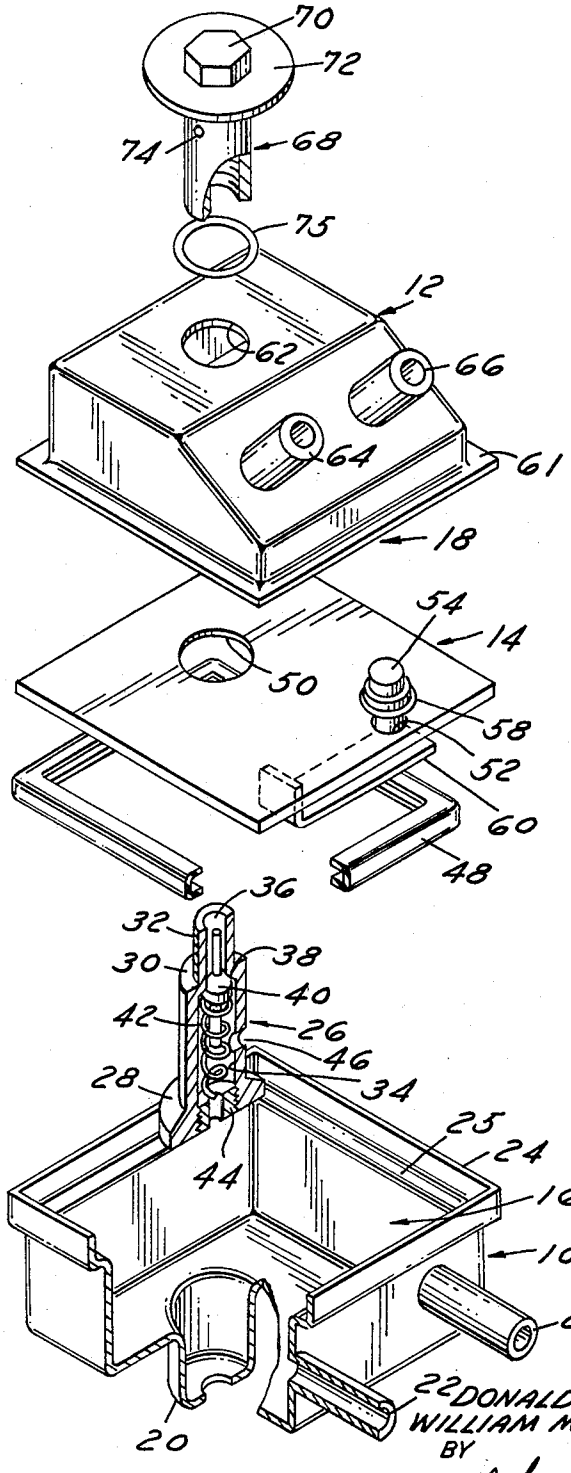
May 28, 1968 D. M. BURNIA ET AL 3,385,275

