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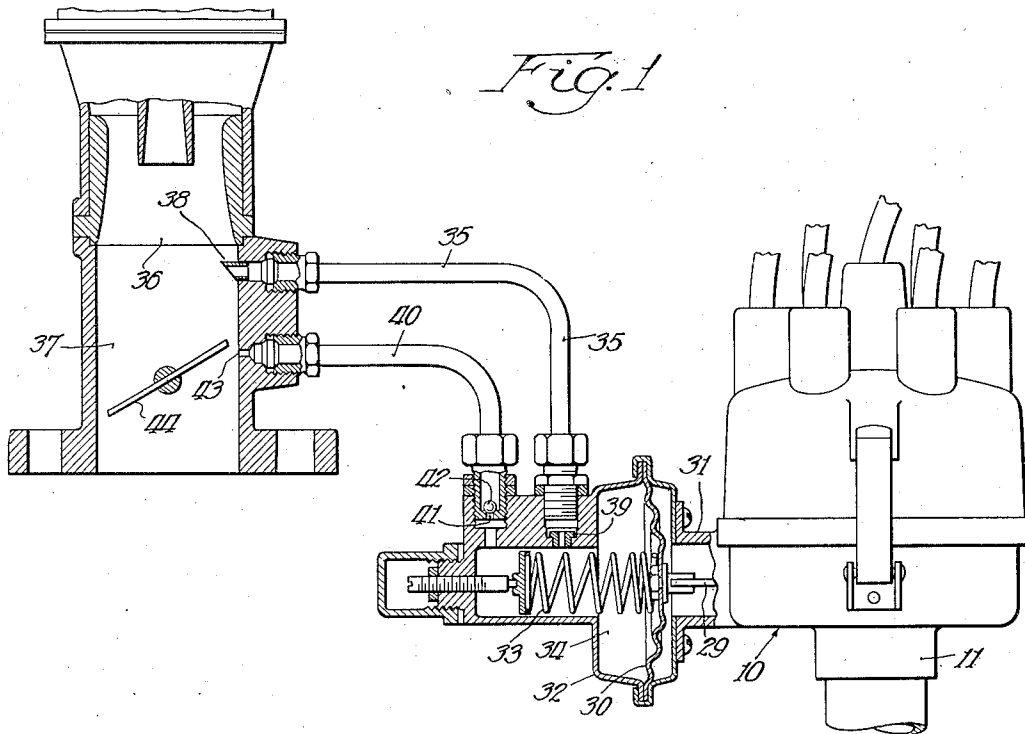
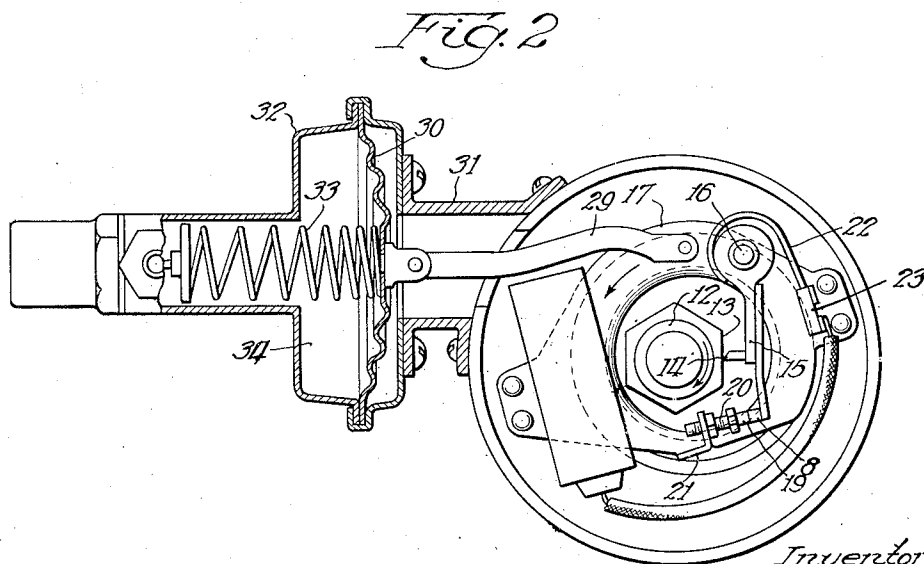
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CIRCUIT BREAKER FOR SPARK DISTRIBUTORS

