

[54] **VACUUM OPERABLE UNITS FOR USE WITH IGNITION DISTRIBUTORS**

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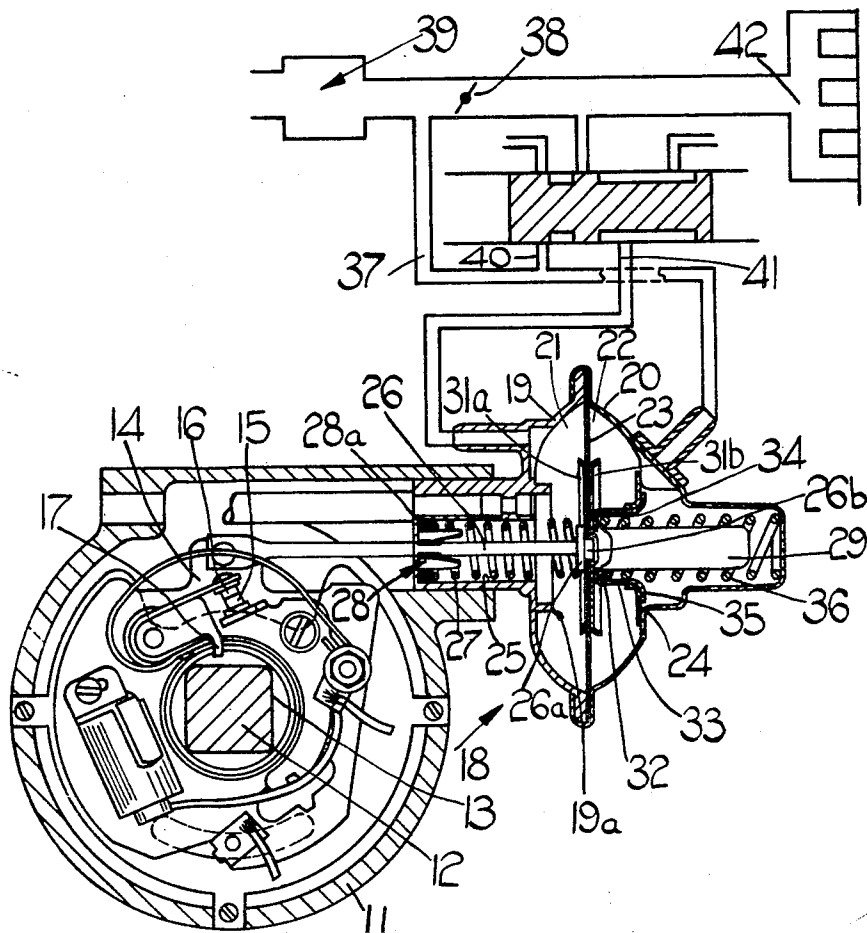
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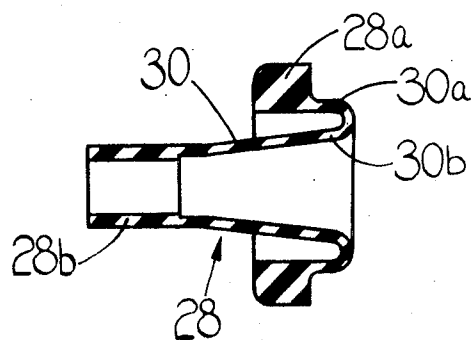
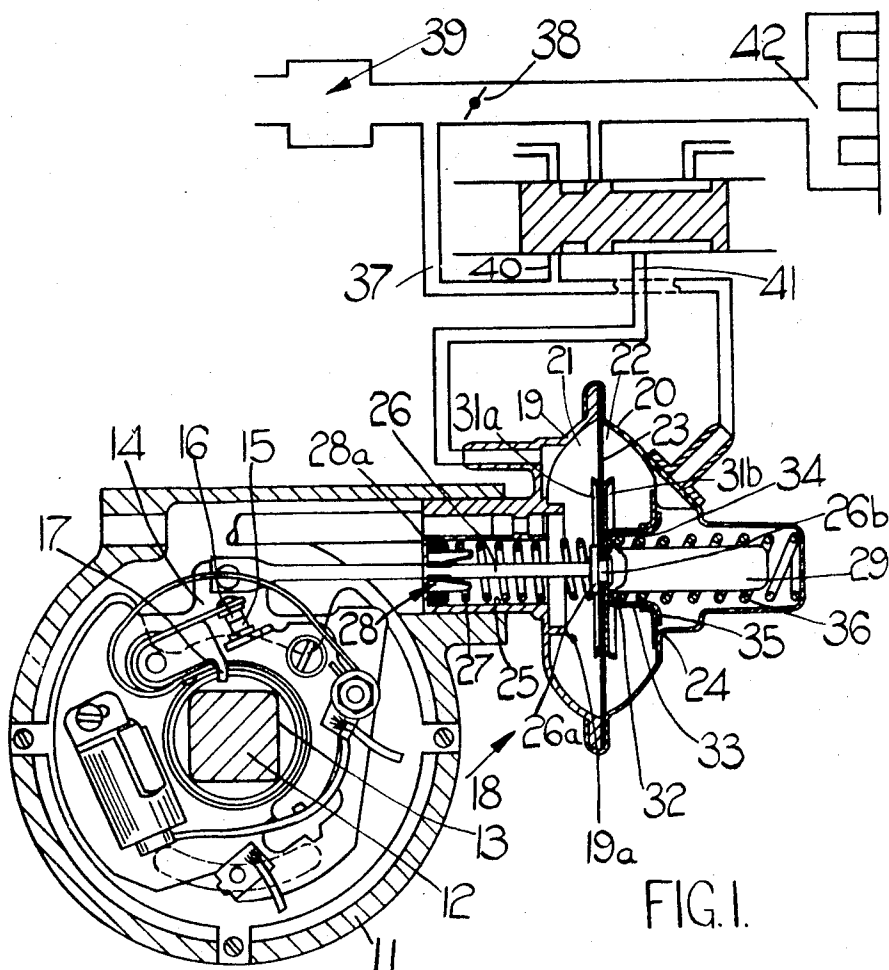
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[57] **ABSTRACT**