IGNITION DISTRIBUTOR ADVANCE CONTROL MECHANISM FOR A RECIPROCATING ENGINE

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FIG. 1




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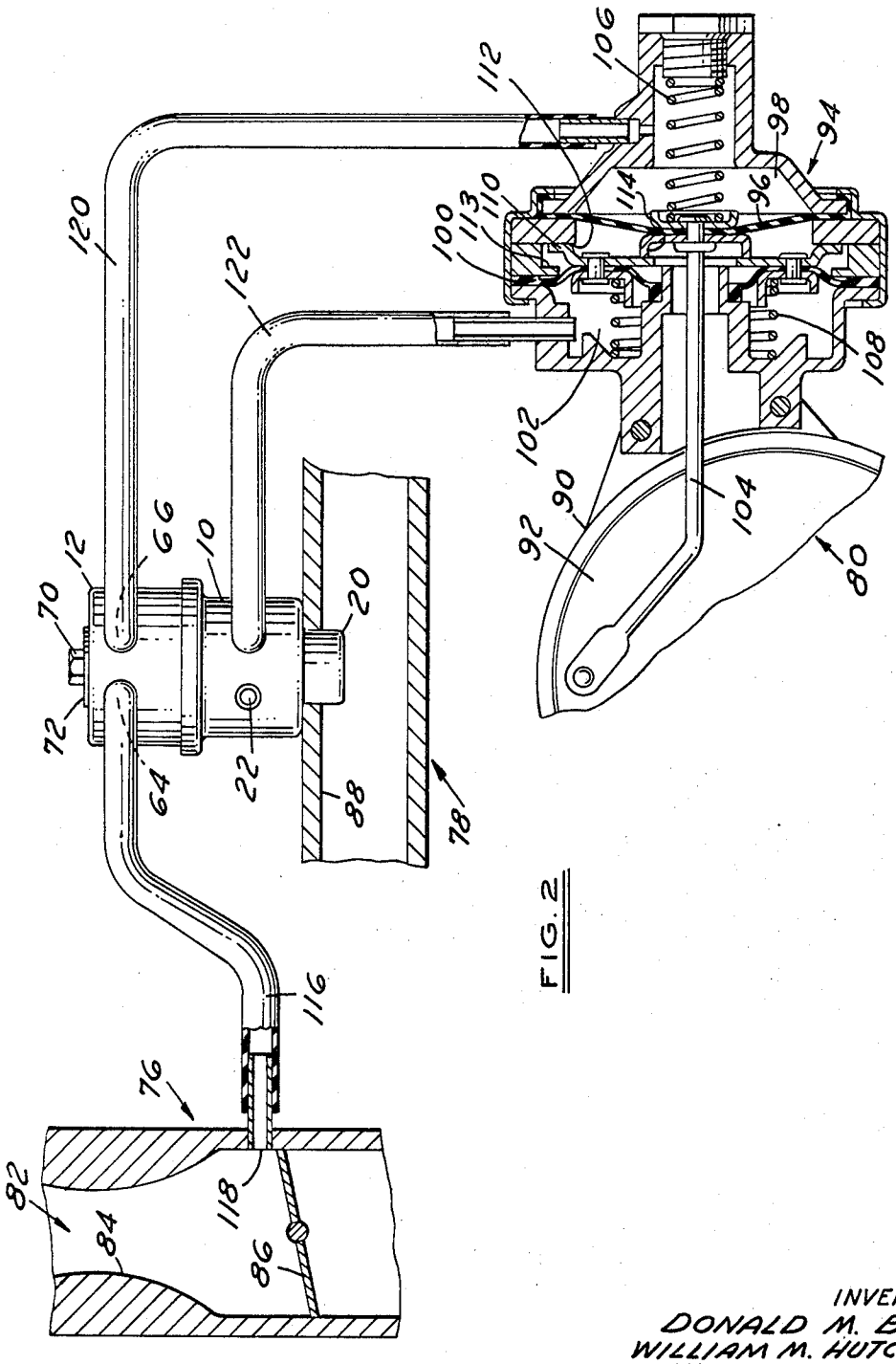



FIG. 2

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# IGNITION DISTRIBUTOR ADVANCE CONTROL MECHANISM FOR A RECIPROCATING ENGINE

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This mechanism is used with a dual diaphragm distributor to advance the ignition timing when the engine is decelerating and also advance the timing when engine temperature exceeds a predetermined maximum while the engine is idling. A housing is divided into lower and upper chambers by a plate carrying a thermally responsive valve. A pressure responsive valve extends through the plate. The bottom of the housing fits into an opening in the intake manifold so intake manifold vacuum is applied to the lower chamber. Hoses connect the upper chamber to the carburetor throttle bore and to the advance diaphragm of the distributor and another hose connects the lower chamber to the retarding diaphragm of the distributor. During normal operation, vacuum in the throttle bore passes through the upper chamber to position the advancing diaphragm. When the engine is decelerating, high manifold vacuum opens the pressure responsive valve to transmit manifold vacuum into the upper chamber, thereby advancing the ignition timing. When the engine is idling at normal temperature, manifold vacuum in the lower chamber acts on the retarding diaphragm to retard ignition timing for emission control. If the engine temperature exceeds a predetermined maximum, the thermally responsive valve opens to admit manifold vacuum to the upper chamber and thereby advance the ignition timing.