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CIRCUIT BREAKER FOR SPARK DISTRIBUTORS

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7 Claims. (Cl. 123-117)

The present invention relates to improvements in circuit breakers for spark distribution in the ignition circuits of internal combustion engines. The principal purpose of the present invention is to provide an improved means for controlling the spark gap opening of the circuit breaker in such a fashion that if the speed of the engine increases the spark is advanced, and the spark gap opening is decreased for a portion of the advancement and then held substantially constant.

The invention further contemplates a circuit breaker of the character described and means for controlling the advance of the spark in response to the speed of the gas fuel mixture passing through the carburetor of the engine. In this connection it is preferred to regulate the advance of the spark at full load by one means responsive to the suction in the intake conduit on the upstream side of the throttle valve through which the air and gas are admitted to the engine, and under road loads at high speed to advance the spark in response to suction on the down stream side of the partially open throttle valve.

The invention is embodied in a device of the character described wherein vacuum, created by the flow of gas and air in the fuel intake of the engine, acts against a spring loaded diaphragm to effect changes in the advance of the spark and in the opening provided in the primary circuit. According to the invention, the breaker arm is carried by a supporting member which is movable about an axis that is offset with respect to the axis of the breaker cam. The offset is such that the heel of the breaker arm backs away from the cam as the supporting member is initially moved by the suction applied to the diaphragm. This backing away of the heel as the breaker arm is advanced, permits the breaker arm to travel through a greater distance than the actual distance of spark advance. This is because part of the actual advance of the breaker arm is nullified by the fact that the heel, when moved outwardly from the cam path first engages the cam at a point closer to the peak of the cam.

The additional breaker arm travel for a given spark advance allows a greater movement of the diaphragm. The spring opposing the movement of the diaphragm can therefore be relatively weak and more accurate response to the initial low vacuums obtainable may be had. Of course the same general results could be accomplished by using a larger plate for the breaker arm to get greater distance from the pivot of the link on the

breaker arm support to the cam axis. However, the size of the distributor would need to be increased and this is not economical. With our device, the size of the distributor may be just sufficient to give the clearance necessary between the high voltage terminals.

The features and advantages of the present invention will appear more fully as the description proceeds, reference being had to the accompanying drawings wherein a preferred embodiment of the invention is shown. It is to be understood, however, that the drawings and description are illustrative only, and are not to be taken as limiting the invention except insofar as it is limited by the claims.

In the drawings,

Fig. 1 is a view partly in side elevation and partly in section showing our improved distributor connected to the gas and air mixture intake pipe of an internal combustion engine;

Fig. 2 is a plan view of the distributor head with the cover removed;

Fig. 3 is a side view, partly in section, of the mechanism shown in Fig. 2;

Fig. 4 is a diagrammatic view illustrating the manner in which the spark is advanced with respect to the engine driven cam, and

Fig. 5 is a sectional view illustrating a modification of the structure shown in Fig. 1.

Referring now in detail to the drawings, and in particular to Figs. 1 and 2, the present invention is shown as applied to a distributor head 10. The general construction of the distributor head 10 is conventional and will not be described in detail. The head 10 provides a bearing portion 11 for a cam shaft 12. The shaft 12, in turn, carries a cam 13 that is adapted to engage a heel 14 on a breaker arm 15.

The breaker arm 15 and the heel 14, which is usually of a fibrous material, may be of any suitable construction. The breaker arm is pivoted by a pin 16 upon a supporting member 17. The breaker arm carries a contact 18 which is adapted to engage a relatively fixed contact 19 that is also supported on the member 17. The contact 19 is carried by an adjustable stem 20 which, in turn, is supported by a bracket 21 on the member 17. A spring 22 connects the breaker arm 15 to a bracket 23 on the member 17. This spring is under tension so as to yieldingly urge the breaker arm 15 toward the cam 13. The breaker arm and its spring are suitably insulated from the member 17.