A vacuum-operable unit for use with an ignition distributor in which a casing is divided into first and second chambers by a resilient diaphragm. A plunger is slidably received in the first chamber, with the plunger being secured at one end to the diaphragm and extending at its other end from the first chamber for connection to a distributor. Axial movement of the plunger varies the ignition timing of the distributor. First and second conduits are provided in communication with the first and second chambers respectively, and resilient means within one of the chambers resists movement of the diaphragm in a direction to reduce the volume of that chamber. Sealing means acts between the wall of the first chamber and the plunger to fill the first chamber while allowing relative movement between the plunger and the wall of the first chamber, with the sealing means being constituted by a pair of annular members secured to the plunger and the wall of the chamber respectively, and interconnected by a flexible tubular member. The diameter of the flexible tubular member of the sealing means tapers from a maximum diameter adjacent one annular member to a minimum diameter adjacent the other annular members and the tubular member is turned inside out intermediate its ends so that part of the tubular member surrounds a further part of the member, and the tubular member together with said annular members constitutes a rolling seal.

2 Claims, 2 Drawing Figures





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VACUUM OPERABLE UNITS FOR USE WITH IGNITION DISTRIBUTORS

This invention relates to vacuum operable units for use with ignition distributors.

A unit according to the invention includes a casing, a diaphragm dividing the casing into first and second chambers, a plunger slidably received in the first chamber, the plunger being secured at one end to the diaphragm and extending at its other end from the first chamber for connection to the distributor, so that axial movement of the plunger varies the ignition timing of the distributor, first and second conduits communicating with the first and second chambers respectively, resilient means within one of the chambers for resisting movement of the diaphragm in a direction to reduce the volume of said one chamber, and sealing means acting between the wall of the first chamber and the plunger to seal to the first chamber while allowing relative movement between the plunger and the wall of the first chamber, said sealing means being constituted by a pair of annular members secured to the plunger and the wall of the chamber respectively, and interconnected by a flexible tubular member the diameter of which tapers from a maximum adjacent one of said annular members to a minimum adjacent the other of said annular members, the tubular member being turned inside out intermediate its ends so that part of the tubular member surrounds a further part of the tubular member and the tubular member together with said annular members constitute a rolling seal.