## SUMMARY OF THE INVENTION

Recently enacted emission control legislation has necessitated reductions in the unburned hydrocarbons content of internal combustion engines during deceleration and idling. One means for accomplishing these reductions is to advance the spark during deceleration and retard the spark during idling, the word "advance" designating an earlier spark occurrence relative to crankshaft rotation.

Difficulties were encountered in devising means of reasonable cost for accomplishing these timing changes without interfering with ignition timing during other operational phases. Additionally, engine idling with retarded timing increases engine operating temperature since the engine is running less efficiently, so it is desirable to eliminate the spark retardation when extended idling raises engine temperature to the point where damage to engine components is probable.

In the past, a combination of at least two devices was used to achieve these features. Multiple devices were considered necessary because it was believed essential to locate the device for advancing ignition timing at idle in the engine cooling system or on the engine head, while the device for advancing the spark during decleration had to be subjected to intake manifold vacuum. In addition to the high material costs resulting from the use of multiple devices, installation procedures were lengthy and complicated and did not lend themselves to mass production techniques.

The distributor control mechanism provided by this invention is contained in a single housing attached to the engine intake manifold and greatly reduces material and assembly costs. In a reciprocating internal combustion engine having a metering device with an induction passage containing a throttle blade for supplying air to an



intake manifold of the engine and having an ignition distributor for distributing ignition sparks to the engine, the distributor control mechanism comprises a housing divided into first and second chambers by a partition. The first chamber is connected to the interior of the intake manifold, while the second is connected to the induction passage anterior of the throttle blade and to the spark advancing means for the distributor. A pressure responsive valve is located within the housing for connecting the second chamber to the intake manifold interior when manifold vacuum exceeds a predetermined maximum. In addition, a thermally responsive valve is located within the housing for connecting the first and second chambers when its temperature exceeds a predetermined maximum.

During acceleration, road load operation, and idling at normal temperatures, vacuum from the induction passage anterior of the throttle blade passes through the second chamber to position the spark advancing means on the distributor. Both of the valves in the control mechanism remain closed during the above operational phases. When the engine is decelerating, the high manifold vacuum opens the pressure responsive valve, which admits the manifold vacuum to the second chamber and thereby advances the timing. When the engine is idling, the temperature of the intake manifold becomes representative of the engine temperature. Thus, when the engine temperature rises, the temperature of a thermal element controlling the thermally responsive valve rises correspondingly and opens the thermally responsive valve when a predetermined temperature is reached.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an exploded view of the control mechanism showing the structural relationship of the housing, the partition and the pressure responsive and temperature responsive valves. Portions of the components are broken away to show internal structure. FIGURE 2 is a schematic diagram showing the control mechanism of this invention with its connections to the carburetor, a dual diaphragm distributor and the engine intake manifold.

## DETAILED DESCRIPTION

Referring to FIGURE 1, the control mechanism of this invention is made up of a lower housing **10** and an upper housing **12** with a flat plate **14** serving as the partition dividing the interior of the assembled housing into a lower chamber **16** and an upper chamber **18**. Lower housing **10** has a projection **20** formed on the bottom surface of two tubes **22** and **23** connected to a side. A lip **24** and a shoulder **25** surround the upper edge of the lower housing.

The valve body for the pressure responsive valve is a cylindrical member indicated by numeral **26**. Valve body **26** has its exterior flared at the bottom as represented by numeral **28** to fit into the interior of projection **20**. A shoulder **30** is formed near the top exterior of body **26** and external screw threads **32** are formed on the portion of body **26** above shoulder **30**.

