

2,473,170

2 Sheets-Sheet 1

INVENTOR.
William Ostling
BY *Philip Subkow*
ATTORNEY.

June 14, 1949.

W. OSTLING

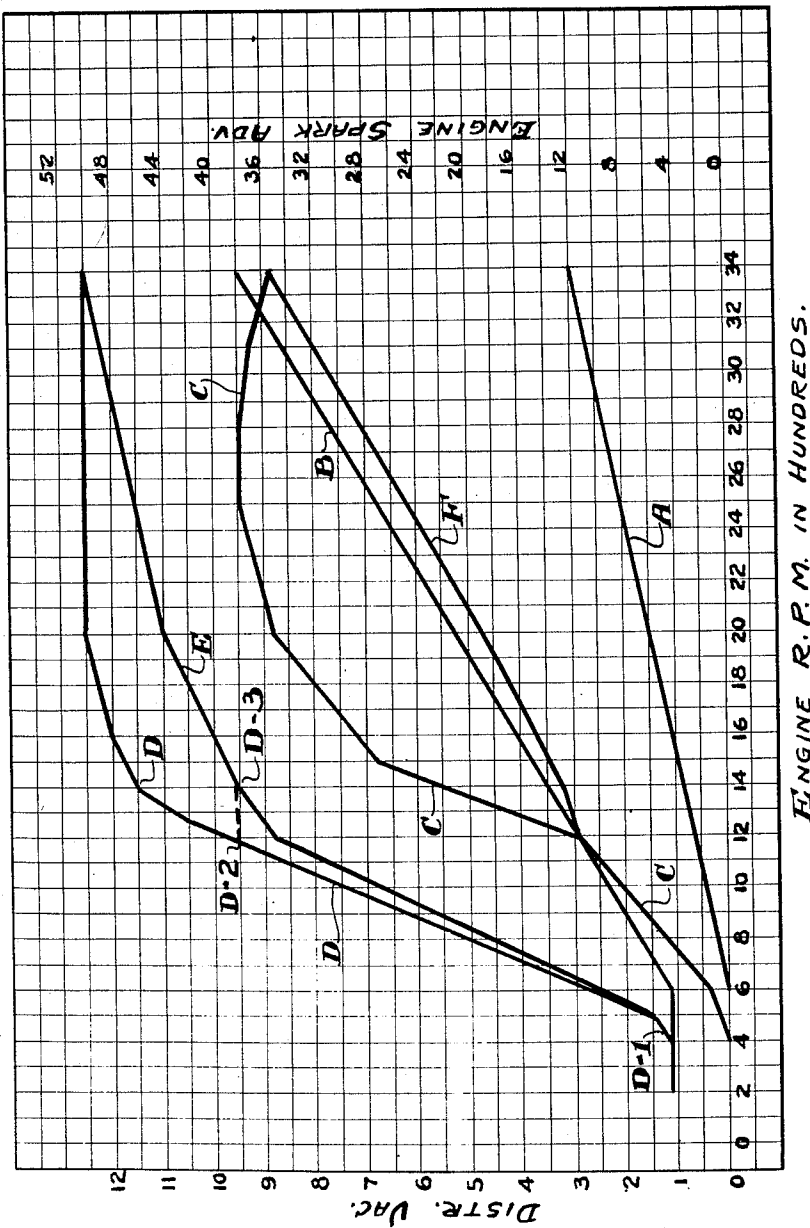
2,473,170

AUTOMATIC SPARK ADVANCE MECHANISM

Filed Feb. 3, 1947

2 Sheets-Sheet 2

Fig. 5.



INVENTOR.
William Ostling
BY *Henry Siskow*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,473,170

AUTOMATIC SPARK ADVANCE
MECHANISM

William Ostling, Los Angeles, Calif., assignor to
California Machinery and Supply Company,
Ltd., Los Angeles, Calif., a corporation of Dela-
ware

Application February 3, 1947, Serial No. 726,112

6 Claims. (Cl. 200—31)

1

As is well recognized in this art, the spark timing has a major effect upon the efficiency of operation of a spark ignition engine. In order to obtain maximum power, ignition must occur before the compression stroke is completed, that is, before top dead center is arrived at by the piston, because the combustion process requires a finite time and it is desirable that the maximum pressure be developed in the cylinder before the expansion of the power stroke begins.