The supporting member 17 is journaled in a ball bearing 24 (see Fig. 3). The inner race 25

of this bearing is mounted on a depending flange 26 of the member 17. The outer race 27 of the bearing is seated in a recess 28 that is formed directly in the body of the head 10. The recess 28 has its axis offset with respect to the axis of the cam 13. The principal part of the offset is in a direction toward the heel 14 of the breaker arm 15 when it is in full load advance position, that is, in the direction of movement of the breaker arm by the cam. The axis of the recess 28 is also offset in a direction transverse to the movement of the breaker arm and toward the direction in which the member 17 is rotated to advance the spark. This latter offset is only a fraction of the first offset, however. For example, in the device as shown in the drawings, the central axis of the bearing 24 is offset .10 inch toward the heel 14 from the axis of the cam 13 and .010 inch toward the pivot pin 16 of the breaker arm in a direction at right angles to the first named offset.

The supporting member 17 is adapted to be turned in the bearing 24 by a link 29 which is connected to the member 17 and to a diaphragm 30. The link 29 passes through a housing 31 to the diaphragm which is housed in a gas-tight housing 32. The diaphragm 30 receives atmospheric pressure on the link side thereof, but on the other side it is balanced between the pressure of a spring 33 and a reduced pressure or suction within the chamber 34 of the housing 32. It will be readily understood that by increasing the vacuum within the chamber 34, the atmospheric pressure on the diaphragm 30 can be made to compress the spring 33 and thus rotate the member 17 in the direction of the arrow as indicated in Fig. 2, that is, in a direction to advance the spark.

The function of the offset member 17 is to so control the gap between the contacts 18 and 19 that as the spark is advanced there is initially a wide gap at idling position of the member 17 which decreases to a minimum value at full load position which is at about 22° of advance of the member 17. At or near the end of the 22° advance, the maximum gap opening is reduced to a minimum value, where it remains for a substantial further period of angular advance of the member 17.

In Fig. 4, we have shown diagrammatically how this operation takes place. In the initial or retarded position of the member 17, the contacts 18 and 19 will be opened .035 inch by the cam striking the heel 14. Now, however, as the member 17 is turned to advance the spark, the gap narrows until the heel 14 is directly in line with the line connecting the axes of the cam 13 and the bearing 24. The minimum gap is .005 inch. It will be evident from Fig. 4 that as the heel 14 approaches the line drawn through the axes of the cam and bearing, there will be a substantial distance of its travel wherein there is a very slight variation in the gap as the member 17 is turned. This particular range of travel is represented by the 10° in Fig. 4.

We take advantage of the foregoing arrangement by utilizing the first 22° of advance of the member 17 for controlling advance of the spark from no load position to full load position. Then when the vehicle is operating on the road at relatively high speed under road load conditions, that is, less than full load, the further advance indicated by the 10° in Fig. 4 may be utilized for the higher speed attained under road load without so narrowing the gap between the con-

tacts 18 and 19 as to make the circuit breaker ineffective. Since a great deal of the operation of vehicles such as automobiles and trucks takes place under road load conditions, this feature is of particular advantage in prolonging the life of the distributor mechanism. For example, it will be appreciated that the heel rides with less force on the cam 13 as the spark is advanced, because the breaker arm is actually moved away from the cam, thus reducing the spring tension due to the spring 22. It is already known, in accordance with United States Patent No. 2,085,817, that there is less burning of the contacts in the distributor head because of the change in electrical dwell produced by the variable gap. That advantage is, of course, obtained here.

