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VACUUM IGNITION ADVANCE

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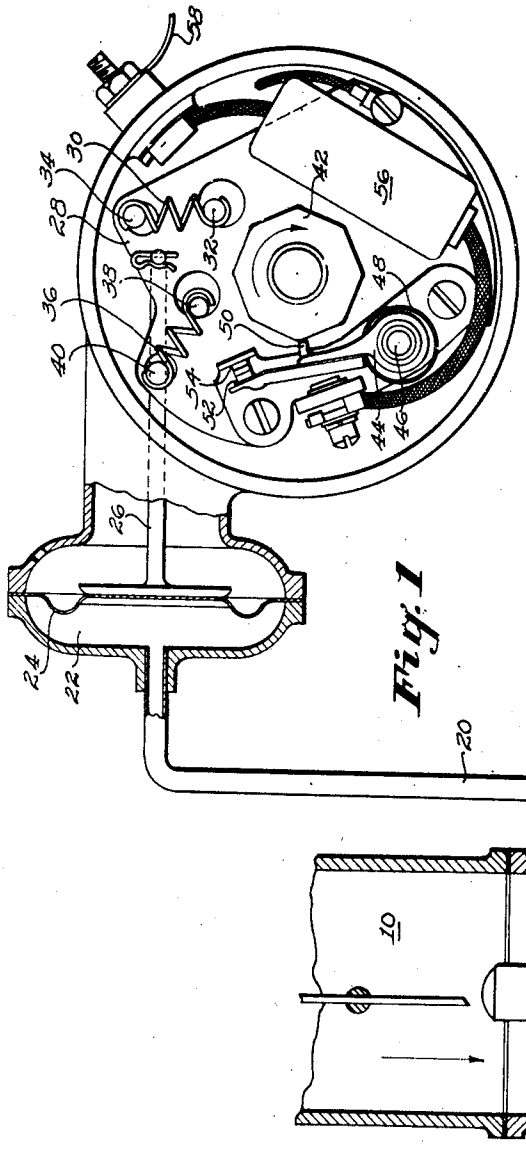


Fig. 1

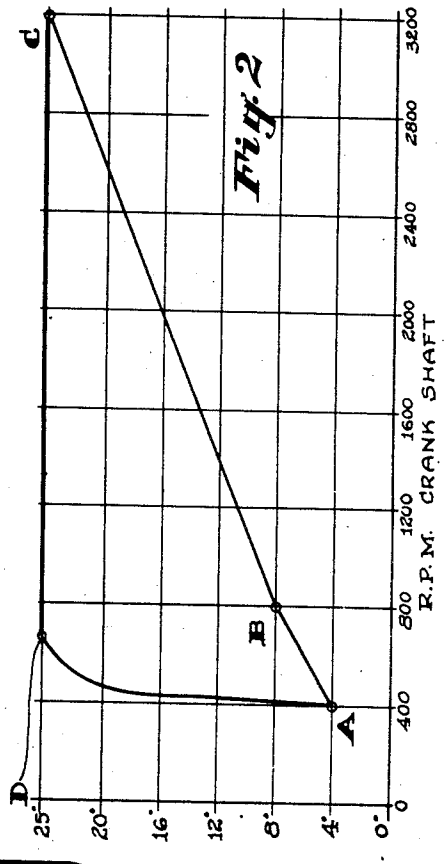


Fig. 2

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VACUUM IGNITION ADVANCE

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The object of this invention is to advance the spark as a function of:

(a) R. P. M. of the engine, and

(b) Inlet manifold suction.

Fig. 1 shows the preferred form of our invention.

Fig. 2 shows the characteristics obtained from this preferred construction.

In Fig. 1 10 is the air entrance to a carburetor venturi 12. 14 is a small opening in the venturi 12. 16 is a somewhat larger opening downstream from the venturi 12. 18 is a throttle which is located so that, when closed down to the idling position, the opening 16 is on the atmospheric side of the upstream lip of the throttle 18 and is on the engine side of the upstream lip of the throttle 18 the moment the throttle moves away from its idling position.

20 is a passage connecting the openings 14 and 16 with a chamber 22, located to the left of a diaphragm 24. A rod 26 is connected to a plate 28 and to the diaphragm 24. Suction applied to the diaphragm 24 rotates a circuit breaker plate 28 counterclockwise. A spring 30, almost at right angles to rod 26, connects the plate 28 with the stationary pin or anchor 32. This spring is always in engagement with a pin 34 on the plate 28 and the stationary pin 32.

A spring 36 exerts its resistance to the angular rotation of plate 28 at an angle between 21° and 22° and substantialy equal to or slightly less than the angle at which the spring 30 acts to resist rotation of the plate 28, and connects a pin 40 on the plate 28 with a stationary pin or anchor 38. This spring 36, however, is loosely mounted on the pins 38—40 so that the spring 30 has to be stretched quite a little before the spring 36 becomes stretched at all.

