July 4, 1961

E. M. MASON

2,991,338

VACUUM SPARK ADVANCE FOR IGNITION SYSTEMS

Filed Oct. 2, 1958

FIG. 1.

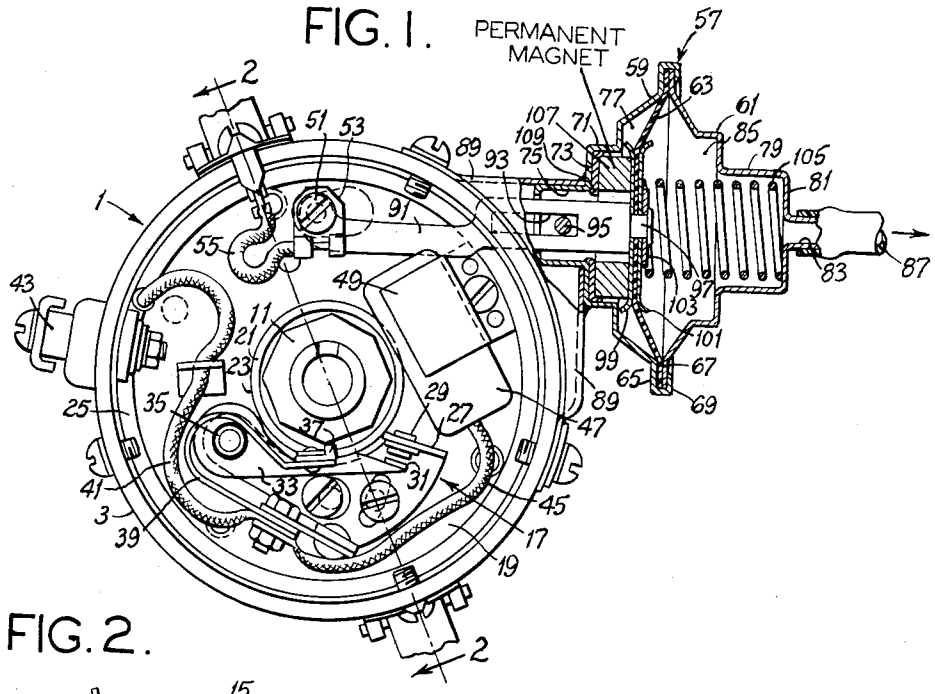
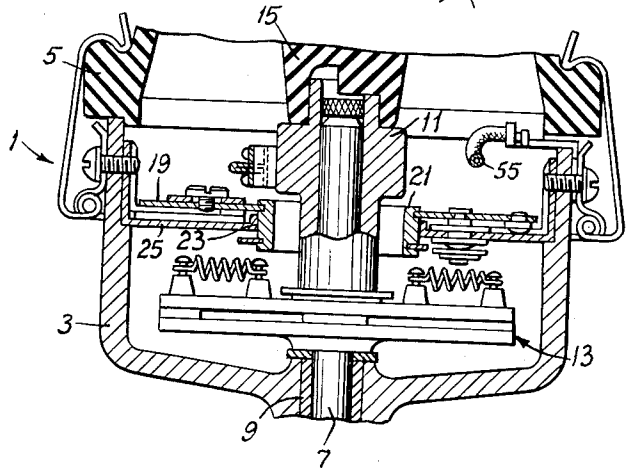


FIG. 2.



INVENTOR

EDWARD M. MASON

BY

Laurence M. Goodridge

ATTORNEY

United States Patent Office

2,991,338

Patented July 4, 1961

2,991,338

VACUUM SPARK ADVANCE FOR IGNITION SYSTEMS

Edward M. Mason, St. Louis, Mo., assignor to ACF Industries, Incorporated, New York, N.Y., a corporation of New Jersey

Filed Oct. 2, 1958, Ser. No. 764,901
7 Claims. (Cl. 200—31)

This invention relates to vacuum-operated motors, and more particularly to a motor of this class which is especially useful as a spark advance mechanism for a distributor such as is used in the ignition system for an internal combustion engine, though not limited to such use.

A conventional type of vacuum-operated spark advance mechanism comprises a diaphragm-type motor, one side of the diaphragm of which is subject to vacuum derived from the intake manifold of the engine, the other side of which is subject to atmospheric pressure. A return spring is provided in the motor biasing the diaphragm toward an initial position of maximum retardation of the spark. The diaphragm is movable away from this initial position in spark-advancing direction upon increase of vacuum.