A large bore **34** extends into the interior of body **26** from the flared end and tapers into a smaller bore **36** at an interior shoulder **38**. Positioned loosely in bore **34** is a valve member **40**. A compressive spring **42** urges valve member **40** onto the seat formed by shoulder **38**. Spring **42** is held in place by a jet **44** threaded into the lower end of bore **34**. The wall of body **26** contains a hole **46** communicating with bore **34** above jet **44**.

Plate **14** has a large hole **50** near the center thereof and a small hole **52** near one edge. A member **54** having a collar **56** formed around its upper end fits loosely in hole **52**. A rubber O-ring **58** surrounds member **52** and

seats against the lower surface of collar 56. Below plate 14, member 54 is fastened to a bimetal strip 60 that is anchored to plate 14. Member 54, strip 60, and associated parts make up the temperature responsive valve.

Upper housing 12 has a flange 61 surrounding its lower edge and a hole 62 in its upper surface. Hole 62 is aligned with hole 50 in plate 14 and projection 20 in lower housing 10. A pair of tubes 64 and 66 are fastened to one side of upper housing 12.

An internally threaded cap member 68 having a hexagon head 70 and an enlarged integral washer 72 is also used in the control mechanism. A hole 74 is formed in the wall of member 68 and an O ring seal 75 is adapted to fit the cylindrical portion of member 68.

The control mechanism is assembled in the following manner. First the flanged end 28 of valve body 26, which contains its internal components, is located in projection 20 so a hole in the bottom of projection 20 communicates with the hole in jet 44. A seal 48 is positioned on shoulder 25 and plate 14 is positioned on seal 48 with the external screw threads 32 projecting through hole 50. Plate 14 rests on shoulder 30 and an O ring (not shown) can be located between plate 14 and shoulder 30 if necessary for sealing purposes.

Upper housing 12 fits on plate 14, usually with another seal (not shown) similar to seal 48 interposed between flange 61 and plate 14. Lip 24 assists in properly locating plate 14, upper housing 12, seal 48 and its corresponding seal. Valve body 26 terminates within chamber 18 below hole 62.

O ring 75 is slipped onto the cylindrical portion of cap member 68 and member 68 is inserted through hole 62 and threaded onto threads 32 until it seats on plate 14. Hole 74 is located so it is above the top of threads 32 and bore 36 communicates with chamber 18 through hole 74.

Referring now to FIGURE 2, numeral 76 designates a carburetor serving in the embodiment as the metering device, numeral 78 designates a portion of the intake manifold, and numeral 80 designates a portion of a dual diaphragm distributor for an internal combustion engine. Carburetor 76 has an induction passage 82 containing a conventional signal generating venturi section 84 and a throttle blade 86. Below throttle blade 86, induction passage 82 communicates with passage 88 in intake manifold 78.

The main housing 90 of the dual diaphragm distributor 80 contains the distributor advance plate 92 plus the distributor cam and other conventional distributor components (not shown). Rotation of the distributor cam is counterclockwise. Connected to the exterior of housing 90 is the vacuum advance motor housing 94. A diaphragm 96 forms an outer vacuum chamber 98 in housing 94 and a second annular shaped diaphragm 100 forms a second chamber 102 in housing 94. An arm 104 connects diaphragm 96 with the advance plate 92 in the distributor. A compressive spring 106 bearing on diaphragm 96 is mounted in chamber 98 and acts through diaphragm 96 and arm 104 to urge advance plate 92 toward a counterclockwise or retarded position.

Similarly, a spring 108 mounted in chamber 102 acts on diaphragm 100 to urge diaphragm 100 in the opposite direction. Diaphragm 100 is fastened to a position plate 110 that seats on a portion of housing 94 represented by numeral 112 when spring 108 is extended to its maximum position and seats on the portion represented by numeral 113 when a vacuum in chamber 102 draws the position plate to the left. The inner portion of plate 110 is adjacent a cup-shaped stop member 114 fastened to diaphragm 96.