The invention further resides in an ignition distributor for a road vehicle, having combined therewith a unit as described in the preceding paragraph.

The invention still further resides in an ignition timing control system for a road vehicle utilizing a unit as described above.

One example of the invention is illustrated in the accompanying drawings wherein

FIG. 1 is a diagrammatic sectional view of an ignition distributor and its associated ignition timing control system, and

FIG. 2 is an enlarged sectional view of the tapered rolling seal shown in FIG. 1.

Referring to the drawings, the distributor includes a casing 11 having rotatable therein an axially extending shaft 12, the periphery of which defines a cam 13. Surrounding the shaft 12 and mounted for angular movement with respect to the shaft 12 is an annular plate 14. The plate 14 carries fixed and the movable contacts 15, 16 respectively of a contact breaker assembly, with the movable contact 16 being carried by a cam follower 17. The cam follower 17 engages the cam 13, and rotation of the shaft 12 serves to operate the contact breaker by opening and closing the contacts 15, 16 while angular movement of the plate 14 serves to adjust the timing of the contact breaker and consequently the ignition timing of the engine.

A vacuum unit 18 is mounted on the casing 11 with the unit 18 comprising a hollow two part housing 19, 20 which is divided into two chambers 21, 22 by a flexible diaphragm 23. The periphery of the part 20 of the housing is rolled over the periphery of the part 19 to secure the parts 19, 20 together, and the periphery of the diaphragm 23 is trapped between the peripheries of the parts 19, 20. The part 19 of the housing is formed with a stepped bore 25 which is of reduced diameter at its outer end. A plunger 26 is axially movable in the narrower part of the bore 25, and the plunger 26 is formed at its inner end with a flange 26a and a spigot 26b. The spigot 26b extends through a first washer 31a, a hole in the diaphragm 23 and a second washer 31b with the free end of the spigot 26b being spread to trap the diaphragm 23 between the washers 31a, 31b. The outer end of the plunger 26 is connected to the plate 14 of the contact breaker assembly. Thus movements of the diaphragm 23 will be transmitted by the plunger 26 to the plate 14 to adjust the ignition timing of the engine. The plunger 26 is urged inwardly by a spring 27 which acts at one end against the washer 31a and at the other end against an annular member 28a at one end of a tapered flexible rolling seal

28. The member 28a of the seal 28 is trapped by the spring 27 in sealing engagement with a shoulder defined between the wider and narrower parts of the bore 25 and the end of the seal 28 remote from the member 28a, includes an annular member 28b which sealingly engages the plunger 26 so that the seal 28 seals the chamber 21 throughout the range of movement of the plunger 26. The rolling seal 28 is molded in a flexible material which is impervious to air, and includes the annular members 28a, 28b and tubular member 30, integral with, and interconnecting the annular members 28a, 28b. The diameter of the member 30 tapers from a maximum adjacent the annular member 28a to a minimum adjacent the annular member 28b. The plunger 26 extends through the member 28b and the diameters of the member 28b and the plunger are such that the annular member 28b grips, and makes sealing engagement with the plunger. Intermediate its ends, the tubular member 30 is turned inside out, so that a portion 30a of the tubular member 30 surrounds, and extends generally coaxially with, a further portion 30b of the tubular member 30. In use, as the plunger of the vacuum unit moves axially relative to the casing, the annular member 28b is caused to move relative to the annular member 28a and so the lengths of the portions 30a, 30b of the tubular member 30 are varied as the tubular member 30 is rolled back upon itself to permit the relative axial movement. It will be appreciated, that since the tubular member 30 tapers, then during said relative axial movement of the annular members the inner surface of the portion 30a of the member 30 is always spaced from the outer surface of the portion 30b thereby eliminating friction between the surfaces of the seal, which would otherwise tend to damp, and impede the movement of the plunger 26.