As will be seen later and as well known in this art, the higher the engine speeds, that is, the higher the linear velocity of the piston, the earlier must be the spark, in order that the combustion process have sufficient time to generate the maximum pressure by the time the piston reaches top dead center. The optimum position for the spark in relation to the stroke is determined by laboratory experimentation, as will be more fully set forth below.

The interval between the time of the spark and the arrival of the piston at top dead center is termed the "spark advance." The earlier the spark is generated in the compression stroke of the engine, the more advanced is the spark, and the nearer to the time of arrival of the piston at top dead center, the more retarded is the spark. The degree of spark advance may be measured in terms of the crank angle.

While the degree of spark advance is a function of engine speed, it is also a function of throttle position. Thus, at any engine speed the degree of spark advance desirable for part throttle operation is greater than that required for full throttle operation. The adjustment of the spark advance in a spark ignition engine is accomplished by adjusting the angular relation between the breaker cam and the breaker points. As is well known in this art, the distributor contains a cam shaft which is rotated usually at half engine speed. The cam shaft rotates a cam usually in the form of a nut with lobes equal in number to the number of cylinders fired by the distributor. Surrounding the cam shaft and concentric therewith is a non-rotating breaker plate upon which is mounted a breaker, the function of which is to open the circuit of the ignition system so that the condenser discharges across the cylinder plug points. The angular relationship between the breaker and the cam determines the point in the stroke of the piston when the breaker points will separate and the spark will jump.

The term "full load" refers to that load which is imposed upon the engine at full open throttle

2

position at any given speed. In other words, it is the maximum load which may be imposed upon an engine when the throttle is wide open in order that a particular chosen speed be maintained at a steady rate.

"Part load" or "load at part throttle position" is that load which at any given speed is tolerable at any throttle position less than full.

"Road load" is that load which is at part throttle position. "Road load" has become a rather generally recognized term in this art to specify as standard a part load which corresponds to the load on an engine equivalent to that imposed by an automobile of medium weight with three people of average size when driving on a straight road without acceleration. This rather arbitrary loading corresponds to about a 35° throttle opening at speeds of about 3400 R. P. M. Road load may thus be stated as the load imposed on an engine operating at 3400 R. P. M. at seal level with the throttle, for example, at 35°, from fully closed. With such road load imposed on the engine, as the throttle is opened beyond 35° the engine speeds up under such constant road load, and as the throttle is closed the engine slows down.

In order to determine the best spark position for all conditions of operation of the engine, the engine is tested under load either in a dynamometer or on the road and the spark is set manually by adjusting the breaker plate for all conditions of throttle position and speed to establish what is known as the ideal spark advance curves for full load and road load positions. If the spark is controlled to advance along these curves at full load and road load they will also be adequate at intermediate load conditions. Such curves and spark advance settings are hereafter referred to as ideal or optimum curves or settings.

During cranking and idling the spark for best operation is retarded. When operating at road load, the spark should be advanced, the degree of advance being greater as the speed at road load operations is higher. As the throttle is opened wider to full throttle position for full load operations the spark is best retarded, but at full throttle operation the spark should be more advanced the higher the speed at full load, i. e., wide open throttle.

Spark ignition internal combustion engines, particularly those used in the automotive field, have devices for automatically adjusting the spark advance in relation to engine speed and also in relation to the throttle position at such engine speed. One method employed is to attach the

cam to centrifugal weights which are rotated by the cam shaft. As the engine speed increases the weights move out under centrifugal force and rotate the breaker cam relative to the drive shaft, thus advancing the spark. However, since at part throttle operation a greater spark advance at any engine speed is desirable than that for full throttle operation, it is desirable that the spark advance mechanism at part throttle operation advance the spark an amount in addition to that which is obtainable from the centrifugal spark advance mechanism. In one standard type of such device now employed the breaker plate is advanced above that obtainable from the centrifugal weight by means of a link connected to a pneumatically operated power means for actuating the link. This means is conventionally a diaphragm positioned in a chamber which is in turn connected to an orifice positioned at the throttle in the air fuel induction system.