Projection 20 of the control mechanism of this invention fits into intake manifold 78. A hose 116 connects a port 118 located just anterior of throttle blade 86 with tube 64 on upper housing 12. Another hose 120 connects tube 66 with chamber 98 in housing 94 and another hose 122 connects tube 23 with chamber 102 of housing 94.

In the FIGURE 2 embodiment, tube 22 is capped or plugged by any conventional means.

## OPERATION

While the engine is operating at road load or is accelerating, the vacuum signal appearing at port 118 is transmitted through hose 116, upper chamber 18, and hose 120 to chamber 98 where the signal positions diaphragm 96. Upper chamber 18 then is isolated from lower chamber 16, which is accomplished by selecting spring 42 so valve 40 remains seated under the relatively low manifold vacuum signals involved and selecting bimetal 60 so O ring 58 is held in contact with plate 14 at the temperatures involved. Manifold vacuum exists in lower chamber 16 and is transmitted to chamber 102 by hose 122, but the portion 112 of housing 94 prevents interference with the position of diaphragm 96 by the position of diaphragm 100.

When the engine is idling at temperatures up to normal, the vacuum at port 118 is substantially zero and consequently the vacuum in chamber 98 also is substantially zero. Spring 106 moves diaphragm 96 to the left until stop member 114 contacts plate 110. The manifold vacuum at idle is relatively high (i.e., 15–18 inches of mercury) and a vacuum signal is transmitted through jet 44 and hole 46 into lower chamber 16. Hose 122 transmits the signal to chamber 102 where it overcomes the force of spring 108 and moves diaphragm 100 to the left against portion 113 of housing 94. This permits spring 106 to move diaphragm 96 further to the left than pictured, thereby turning plate 92 counterclockwise and retarding the ignition.

The air flow over the engine at engine idle is reduced sufficiently so the heat transfer through the metal walls of the manifold renders the temperature of the control mechanism representative of engine temperature. If engine temperature rises, the temperature of bimetal strip 60 also rises and eventually strip 60 moves cylindrical member 54 upward, thereby moving O ring 58 out of contact with plate 14. A vacuum signal representative of the manifold vacuum existing in chamber 16 then is transmitted into chamber 18 and via hose 120 to chamber 98. In chamber 98 the vacuum signal draws diaphragm 96 to the right, thereby advancing the ignition timing.

During decelerations, manifold vacuum rises above the values of manifold vacuum at engine idle (e.g., 23–25 inches of mercury). The higher manifold vacuum is applied through jet 44 to valve 40 and pulls valve 40 off shoulder 38. A vacuum signal then passes through bore 36 and hole 74 into upper chamber 18 and via hose 120 to chamber 98. In chamber 98, the vacuum draws diaphragm 96 to the right and thereby advances the ignition timing.

The sizes of the orifice in jet 44, hole 46, and hole 74 can be selected so vacuum signals less than but representative of manifold vacuum appear in lower chamber 16 and upper chamber 18. Hole 46, hole 74, valve 40 and hole 52 and valve member 54 can be selected so the vacuum signal appearing in chamber 18 during deceleration differs from the signal during hot idling.

Usually the signal in the upper chamber is about four to five inches of mercury when either of the pressure or temperature responsive valves are open. Note, however, that full manifold vacuum can be supplied to upper chamber 18 during deceleration while modulated vacuum is supplied during hot idling. A restriction can be inserted in tube 64, hose 116 or port 118 to prevent the vacuum signals appearing in upper chamber 18 when either the pressure or temperature responsive valve is open from being transmitted back to induction passage 82. In a preferred arrangement, hole 46 modulates the vacuum signal in chamber 16 to control the increase in engine idling speed when the temperature responsive valve opens, because full manifold vacuum can increase idling speed by several hundred r.p.m.'s. Tapering mem-

ber **54** produces the same control with the added feature of proportioning the speed increase to the temperature.

The dual diaphragm distributor used in the illustrated embodiment provides extra retardation of the ignition timing at idle. Of course, the control mechanism of this invention can be used with a conventional single diaphragm distributor lacking this feature. If desired, port **118** can be located in the carburetor venturi **84** or the signal for port **118** can be taken from a passage communicating with the venturi and the illustrated location just anterior of the throttle blade, with appropriate metering jets.