It has been found that there is an optimum taper angle for the member 30 of the seal 28, which depends upon the material from which the seal is manufactured. For the material is produced by Lucas Ebonite Ltd. and known as synthetic rubber nitrile 6-18-17, synthetic rubber nitrile 6-18-54, and neoprene 6-18-57, the optimum taper angle of the plate 14 lies in the range 7° to 11°.

The unstressed condition of the diaphragm 23, that is to say, the condition of the diaphragm when the chambers 21, 22 are both subject to atmospheric pressure, corresponds to the normal zero ignition advance position of the plate 14 of the distributor. It will be appreciated that the normal zero advance position of the distributor does not necessarily correspond to a condition in which the engine with which the distributor is associated is fired at top dead center. The normal zero advance position of the distributor will correspond to the degree of ignition advance or retard the ignition by means of the vacuum unit.

A further plunger 29, coaxial with the plunger 26 is slidably received by the part 20 of the housing. The plunger 29 extends at one end through a central hole in an annular plate 24 towards the washer 31. A cylindrical sleeve 33 extends coaxially with the plunger 29, through the hole in the plate 24. At its end adjacent to the washer 31, the sleeve 33 is formed with an inwardly directed peripheral flange 34 and at its opposite end the sleeve 33 includes an outwardly directed peripheral flange 35 the diameter of which is greater than that of the hole in the plate 24. The plunger 29 is formed at its end adjacent the washer 31 with an outwardly directed flange 32, and a spring 36 acts between the flange 32. The part 20 of the housing urges the plunger 29 towards the washer 31, movement of the plunger 29 towards the washer 31 being limited by engagement of the flange 32 of the plunger 29, with the flange 34 of the sleeve 33 and engagement of the flange 35 of the sleeve 33 with the plate 24.

The chamber 22 is connected by way of a conduit 37 to the air inlet side of a throttle valve 38 of a carburetor 39 associated with the engine, and is further connected by way of a conduit 40 to a two position spool valve 44. Moreover, a further conduit 41 serves to connect the chamber 21 to the valve 44. The valve 44 is operated automatically, for example, in response to the pressure in an inlet manifold 42 of the en-

gine, so as to occupy a first position when the pressure in the manifold 42 rises above a first predetermined value and to move to a second position when the pressure in the manifold 42 falls below a second predetermined value. In its first position, the valve 44 closes the conduit 40 and connects the conduit 41 to atmosphere, thereby subjecting the chamber 22 to the pressure conditions at the air inlet side of the throttle valve 38 and opening the chamber 21 to atmosphere. In its second position the valve 44 connects the conduit 40 to atmosphere and connects the conduit 41 to the manifold 42, thereby opening the chamber 22 to atmosphere and subjecting the chamber 21 to the pressure conditions at the manifold 42.

The operation of the system is as follows. When the engine of the vehicle is inoperative, the pressure in the manifold 42 will be atmospheric pressure and the valve 44 will be in its first position. Thus, the chambers 21, 22 will both be at atmospheric pressure, and the diaphragm 23 will be in its rest position. With the engine idling, and the throttle valve 38 closed, the pressure in the manifold 42 drops below the second predetermined value and the valve 44 moves to its second position to subject the chamber 21 to the manifold pressure and to open the chamber 22 to atmosphere. Since the throttle valve 38 is closed, the percentage of noxious products in the exhaust of the engine increases and therefore the air supply to the cylinders is increased to increase the combustion of these products. However, the resultant increase in engine speed is reduced since the pressure difference between the chambers 21, 22 moves the diaphragm 23 and the plunger 26 to the left as seen in the drawing until the washer 31a on the plunger 26 engages a stop 19a integral with the part 19 of the housing. The movement of the plunger 26 from its rest position to the left serves to move the plate 14 angularly in a direction to retard the ignition timing of the engine thereby slowing the speed in known manner. During normal operation of the engine, the throttle valve 38 is open and the pressure in the manifold 42 rises above the first predetermined value and the valve 44 moves to its first position to open the chamber 21 to atmosphere and to subject the chamber 22 to the pressure at the air inlet side of the throttle valve 38.