A present requirement of automotive engine designers is that the diaphragm be held in its initial position until the vacuum reaches a predetermined value, and that the diaphragm then moves through its full stroke (fully to advance the spark) in response to a further increase in vacuum which is considerably less than heretofore allowed. For example, it is now required that the diaphragm remain in its initial position up to a vacuum of 8 inches Hg, then move through its full travel on increase of vacuum from 8 inches Hg to 12 inches Hg. Heretofore, it was required that the diaphragm remain in its initial position up to a vacuum of 7 to 8 inches Hg, but then a further increase in vacuum up to 17 to 18 inches Hg was allowed to attain full travel of the diaphragm.

This prior requirement could be fulfilled simply by using a relatively strong compression spring, strong enough to hold the diaphragm in initial position until the vacuum reached 7 to 8 inches Hg, and then being adapted to allow for full stroke of the diaphragm on increase of vacuum up to 17 to 18 inches Hg. However, where the full stroke of the diaphragm has to be accomplished on increase of vacuum from 8 inches Hg to 12 inches Hg, for example, it is difficult if not impossible to provide a spring which, while strong enough to hold the diaphragm in initial position up to a vacuum of 8 inches Hg, is weak enough to allow for full travel of the diaphragm on further increase of vacuum up to only 12 inches Hg.

Accordingly, it is an object of this invention to provide a spark advance mechanism of the class described which, while being of economical and compact construction, is capable of holding the diaphragm (or other equivalent movable element such as a piston) in its initial position of maximum spark retardation up to a predetermined value of vacuum, and then to allow for full stroke of the diaphragm on a relatively low further increase in vacuum.

In general, the object of the invention is attained by providing, in addition to a return spring, a means which is operable only when the diaphragm (or other equivalent movable element) is in or near its initial position for exerting a supplemental hold on the diaphragm to retain it in its initial position, this means being rendered inoperative to exert any substantial hold on the diaphragm upon movement of the diaphragm away from its initial position. More specifically, this means is a magnetic means operable by magnetic attraction on the diaphragm.

Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a plan view of a distributor provided with a spark advance mechanism of this invention, the cap of the distributor being removed and said mechanism being shown in section; and,

FIG. 2 is a vertical section on line 2—2 of FIG. 1, showing a portion of the cap.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, there is indicated at 1 an ignition distributor for an internal combustion engine of the automotive type. This comprises the usual case 3 and cap 5. Only a part of the cap appears in FIG. 2. A shaft 7 extends into the case through a bearing 9 at the center of the bottom of the case. This shaft is driven by the engine. Shaft 7 drives the usual timer cam 11 through the usual speed-responsive mechanism 13, the latter being adapted to change the phase of the cam relative to the shaft 7 in response to change in speed of the shaft. Cam 11 drives the usual rotor 15, part of which appears in FIG. 2, for contacting the usual distributor contacts (not shown) which are carried by the cap. Cam 11 actuates the usual circuit breaker, which is generally designated 17.

The circuit breaker 17 comprises a breaker plate 19 having a central hub 21 rotatable in a bearing 23 centrally formed in a supporting plate 25 fixed in the case 3. Adjustably mounted on the breaker plate 19 is a terminal 27 carrying a contact 29 adapted for engagement by a contact 31 on a breaker arm 33 pivoted at 35 on plate 19. Arm 33 has a finger 37 engageable with the cam 11 and is biased toward the cam by a spring 39. Terminal 27 is electrically connected by a wire 41 to a terminal 43. Terminal 27 is also electrically connected by a wire 45 to one terminal of condenser 47 mounted on the breaker plate 19. The other terminal of the condenser is electrically connected to plate 19 by the metal case of the condenser and a clip 49 which holds the condenser on plate 19, and plate 19 is grounded by means of a screw 51 threaded in plate 19, a clip 53 on the screw, and a wire 55 connected to the case 3.

The breaker plate 19 is rotatable in bearing 23 to change the phase of finger 37 relative to the cam 11 to advance or retard the spark, and a diaphragm-type motor 57 is provided for rotating the plate 19 for this purpose. Motor 57 comprises a hollow body constituted by a cup-shaped housing 59 and a cap 61 and containing a diaphragm 63. The diaphragm has its margin clamped between the rim 65 of housing 59 and the rim 67 of cap 61. As shown, clamping may be accomplished by swaging a portion 69 of rim 65 over on rim 67. The base of the cup-shaped housing 59 is formed to have an outwardly extending cylindrical wall portion 71, an inwardly directed shoulder portion 73 at the outer end of the portion 71, and a cylindrical extension 75 of smaller diameter than portion 71 projecting outward from shoulder portion 73. Extension 75 is open at its outer end. Housing 59 defines a chamber 77 on one side of diaphragm 63 (its left side as illustrated in FIG. 1) which is open to the atmosphere via the open-ended extension 75. The base of the cup-shaped cap 61 is formed to have an outwardly extending cylindrical wall portion 79, an inwardly directed shoulder portion 81 at the outer end of portion 75, and a nipple 83 pro-

jecting outward from shoulder portion **81**. Cap **61** defines a vacuum chamber **85** on the other side of the diaphragm (its right side as illustrated in FIG. 1) adapted for connection to the intake manifold as by means of a line such as indicated at **87** connected at one end to the nipple **83** and at its other end to the usual so-called spark port of the carburetor for the engine.