In another form of such automatic spark advance, such as represented by the Vanderpoel and Ostling Patent No. 2,249,446, the centrifugal weights are omitted and the entire advance is pneumatically controlled.

In addition to the orifice positioned at the throttle, an orifice is placed either at the main carburetor venturi or at an auxiliary venturi, as described in the co-pending application Serial No. 694,266, filed August 31, 1946, by Garth L. Young and William Ostling. A by-pass is provided between the two orifices which are in turn connected to the pneumatic power means, specifically the diaphragm chamber similar to that described above. If desired a check valve may be placed in this by-pass. With such an arrangement the centrifugal weights may be entirely omitted and the spark advance may be obtained entirely by the rotation of the breaker plate by means of a stem connected to the diaphragm in the diaphragm chamber.

With such an arrangement at idling position the throttle orifice is on the carburetor side of the throttle and the velocity is so low that the vacuum generated is low. It is insufficient to advance the spark. When the throttle is opened to part throttle position the throttle orifice is on the manifold side of the throttle and is subjected to the vacuum of the intake manifold but this vacuum is in part bled through the Venturi orifice which is, of course, at a higher pressure, i. e., lower vacuum, and this modifies the excessive vacuum thus created by the manifold and the spark is advanced. When the throttle is opened to full open position, such as in the full load operation, the manifold vacuum drops substantially and is at practically atmospheric, but due to the velocity of the gases through the venturi there is a vacuum at the Venturi orifice which prevents the spark from being retarded to the degree it would have been if it had only been subjected to the manifold vacuum.

By positioning the check valve when the pressure at the venturi is lower than at the throttle orifice, as it is in full throttle position, the check valve closes so that the vacuum generated at the venturi is not bled by the higher pressure in the manifold, and thus the advance of the spark is increased over that which would have been obtained if the check valve had not been present.

It is an object of my invention to improve the operation of such spark advance mechanisms.

Experience with these types of automatic spark advances of the prior art has shown that

while it is usually possible by proper adjustment of the orifices sizes and their location, proper choice of the tension of the retarding spring, to obtain a spark advance with engine speed at full load, i. e., at wide open throttle operation, which may be adjusted to correspond to the ideal or optimum spark advance obtained in the laboratory, in the case of road load operations it is virtually impossible to obtain a spark advance curve at all engine speeds at part throttle operation which would coincide with the desirable spark advance curve for such different engine speeds.

In the case of the governor controlled automatic spark advance mechanism employing also a vacuum controlled road load advance as previously described, while it is possible by properly adjusting the centrifugal weights and spring tension to obtain a full load advance as desired, the advance at part throttle operation cannot be made to fit the optimum or ideal curve. Thus, if it were made to fit the optimum curve at low speeds it is over advanced at higher speeds and if it fits the curve at some higher speed it will be far under advanced at lower engine speeds.

A similar difficulty occurs with the type of spark advance mechanism in which the advance is pneumatically controlled and the centrifugal weights omitted. In this case also while it is possible by proper adjustment of the orifices and the retarding spring tension to duplicate the desirable full load advance the road load advance is, however, more difficult and for some engines virtually impossible to fit on the desirable road load advance. Thus, if the road load advance curve is made to coincide with the ideal advance at low speeds it will be over advanced at high speeds and if it fits the curve at high speeds it will be far under advance at low speeds. While the curve is made to fit the ideal advance curves at higher intermediate speeds it may be far under advanced at speeds higher than the speed at which the fit is made and under advanced or over advanced at the lower speeds. In this case also where the adjustment is made by means of changes in spring tension the full load advance may not be attained according to the ideal or desired curve. The difficulty thus presented by the automatic spark advance mechanisms which are in part controlled by the vacuum generated by the engine arises from the fact that the degree of vacuum which is exerted in the diaphragm chamber is excessive at vacuums much above that which are obtained at full load operations. Thus, full load vacuums rarely reach above 2 to 6 inches at speeds up to about 3400 R. P. M. or higher. In this range of vacuum the retarding spring can be adjusted to give the desired full load advance, but since at part throttle operation the vacuums existing at the orifices are far above this degree of vacuum at higher engine speeds the advance obtained at such higher vacuums may be much greater than is desirable to obtain the ideal spark advance.