By virtue of the fact that the axis of spring 30 forms an appreciable angle with the initial direction of movement of the movable pin 34 (normal to the radius line joining the pin 34 and the axis of the cam 42), a relatively straight line relationship between the deflection of the spring 30 and the force exerted thereby is obtained. It has been found that the rate of increase of spark advancement can be made to vary as a straight line function of the force exerted by spring 30 if the angle between the axis of the spring 30 and the direction of movement of pin 34, beginning at the unstressed condition of spring 30, is between 55° and 85°. The same angular relationship should exist between the axis of spring 36 and the direction of movement of movable pin 40 beginning at the point where the spring 36

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starts to become stressed. To express this angular relationship in terms of the complements of the above described angles, we have found specifically that if a line joining the center of cam 42 at the center of pin 34 is arranged to be at an angle of approximately 24° with the center line of the first spring 30, and, if a line joining the center of cam 42 with the center of pin 40 is arranged to be at an angle of approximately 21° with the center line of the second spring 36, then the desired spark advance characteristic can be obtained with only a slight initial looseness in the second spring 36. The latter angle is slightly less than the first angle so that when the second spring 36 takes hold it will exert a force at approximately the same angle as the initial angle of the first spring 30.

A cam 42 engages with a circuit breaker arm 44 mounted on a pin 46. A spring 48 is mounted on the arm 44 and is anchored to the pin 46, so that the arm 44 pushes the fiber breaker 50 against the cam 42. The fiber breaker 50 is mounted on the arm 44. At the end of the arm 44 is mounted a contact point 52 which presses against a stationary contact 54 in a well known manner. By this means when the cam 42 rotates clockwise the time at which the contacts 52 and 54 are open occurs earlier when the diaphragm 24 moves to the left in response to a suction in the passage 20 and in the chamber 22. The usual elements are present, namely a condenser 56 and an electric connection 58. Such condensers are common in the art and constitute no part of our invention.

In Fig. 2, A is the initial minimum spark advance 4° at 400 crankshaft R. P. M. and the advance of 4° is measured on the crankshaft. Actually the timer moves on the cam shaft at one-half engine speed.

B is the point at which the loose spring 36 becomes tight. This occurs at 800 R. P. M. and when it occurs the spark advance is 8° crankshaft.

C is 25° advance crankshaft at 3200 R. P. M. crankshaft.

The transition from B to C occurs when springs 30 and 36 are both being stretched by the diaphragm 24 and the diaphragm rod 26. When the throttle 18 is moved towards the closed position the depression in the pipe 20 becomes quite considerable. One reason for this is that the opening 16 is quite a percentage larger than the opening 14, therefore the relatively low suction in the venturi in the opening 14 is overcome by inlet manifold suction which is greater. In other

words the opening 16 dominates the opening 14 both in size and in the suction applied.

Cd represents the spark advance due to the closure in the throttle. This high suction advance of 25° is maintained constant until the point D is reached when the throttle 18 moves over the opening 16 thus placing the opening 16 in communication with the atmosphere. This causes an immediate drop in spark advance to the point A.

The natural result of Venturi suction is to increase as the square of the speed when the throttle is wide open.

The location of the spring 30, almost at right angles to the rod 26, makes the spark advance line AB almost straight.

When the point C is reached the spark advance has reached its maximum. No matter how much more the suction is increased it results in no more spark advance as the stops limit the advance. These stops are the clearance openings between the pins 32 and 38 and their corresponding openings in the circuit breaker plate.

What we claim is:

1. An ignition timing device for a combustion engine having a fuel mixture intake passageway leading to said engine including a venturi, a throttle valve positioned in the passageway, a conduit having two restricted communications, one connected with the venturi and the other connected with the passageway on the atmospheric side of the throttle when the throttle is in its idling position and connected with the engine suction when the throttle initially opens from said idling position, a chamber connected to said circuit, a moving wall in said chamber, a circuit breaker, a rotatable plate supporting said circuit breaker, a rod connected thereto and to said moving wall, a spring anchored to and restraining the rotation of said plate, said spring being attached at one end to said supporting plate and at the other end anchored to a fixed support so that the line of force exerted thereby on initial stress thereof is substantially parallel to the principal plane of said supporting plate and forms an angle between 55° and 85° with a line normal to a radius line joining the point of connection of said spring to said rotating plate and the center of rotation of said rotating plate.

2. A device as set forth in claim 1 in which there is a second spring restraining the rotation of said plate and which is loose initially and which is located so as to pull at a similar angle to that of the first spring so that the first spring has to be stretched an appreciable amount before the second spring becomes effective to delay the rotation of said supporting plate until the flow through the venturi is sufficiently great to permit the maximum spark advance without knocking.

3. An ignition timing device for an internal combustion engine having an air entrance of the type in which a cam operates a circuit breaker mounted on a movable plate, the movement of which is responsive to the suction created by air flow in the air entrance, the improvement which consists in the provision of a restraining tension spring mounted in a plane parallel to that of the plate, an anchor pin mounted on the plate, a stationary anchor pin, said spring being supported between the movable anchor pin and the stationary anchor pin, the axis of said spring when said spring is unstressed being at an angle of from 5° to 35° with the radial line from its movable anchor pin to the center of the cam.