The cylindrical extension **75** of the housing **59** is received in a bracket **89** on the distributor case **3**. A link **91** is secured at one end to the center of the diaphragm **63** and extends through the extension **75** and into the case **3**, having its other end connected as by means of the screw **51** to the breaker plate **19**. The link is shown as having a longitudinal slot **93** receiving a guide pin **95** extending across the extension **75**, but this is not essential. The link is secured to the diaphragm by having a reduced end portion **97** which extends through a central hole in a cupped washer **99** on the one side of the diaphragm, a central hole in the diaphragm, a central hole in a cupped washer **101** on the other side of the diaphragm, and a central hole in flat washer **103** which backs up the washer **101**, the end of portion **97** being riveted over on washer **103**.

Movement of the diaphragm **63** and the link **91** toward the left as viewed in FIG. 1 rotates the breaker plate **19** counterclockwise as viewed in FIG. 1 to retard the spark, and movement of the diaphragm and the link toward the right rotates the plate clockwise to advance the spark. Movement of the diaphragm toward the right is against the resistance of a coil compression spring **105** in cap **61** reacting from shoulder **81** against washer **101**. The end of the spring engaging washer **101** is maintained centered by washer **103**. The washers are all made of magnetizable metal, mild steel, for example, though only washer **99** need be made of magnetic metal. A ring-shaped permanent magnet **107** is mounted in the housing **59** surrounding the link **91**. As shown, the magnet is accommodated in the recess defined by portions **71** and **73** of the base of the housing, being secured as by cement **109** to portion **73**.

The arrangement is such that with atmospheric pressure in vacuum chamber **85** (as when the engine is not running), spring **105** holds the diaphragm **63** at the left end of its stroke, determined by engagement of washer **99** with magnet **107**, in the position of maximum retardation of the spark. Magnet **107**, by its attraction on the washer **99**, adds a force supplementing the spring force to hold the diaphragm in the stated position. When vacuum is established in vacuum chamber **85**, diaphragm **63** is subjected to differential of pressure on opposite sides (atmospheric pressure on its left side and lower pressure because of the vacuum on its right side), and the pressure differential acts in opposition to the force of the spring **105** and the magnet **107**. Upon increase of vacuum to a value sufficient to overcome the force of the spring and the magnet, the diaphragm moves toward the right, thereby drawing the washer **99** away from the magnet. Upon separation of the washer **99** from the magnet, thereby establishing an air gap between the magnet and the washer, the force exerted by the magnet drops off sharply, and with further movement of the diaphragm to the right upon further slight increase in vacuum, the magnet is substantially ineffective. Thereafter, upon further increase in vacuum, substantially the entire force resisting the movement of the diaphragm toward the right is the force of the spring **105**.

With the above-described arrangement, it is readily possible to select a spring **105** and a magnet **107** which will take care of a requirement for holding the diaphragm **63** in its initial position of maximum retardation (its extreme left position as illustrated in FIG. 1) until the vacuum reaches a predetermined value (for example, 8 inches Hg), and for full-stroke travel of the diaphragm upon a relatively low further increase in vacuum (for example, from 8 inches Hg to 12 inches Hg). This is because the spring may be a relatively weak spring, since the spring need not be relied upon as the only source of force for holding the diaphragm in its initial position, and with a weak spring it is possible to obtain full travel of the diaphragm on a relatively low increase in vacuum.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A vacuum-operated motor comprising means defining a vacuum chamber, a movable element closing said chamber subject on one side to vacuum in the chamber, said element being adapted for movement in one direction upon increase of vacuum in said chamber, spring means biasing said element to move in the opposite direction toward an initial position and adapted to hold said element in said initial position with a predetermined force, and means operable only when said element is in or near its initial position for exerting a supplemental hold on said element to retain it in its initial position, said holding means being rendered inoperative to exert any substantial hold on said element upon movement of said element away from its initial position.