In the governor controlled type of operation, one method employed is to limit the amount of advance obtained by the vacuum over that which is obtained by the centrifugal governor so that any rise in vacuum above a predetermined limit would not cause any further advance over that obtained by the centrifugal governor. In other words, the advance is controlled both by the governor and by the vacuum up to a certain predetermined limit of advance and from then on

the vacuum is not permitted to further advance the spark and the sole advance is that controlled by the governor. In this type of operation so long as the attained vacuums exist above the predetermined limit, the spark advance proceeds proportional to the governor advance until the vacuums start dropping as the throttle becomes wider open and then this spark advance flattens out as the vacuums generated drop below the aforementioned predetermined upper limit.

The result of this type of construction is that we obtain an over advance at high engine speeds, although a fit at lower speeds is obtainable.

In the case of the pneumatically actuated types referred to above in which the full load advance is also pneumatically controlled, the vacuums exceed the maximum full load vacuums at relatively low engine speeds, and the advance obtained at higher engine speeds is excessive and beyond that desired because of this excessive vacuum generated in the diaphragm chamber. If the tension of the retarding spring is increased or the orifices are differently arranged to cause a lower spark advance, then the advance obtained at full load, i. e., at wide open throttle is insufficient.

I have devised a new spark advance mechanism which overcomes the difficulties of the above two cases. In my co-pending application, Serial No. 694,461, filed Sept. 3, 1946, I have introduced a manually operated bleed valve so that these excessive vacuums at any engine speed may be bled down by a manual control of the valve. In the present invention I provide an automatic bleed so controlled that as the spark advance exceeds that desired by reason of an excessive vacuum generated in the diaphragm chamber, the excessive vacuum is lowered by means of a bleed which reduces the vacuum in the diaphragm chamber and produces the desired spark advance. I have obtained this desired end by introducing into the line connecting the diaphragm chamber and the air fuel passageway a bleed valve which is opened in degree at each position of the spark advance to produce a vacuum in the diaphragm chamber just sufficient to overcome the retarding spring tension at such spark advance. I obtain this desired end by providing a cam which is operatively connected to said valve in said vacuum line and which cam is operatively connected to said circuit breaker to open the valve to the proper degree at each position of the breaker plate to maintain the breaker plate in its desired position against the retarding spring tension.

These and other objects of my invention will be better understood by reference to the drawings, in which:

Fig. 1 is a view partly in section of one form of distributor according to my invention with the cap removed;

Fig. 2 is a fragmentary view partly in section along 3 taken through the valve mechanism;

Fig. 3 is a view in part section taken along line 3-3 of the distributor of the spark advance mechanism;

Fig. 4 is a view showing the use of the distributors with one type of carburetor construction.

Fig. 5 is a chart showing the relationship of engine speed, distributor vacuum, and spark advance employing the distributor of my invention.

The spark advance distributor mechanism of Figs. 1 and 3 has a conventional case 1 in which is mounted the conventional cam shaft 2 which

is rotated through a conventional connection at half engine speed and carries the conventional breaker cam 4. Cam 4 is rotated by shaft 2 which rotates in bearing sleeve 3. The shaft carries the rotating contact mounting 5 which carries the usual contact 6 which makes contact with the distributor contact 8 mounted in a removable cap 7. A rotatable sleeve 9 is mounted externally of the sleeve 3 and carries the breaker plate 10 upon which is mounted the conventional breaker 11 which is connected to the electrical circuit of the motor in the usual manner. The breaker plate 10 is adjusted angularly around the vertical axis of the cam shaft 2 and the cam 4 on its sleeve 9 by the rod 12 which is pinned to the plate 10 in a conventional manner. The plate 10 has a limit motion stop, composed of a hole 11' through which passes a pin 10', mounted on plate 12 angularly adjustable in case 1 around the axis of 2. A spring 13' connected to the plate and to the pin 10' may also be provided in the conventional manner. The rod moves in a housing 13 attached to the case 1 and is backed by a spring 14.

