 wherein the rotatable means comprises an electrical insulating cylinder with electrical conductors extending radially through the cylinder from a ground and terminating in the cylinder surface in an exposed conductive surface and wherein the second communicating means comprise electrically conductive brushes and wherein the communicating of the second communication means comprises ground of the brushes through the first communication means conductors.

3. The apparatus of claim 2 wherein the electrical conductors extend diametrically through the cylinder.

4. The apparatus of claim 1 wherein the first communication means comprise magnetic materials mounted in the rotatable means and wherein the second communication means comprise coils spaced slightly from outer surfaces of the first communication means and wherein the communicating comprises establishing electrical currents in the coils by virtue of the magnetic means passing the coils.

5. The apparatus of claim 1 wherein the speed responsive means comprise fluid propulsion blades mounted on the rotatable means and fluid directing means mounted adjacent the blades and a movable fin mounted adjacent the fluid directing means, guide means connected to the fin for guiding movement of the fin in response to deflection by fluid, and connecting means connecting the fin and the second communicating means for movement with the fin, and spring means connected to the fin for urging the fin in a direction against fluid pressure from the fluid directing means, whereby the fin moves to balance forces from fluid pressure and from the spring means and thereby moves the second communication means.

6. The apparatus of claim 1 wherein the speed responsive means comprises a vacuum chamber, a diaphragm connected to the vacuum chamber and a source of vacuum connected to the vacuum chamber, a connection means connected to the diaphragm and to the second communication means for moving the second communication means upon movement of the diaphragm.

7. The apparatus of claim 1 further comprising a bistable multivibrator having an input connected to the second communication means and solenoid actuating means connected to an output of the multivibrator.

8. The apparatus of claim 7 further comprising a pilot valve connected to the solenoid, a source of fluid pressure connected to the pilot valve, a fluid actuator connector to the pilot valve whereby the actuator is driven in one direction when the solenoid means is in a first position corresponding to a first bistable condition of

the multivibrator, and wherein the actuator is driven in a second opposite direction when the pilot valve is moved to a second position by the solenoid means moving to a second position, which corresponds to a second stable condition of the bistable multivibrator.

9. The apparatus of claim 8 further comprising a second valve connected to the actuator and to the source of fluid pressure and a second relatively large actuator connected to the second valve for movement between first and second positions in response to movement of the first actuator.

* * * * *