2. A vacuum-operated motor comprising means defining a vacuum chamber, a movable element closing said chamber subject on one side to vacuum in the chamber, said element being adapted for movement in one direction upon increase of vacuum in said chamber, spring means biasing said element to move in the opposite direction toward an initial position and adapted to hold said element in initial position with a predetermined force, and magnetic means operable by magnetic attraction only when said element is in or near its initial position for exerting a supplemental force for holding said element in its initial position, said magnetic means being rendered inoperative to exert any substantial force by attraction upon movement of said element away from its initial position.

3. A vacuum-operated motor comprising a body defining a vacuum chamber, a pressure-responsive diaphragm closing said chamber and subject on one side to vacuum in the chamber and on the other side to atmospheric pressure, said diaphrgam having a magnetic member positioned thereon, a permanent magnet carried by the body on the atmospheric pressure side of the diaphragm, and spring means biasing the diaphragm in the direction toward said magnet and to a limiting position determined by engagement of said magnetic member with said magnet.

4. A vacuum-operated spark advance mechanism for controlling an ignition distributor for an internal combustion engine by means of vacuum such as may be derived from the intake manifold of the engine, said mechanism comprising means defining a vacuum chamber, a movable element closing said chamber subject on one side to vacuum in the chamber, means for connecting said element to the distributor, said element being adapted for movement in spark-advancing direction upon increase of vacuum in said chamber, spring means biasing said element to move in the opposite direction toward an initial position of maximum spark retardation and adapted to hold said element in said initial position with a predetermined force, and means operable only when said element is in or near its initial position for exerting a supplemental hold on said element to retain it in its initial position, said holding means being rendered inoperative to exert any substantial hold on said element upon movement of said element away from its initial position.

5. A vacuum-operated spark advance mechanism for controlling an ignition distributor for an internal combustion engine by means of vacuum such as may be derived from the intake manifold of the engine, said mechanism comprising a body defining a vacuum chamber adapted for connection to the intake manifold, a movable pressure-responsive element carried by the body closing said chamber and subject on one side to vacuum in the chamber and on the other side to atmospheric pressure, means for connecting said element to the distributor, said element being adapted for movement in spark-advancing direction by atmospheric pressure upon increase of vacuum in said chamber, spring means biasing said element to move in the opposite direction toward an initial position of maximum spark retardation and adapted to hold said element in initial position with a predetermined force, said element being at least in part magnetic, and a permanent magnet carried by the body for attracting said element to its said initial position, said magnet being ineffective to exert any substantial force by attraction upon movement of said element away from its initial position.

6. A vacuum-operated spark advance mechanism for controlling an ignition distributor for an internal combustion engine by means of vacuum such as may be derived from the intake manifold of the engine, said mechanism comprising a body defining a vacuum chamber adapted for connection to the intake manifold, a pressure-responsive diaphragm carried by the body closing said chamber and subject on one side to vacuum in the chamber and on the other side to atmospheric pressure, said diaphragm having a magnetic member positioned thereon, means for connecting said diaphragm to the distributor, a permanent magnet carried by the body on the atmospheric pressure side of said diaphragm, said diaphragm being adapted for movement in spark-advancing direction away from the magnet by atmospheric

pressure upon increase of vacuum in said chamber, and spring means biasing said diaphragm in the opposite direction toward an initial position of maximum spark retardation determined by engagement of said magnetic member with said magnet.

7. A vacuum-operated spark advance mechanism for controlling an ignition distributor for an internal combustion engine by means of vacuum such as may be derived from the intake manifold of the engine, said mechanism comprising a body defining a vacuum chamber adapted for connection to the intake manifold, a movable pressure-responsive diaphragm attached at its margin to the body closing said chamber and subject on one side to vacuum in the chamber and on the other side to atmospheric pressure, a link for connecting said diaphragm to the distributor, said link being connected to the diaphragm by means including a magnetic washer on the atmospheric pressure side of the diaphragm, a permanent magnet carried by the body on the atmospheric pressure side of said element, said diaphragm being adapted for movement in spark-advancing direction away from the magnet by atmospheric pressure upon increase of vacuum in said chamber, and a compression spring in said chamber biasing said diaphragm in the opposite direction toward an initial position of maximum spark retardation determined by engagement of said washer with said magnet, said magnet being ring-shape, and said link extending through said magnet.

References Cited in the file of this patent

UNITED STATES PATENTS

2,302,685	Dyer	Nov. 24, 1942
2,628,296	Dillman	Feb. 10, 1953
2,640,116	Dyer et al.	May 26, 1953
2,643,304	Lautzenhiser	June 23, 1953
2,717,286	Bales	Sept. 6, 1955
2,922,002	Gilman	Jan. 19, 1960