The rod 12 is connected to a diaphragm 15 which is mounted in a diaphragm chamber 17 which is mounted in a housing 16. The diaphragm chamber 17 is covered by a cover 18 forming an air tight chamber 17. The diaphragm on its underneath side, that is, the other side away from chamber 17, is exposed to atmospheric pressure in the case 1 and is exposed to vacuum in chamber 17 as further explained. The case 18 is connected by a conduit 19 to the carburetor, as will be further described. In line 19 is a T 20 which is connected to a by-pass line 21 which is in turn connected to a valve 23 positioned in the case 1, as is shown in Figs. 1, 2, and 3. The valve 23 has a valve seat 24 in which there is a ball valve 26 operating against a spring 25. The breaker plate 10 is cut away at 29' to provide room for the positioning of a cam 28 having a cam surface 29 cooperating with the ball valve 26 as further described herein.

The spark advance distributor mechanism is connected to the carburetor of a spark ignition engine by means of line 19, as shown more fully in Fig. 4. The carburetor is composed of the conventional air intake line 29a, fuel nozzle 31, and the air passage carries a venturi 32 and the air fuel line 33 with the throttle 34 connected to the manifold at 35. A bore 36 is provided at the vena contracta (throat) of the venturi to give an orifice 37 at the throat and a bore 38 is provided at the throttle to give an orifice 39 positioned with respect to the throttle 34 so that it is on the carburetor (venturi) side of the throttle when the throttle is in idling position and on the manifold side of the throttle when the throttle is in part open position. The bore 38 is connected to bore 36 by a by-pass bore 39' and the line 19 is connected to the bore 38 and by-pass 39' by means of fitting 40. A check valve 41 may be provided in the by-pass with a ball check 42 and a spring 43 so arranged that the spring holds the ball 42 against the valve seat 44 when pressure is equalized on both sides of the ball and the spring is just sufficient to hold the ball against gravity.

The operation of this device will be made clear by reference to the drawing Fig. 5. For purposes of clarification the action of the device may be considered as if a valve has been placed in line 21 and completely closed; in other words, to make the bleed through valve 23 ineffective.

With the throttle wide open at full load the vacuum generated in chamber 17 at various engine speeds is given by line A, showing that at speeds of about 600 R. P. M. the vacuum is zero, i. e., the pressure in chamber 17 is atmospheric. As engine speed increases the vacuum in chamber 17 rises substantially in a straight line with engine speed until a vacuum (difference between atmospheric pressure and pressure in chamber 17) of about 3" is obtained at a speed of 3400 R. P. M.

The spring tension of spring 14 gives the full load advance as shown in curve B from an initial setting of 5°, rising to 37° at 3400 R. P. M. corresponding to 3" vacuum.

Curve C gives the vacuum generated in chamber 17 with no bleed at road load from engine speeds of 400 R. P. M. to 3400 R. P. M. Starting at low speeds of 400 R. P. M., the vacuum in the diaphragm chamber 17 is zero (pressure equal atmospheric) and with the throttle opening at the carburetor side of the throttle.

As the throttle is opened wider, the orifice 39 being on the manifold side of the throttle 34, vacuum starts to climb as speed is increased and throttle is opened wider and wider. Pressure at the orifice 37 is greater than at the orifice 39 and the valve 42 remains open and the vacuum in 17 starts to climb along curve C. The rise of vacuum with increase of speed, however, is not as sharp as would have occurred had no orifice 37 been provided. The valve 42 being opened, the pressure being greater at 37 than at 39, part bleed occurs through orifice 37 causing the pressure to rise more slowly along curve C than would be the case if no Venturi orifice 37 had been provided.

It will be observed that at a speed of about 1200 R. P. M. the vacuum in the diaphragm chamber 17 is that attained at full load operation with wide open throttle at 3400 R. P. M. Under full load operation with wide open throttle the pressure at the Venturi orifice 37 is actually less than at the throttle orifice 39 due to the effect of the venturi and valve 42 is closed under full load operation and the vacuum generated in chamber 17 is only that attained at orifice 37. As the throttle under road load conditions is opened wider and speed increases vacuum climbs continually along curve C. Due to the part throttle position at part load the vacuum at road load for equal speeds is higher than at full load.