4. An ignition timing device for an internal combustion engine having an air entrance of the type in which a cam operates a circuit breaker mounted on a movable plate, the movement of which is responsive to the suction created by air flow in the air entrance, the improvement which consists in the provision of two restraining tension springs mounted in a plane parallel to that of the plate, two anchor pins mounted in the plate, two stationary anchor pins, one of the springs being stressed between a movable pin and a stationary pin, the axis of said spring when the spring is unstressed being at an angle of from 5° to 35° with the radial line from its movable anchor pin to the center of the cam, the other spring being loosely mounted on the other of the two anchor pins and the axis of the loose spring when the first mentioned spring is unstressed being at an angle with the radial line from its movable anchor to the center of the cam which is slightly less than the first mentioned angle.

5. An ignition device comprising a cam rotatable about an axis in proportion to the speed of a combustion engine ignited thereby, a supporting plate rotatably adjustable about said axis, a circuit breaker carried by said supporting plate, said circuit breaker having a movable contact carrying member engaging with and moved by said cam, said supporting plate being adapted to be connected to means for exerting a varying force tending to rotate said supporting plate about said axis in response to varying operating conditions of a combustion engine served by said ignition device, and spring means resisting the rotating action of said varying force comprising a spring having one end thereof attached to a fixed anchoring means and the other end thereof attached to an anchor means on said supporting plate, the line of force exerted by said spring being at an angle of from 5° to 35° with a radial line between said anchor means on said supporting plate and center of rotation of said cam when said spring is initially stressed.

6. An ignition device comprising a cam rotatable about an axis in proportion to the speed of a combustion engine ignited thereby, a supporting plate rotatably adjustable about said axis, a circuit breaker carried by said supporting plate, said circuit breaker having a movable contact carrying member engaging with and moved by said cam, said supporting plate being adapted to be connected to means for exerting a varying force tending to rotate said supporting plate about said axis in response to varying operating conditions of a combustion engine served by said ignition device, and spring means resisting the rotating action of said varying force comprising a first spring having one end thereof attached to a fixed anchoring means and the other end thereof attached to an anchor means on said supporting plate, the line of force exerted by said spring being at an angle of from 5° to 35° with a radial line between said anchor means on said supporting plate and center of rotation of said cam when said spring is initially stressed, and a second spring anchored at one end to a fixed point and attached at the other end to said supporting plate, the second spring being stressed by rotation of said supporting plate in response to said varying operating conditions only after movement of said supporting plate has stressed said first spring, the line of force of the second spring being at an angle with a radius line between the point of attachment of said second spring to said supporting plate and

the center of rotation of said supporting plate which angle is slightly less than the first mentioned angle when the said first spring is initially stressed.

7. An ignition device comprising a cam rotatable about an axis in proportion to the speed of a combustion engine ignited thereby, a supporting plate rotatably adjustable about said axis, a circuit breaker carried by said supporting plate, said circuit breaker having a movable contact carrying member engaging with and moved by said cam, said supporting plate being adapted to be connected to means for exerting a varying force tending to rotate said supporting plate about said axis in response to varying operating conditions of a combustion engine served by said ignition device, and spring means resisting the rotating action of said varying force comprising a first spring having one end thereof attached to a fixed anchoring means and the other end thereof attached to an anchor means on said supporting plate, the line of force exerted by said spring being at an angle of from 20° to 27° with a radial line between said anchor means on said supporting plate and center of rotation of said cam when said spring is initially stressed, and a second spring anchored at one end to a fixed point and attached at the other end to said supporting plate, the second spring being stressed by rotation of said supporting plate in response to said varying operating conditions only after movement of said supporting plate has stressed said first spring, the line of force of the second spring being at an angle with a radius line between the point of attachment of said second spring to said supporting plate and the center of rotation of said supporting plate which angle is slightly less than the first mentioned angle when the said first spring is initially stressed.

8. An ignition timing device for an internal combustion engine having a fuel intake passageway responsive to and capable of producing multiple variable suction conditions in accordance with engine speed and load comprising suction operable means operatively connected to an oscillatable plate responsive thereto, a plurality of elastic means resisting oscillations of said plate, each of said elastic means being anchored to fixed anchor means and to a point on said oscillatable plate, the line of force exerted by each of said elastic means being at an angle other than 90° with the radial line from its anchor point on said oscillatable plate to the center of oscillation of said plate when the elastic means is initially stressed, one of said elastic means being stressed before the other in response to oscillations of said plate, the said fixed anchor means being disposed within the outline of said plate and said plate having openings through which the said fixed anchor means project for connections to said elastic means, a rotating cam, a relatively stationary electrical contact mounted on said plate, a breaker arm pivoted on said plate and engaged by said cam, a relatively movable electrical contact mounted on said breaker arm, an electric circuit which is made and broken by said pair of contacts.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,798,726	Chryst et al.	Mar. 31, 1931
2,317,885	Colvin	Apr. 27, 1943