The pressure difference between the chambers 21, 22 is now such that the diaphragm 23 is moved from its rest position to the right as seen in the drawing thereby moving the plunger 29 against the action of the spring 36. In this condition, the unit 18 acts in a convenient manner to control the ignition timing of the engine. As the pressure at the air inlet side of the throttle valve 38 varies, the position of the diaphragm 23 varies correspondingly and movements of the diaphragm 23 move the plate 14 in a direction to advance the ignition timing of the engine, or to retard the ignition timing from an advance setting back towards the zero advance setting.

It will be appreciated that the position of the plate 24, the axial length of the sleeve 33 and the rating of the spring 36 together define the minimum pressure difference which must exist between the chambers 21, 22 before there is any movement of the diaphragm 23 and consequently the plate 14, in the advance direction.

Assuming now that the throttle valve 38 is closed when the engine is running at speed and driving a load, then an overrun condition is established wherein the pressure in the manifold 42 drops below the second predetermined value and there is consequently a high percentage of noxious products in the exhaust of the vehicle. The valve 44 moves to its second position and the pressure in the manifold 42 is applied to the chamber 21 thereby retarding the ignition timing of the engine to minimize the loss of engine braking which occurs when the air supply to the engine is increased to cut down the percentage of noxious products in the exhaust.

It will be appreciated that the unit 18 will be adjustably mounted on the casing 11, so that the ignition timing of the en-

gine can be adjusted manually, for example, during assembly and maintenance.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An ignition timing control system for use in an ignition distributor for a road vehicle said distributor including a casing, a shaft journaled for rotation within said casing and including a cam, a plate movable angularly within the casing relative to said shaft, a contact breaker assembly carried by said plate and operable in response to rotation of said shaft and a vacuum operable unit carried by said casing, said unit comprising a casing, a diaphragm dividing said unit casing into first and second chambers, a plunger slidably received in the first chamber, the plunger being secured at one end to the diaphragm and extending at its other end from the first chamber, first and second conduits communicating with the first and second chambers respectively, first resilient means within the first chamber and acting on the diaphragm to resist movement of the diaphragm in a direction to reduce the volume of the first chamber, second resilient means in the second chamber, and acting on the diaphragm in a direction to resist movement of the diaphragm in a direction to reduce the volume of the second chamber, the first and second resilient means acting on the diaphragm so that the diaphragm is urged by the first and second resilient means to a rest position corresponding to the normal zero advance position of the distributor, stop means associated with the second resilient means in the second chamber, the stop means preventing said second resilient means acting on the diaphragm during reduction in volume in the first chamber, and sealing means acting between the wall of the first chamber and the plunger to seal the first chamber, the sealing means allowing relative movement between the plunger and the wall of the first chamber, and including first and second annular members secured to the plunger and to the wall of the first chamber respectively, and a flexible tubular member interconnecting the first and second annular members, the diameter of the tubular member tapering from a maximum adjacent one of the annular members to a minimum adjacent the other of the annular members, and the tubular member being turned inside out intermediate its ends so that part of the tubular member surrounds a further part thereof and the tubular member together with the first and second annular members define a rolling seal, the plunger of said unit being connected to said plate so that axial movement of the plunger varies the ignition timing of the distributor, and a valve operable in a first position, during normal running of the engine of the vehicle, to connect one of said chambers to atmosphere while connecting the other chamber to the air inlet side of a throttle valve of the engine, so that variations in pressure at the air inlet side of the throttle valve serve through the unit to control the ignition timing of the distributor to advance the ignition timing of the distributor from, or retard the ignition timing of the distributor to, said normal zero advance position and operable in a second position, during idling or overrun conditions of the engine, to connect said one chamber to an inlet manifold of the engine while connecting the other chamber to atmosphere so that the reduced pressure in the inlet manifold serves through said unit, to retard the ignition timing of the distributor from said normal zero advance position.

2. The system as claimed in claim 1 wherein said valve is operated in response to variations in pressure in the inlet manifold of the engine, the valve being moved from its second position to its first position when the pressure in the inlet manifold of the engine rises above a first predetermined value and the valve being moved from its first position to its second position when said pressure falls below a second predetermined value.

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