The advance obtained as a result of this vacuum is shown in curve D. It will be observed that due to the closing of the valve 42 at full load and the resulting lower vacuum at equal speed, the spark is part retarded at full load. An advance of 50° is obtained when engine speed of 2000 R. P. M. at road load is obtained and a vacuum of 8.7" is obtained. This advance is not exceeded notwithstanding the further increase in vacuum at higher speeds since the bracket 12' has been adjusted to bring the pin 11' against the wall of the opening 10' when this degree of advance is obtained.

The ball check valve 41 may be omitted as the operation will be substantially as above, but the absolute magnitude of the resulting vacuum will be different and the orifices and/or the tension retarding spring 14 will need to be adjusted to give the desired full load advance and road load advance.

Curve E gives the advance for this particular engine attained under the same road load con-

ditions but with manual setting of the advance to give the ideal or optimum advance at each engine speed. It will be observed that the advance obtained with the bleed closed is excessive throughout the whole range of engine speeds from about 600 R. P. M. to 3400 R. P. M. From 600 to 1200 R. P. M. the over advance does not exceed 2° and therefore may be ignored. However, in the range between 1200 R. P. M. and 3400 R. P. M., particularly between 1200 R. P. M. and about 2800 R. P. M., the advance is excessive.

The effect of the automatic bleed will be apparent by reference to curves D and E. Cam 28 is positioned upon the breaker plate so that it first comes in contact with the ball 26 when the advance has reached 38°. In this position the vacuum in the chamber 17 is equal to 3". In other words, the cam does not actuate the valve at vacuums under 3" and therefore the cam has no effect upon the full load advance which follows the ideal advance curve B. In this region the advance obtained at road load is that along curve D; in other words, the advance obtained with this condition of the system is in the branch of D—1 to D—2.

When the breaker plate has rotated to this degree the cam contacts the valve and any further increase in vacuum in chamber 17 due to increase in engine speed proceeds along the curve F from 1200 to 3400 R. P. M. as the cam rides over the ball and bleeds the chamber down to the vacuum corresponding to that of curve F instead of curve C until the speeds of 3400 R. P. M. is obtained when the valve 26 becomes closed and the vacuum generated in chamber 17 is that which is obtained with no bleed. The cam surface is so designed that at any position of the breaker plate corresponding to an advance given on curve E, the valve is opened to bleed down the vacuum from the corresponding value given on curve E to the corresponding value on curve F. The degree of opening of the ball 26 caused by the cam 28 creates a bleed equivalent to the difference between the curve C and curve F at each engine speed, i. e., at each degree of breaker cam rotation.

As a result of this bleed the advance proceeds along the branch D—1, D—2 and in the interval between 1200 and 1400 R. P. M. along the branch D—1—D—3, until it intercepts the curve E and from 1400 to 3400 R. P. M. will proceed along curve E.

In order to establish the nature of the cam surface for any engine design and vacuum line system, I may establish the curve D and curve E as well as the curve C by appropriate measurements and engine operation. The curve F (i. e., the vacuum in 17 at each engine speed necessary to establish curve E) is obtained directly from curves C and D. The degree of the opening of the valve necessary for each engine speed and degree of desirable spark advance (curve E) is then determined by the difference between the curves C and F. From this difference the cam surface necessary to give the valve opening to give this degree of bleed may be determined.

The charts illustrate a specific application to a specific condition and engine operation, but they illustrate the principle whereby the cam surface and the valve may be designed to give the desired road load and full load advance. Thus, the values of the vacuums and advance, as a function of engine speed and the degree of bleed, will change with variation in engine de-

sign and their values at road load will change as the throttle setting and speed and load chosen as representing road load change. However, the nature of the cam surface and the valve to give the desired degree of bleed, required to give any chosen advance at the load chosen as representing road load, will be obtained by the application of the principles explained in connection with the specific examples described above.

While I have described a particular embodiment of my invention for the purpose of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

I claim:

1. An automatic spark advance mechanism for spark ignition engines, which comprises a rotatably mounted breaker cam, a cam shaft for rotating said breaker cam, a circuit breaker in operative association with said breaker cam, a mounting for said circuit breaker, said mounting being angularly adjustable about said cam, a pneumatically operated power means including an air tight chamber, a diaphragm in said chamber, a rod connecting said diaphragm to said mounting, a conduit connected to said chamber, a bleed line connected to said chamber, a valve in said bleed line, and means for regulating the opening of said valve responsive to the angular position of said circuit breaker around said breaker cam, said means comprising a second cam operatively connected, for motion, to said mounting.