Since cap member **68** seats on plate **14** which in turn seats on shoulder **30**, member **68** combines with body **26** to form a rigid structure extending vertically through the control mechanism so a force sufficient to press projection **20** into the opening in the intake manifold can be applied to the top of member **62**. This arrangement greatly simplifies assembly of the control mechanism into the engine. If desired, hole **50** can be enlarged so member **68** seats directly on shoulder **30**. Tube **22** can be used as a hose connection for routing manifold vacuum to other vehicle components.

Thus, this invention provides a unitary control mechanism for advancing ignition timing during engine deceleration and hot idling. The control mechanism is relatively inexpensive to build and assemble into vehicles, does not interfere with ignition timing during other operating phases, and permits varying the amount of advance during deceleration from the amount of advance during hot idling.

We claim:

**1.** In a reciprocating internal combustion engine having a metering device with an induction passage containing a throttle blade for supplying air to an intake manifold of said engine and having an ignition distributor for distributing ignition producing energy to said engine, a distributor control mechanism comprising:

a housing attached by heat conducting means to the intake manifold,

a partition dividing said housing into first and second chambers with the first chamber connected to the interior of the intake manifold and the second chamber connected to the induction passage anterior of the throttle blade,

passage means connecting said second chamber to an ignition timing means for the distributor, and

thermally responsive valve means located within said housing for connecting said first chamber to said second chamber, said thermally responsive valve means connecting said first and second chambers when engine temperature exceeds a predetermined maximum, said thermally responsive valve means being responsive to the temperature of the intake manifold.

**2.** The engine of claim **1** in which the thermally responsive valve means is located in the partition and comprising pressure responsive valve means located within said housing for connecting said second chamber to the intake manifold interior, said pressure responsive valve means making such connection when manifold vacuum exceeds a predetermined maximum.

**3.** The engine of claim **2** in which the control mechanism comprises a cylindrical member having an axial passage therein, said cylindrical member being positioned in said housing and extending through said partition with the bottom of said passage communicating with the intake manifold and the top communicating with the second chamber, said cylindrical member having an opening in its wall to connect the first chamber to the intake manifold via the lower part of said axial passage, said pressure responsive valve means being located in said passage above said opening.

**4.** The engine of claim **3** in which the housing of said control mechanism is pressed into a hole in the engine intake manifold.

**5.** The engine of claim **4** in which the control mechanism comprises a cap member threadably engaging said cylindrical member, said cap member and said cylindrical member having sufficient structural rigidity to transmit a force capable of pressing the housing of the control mechanism into the engine intake manifold.

**6.** The engine of claim **5** in which the ignition distributor is a dual diaphragm distributor, the second chamber of the control mechanism is connected to the chamber in the distributor positioning the advance diaphragm, and the first chamber is connected to the chamber in the distributor positioning the retard diaphragm.

**7.** The engine of claim **2** in which the control mechanism comprises a cylindrical member having an axial passage therein, said cylindrical member being positioned in said housing and extending through said partition with the bottom of said passage communicating with the intake manifold and the top communicating with the second chamber, said cylindrical member having an opening in its wall to connect the first chamber to the intake manifold via the lower part of said axial passage, said pressure responsive valve means being located in said passage above said opening.

**8.** The engine of claim **7** in which the control mechanism comprises a cap member threadably engaging said cylindrical member, said cap member and said cylindrical member having sufficient structural rigidity to transmit a force capable of pressing the housing of the control mechanism into the engine intake manifold.

**9.** The engine of claim **1** in which the housing of said control mechanism is pressed into a hole in the engine intake manifold.

**10.** The engine of claim **1** in which the ignition distributor is a dual diaphragm distributor, the second chamber of the control mechanism is connected to the chamber in the distributor positioning the advance diaphragm, and the first chamber is connected to the chamber in the distributor positioning the retard diaphragm.

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