2. An automatic spark advance mechanism for spark ignition engines, which comprises a rotatably mounted breaker cam, a cam shaft for rotation of said breaker cam, a circuit breaker in operative association with said breaker cam, a mounting for said circuit breaker, said mounting being angularly adjustable about said cam, a pneumatically operated power means including an air tight chamber, a diaphragm in said chamber and a rod connecting said diaphragm to said mounting, a conduit connected to said chamber, a bleed by-pass line connected to said chamber, a valve in said bleed by-pass line, and a cam positioned on said circuit breaker mounting and in operative association with said valve to open said valve in a predetermined relation to the angular position of said circuit breaker around said breaker cam.

3. An automatic spark advance mechanism, comprising a case open to atmospheric pressure, a cam shaft rotatably mounted in said case, a breaker cam mounted for rotation by said shaft, a circuit breaker operatively associated with said breaker cam, a mounting for said circuit breaker, said mounting being adjustable about said breaker cam, a diaphragm chamber, a diaphragm in said chamber, the chamber on one side of said diaphragm being open to said case, the chamber on the other side of said diaphragm being air tight, a rod connecting said diaphragm to said circuit breaker mounting, a conduit connected to said chamber at its air tight side, a by-pass conduit connected to said first mentioned chamber, a valve mounted in said case, said valve being positioned in said by-pass conduit, and a valve opening means comprising a cam mounted on said mounting in operative association with said valve to open said valve.

4. An automatic spark advance mechanism,

comprising a case open to atmospheric pressure, a cam shaft rotatably mounted in said case, a breaker cam mounted for rotation by said shaft, a circuit breaker operatively associated with said breaker cam, a mounting for said circuit breaker, said mounting being adjustable about said breaker cam, a diaphragm chamber, a diaphragm in said chamber, the chamber on one side of said diaphragm being open to said case, the chamber on the other side of said diaphragm being air tight, a rod connecting said diaphragm to said circuit breaker mounting, a conduit connected to said chamber, a by-pass conduit connected to said air tight chamber, a valve mounted in said case, said valve positioned in said by-pass conduit, said valve comprising a valve housing, a ball valve, a valve seat, a valve retaining spring, said ball valve projecting below said seat, a valve opening means comprising a second cam mounted on said mounting in operative association with said valve.

5. An automatic spark advance mechanism, comprising a case open to atmospheric pressure, a cam shaft rotatably mounted in said case, a breaker cam mounted for rotation by said shaft, a circuit breaker operatively associated with said breaker cam, a mounting for said circuit breaker, said mounting being adjustable about said breaker cam, a diaphragm chamber, a diaphragm in said chamber, the chamber on one side of said diaphragm being open to said case, the chamber on the other side of said diaphragm being air tight, a rod connecting said diaphragm to said circuit breaker mounting, a conduit connected to said chamber at its air tight side, a by-pass conduit connected to said chamber at its air tight side, a valve mounted in said case, said valve positioned in said by-pass conduit, said valve comprising a valve housing, a ball valve, a valve seat, a valve retaining spring, said ball valve projecting below said seat, a valve opening means comprising a second cam mounted on said mounting, said second cam bearing against said ball during the motion of said second cam with said mounting upon adjustment of said mounting about said second cam on motion of said diaphragm.

6. An automatic spark advance mechanism for spark ignition engines, which comprises a rotatably mounted breaker cam, a cam shaft for rotating said breaker cam, a circuit breaker in operative association with said breaker cam, a mounting for said circuit breaker, said mounting being angularly adjustable about said cam, a pneumatically operated power means, a pneumatic pressure line connected to said power means, an operative connection between said power means and said mounting, said connection being operative to adjust the mounting and said circuit breaker about said cam, a bleed line connected to said pneumatic pressure line, a valve in said bleed line, and means for regulating the opening of said valve responsive to the angular position of said circuit breaker about said cam.

WILLIAM OSTLING.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,249,446	Vanderpoel et al.	July 15, 1941