In order to control the rotation of the member 17 in response to the flow of gas and air mixture to the internal combustion engine, we provide one conduit 35 leading from the chamber 34 into the fuel intake conduit 37. An inverted Pitot tube 38 opens into the conduit 37 from the conduit 35. Thus the velocity of gas flow through the conduit 37 will determine the vacuum in the chamber 34. An orifice 39, which may be removed and replaced with one of a different size, connects the conduit 35 with the chamber 34. The size of this orifice 39 controls the amount of vacuum advance required.

When operating under road load conditions with the throttle valve partly closed, it is obvious that the velocity of gas flow through the conduit 37 will be considerably lower than that at full load operation. In order to obtain the proper spark advance under such conditions, we provide a second conduit 40 which opens into the chamber 34 through an orifice 41 controlled by a ball check valve 42. The conduit 40 opens into the fuel intake pipe 37 at 43. The point 43 is chosen so that when the throttle valve 44 is closed to idling position the inlet 43 will be on the upstream side of the valve. However, when the valve is partly open, as it will be for road load conditions, the opening 43 is on the downstream side and at the point of substantially the greatest velocity of air flow past the valve. In this position, the suction caused by the air flow past the opening 43 will create a higher vacuum in the chamber 34 than normal full load conditions, and thus advance the spark beyond the range of full load operation.

There is a retarding effect on the spark advance under such conditions, however. This effect is established by the fact that when the vacuum in the chamber 34 is increased beyond a certain point, air is taken from the conduit 37 into the chamber 34 through the conduit 35, and this acts to offset the effect of the withdrawal of air through the conduit 40. We find that by properly proportioning the orifices 39 and 41, the relation of full load advance to road load advance can be very nicely controlled.

In Fig. 5 we have shown a slight modification of the construction illustrated in Fig. 1. In this figure, the conduit 40 is done away with, and a channel 45 is taken directly from the junction of conduit 35' which leads to the throat 36, through the wall of the fuel intake pipe 37, directly to the inlet 43'. A ball valve 42' is inserted in the channel 45 to serve the same purpose as the ball valve 42. The operation of this form of the invention is the same as the principal form.

From the foregoing description it is believed that the construction and advantages of the present invention will be readily apparent to

those skilled in this art. Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a circuit breaker for spark distributors for internal combustion engines, the combination of a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, and mechanism connected to said supporting means for adjusting the same angularly about said cam, to advance or retard the spark, said supporting means being operable in its adjustment to decrease the separation of the contacts by said cam during a portion of the angular movement of the supporting means to advance the spark, and said means being operable to maintain the separation of said contacts substantially constant during a further angular movement of the supporting means in a direction to advance the spark, said adjusting mechanism comprising a pressure responsive diaphragm connected with the intake of the carburetor of the engine at two different points therealong with one of the said connections open for flow in either direction and the other open for flow only toward said intake.

2. In a circuit breaker for spark distributors for internal combustion engines, the combination of a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, and mechanism connected to said supporting means for adjusting the same angularly about said cam, to advance or retard the spark, said supporting means being operable in its adjustment to decrease the separation of the contacts by said cam during a portion of the angular movement of the supporting means to advance the spark, said adjusting mechanism comprising a pressure responsive diaphragm connected with the intake of the carburetor of the engine at two different points therealong with one of the said connections open for flow in either direction and the other open for flow only toward said intake.

3. In a circuit breaker for spark distributors for internal combustion engines, said circuit breaker including a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, and mechanism connected to said supporting means for adjusting the same angularly about said cam, to advance or retard the spark, said mechanism comprising a pressure responsive diaphragm connected with the intake of the carburetor of the engine at two different points therealong with one of the said connections open for flow in either direction and the other open for flow only toward the intake.

4. In a circuit breaker for spark distributors for internal combustion engines, said circuit breaker including a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, and mechanism connected to said supporting means for adjusting the same angularly about said cam,

to advance or retard the spark, said mechanism comprising a diaphragm, a conduit for applying suction to the diaphragm from the throat of the carburetor, and a second conduit for applying suction to the diaphragm from the discharge side of the throttle valve in partly open position.

5. In a circuit breaker for spark distributors for internal combustion engines, said circuit breaker including a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, mechanism connected to said supporting means for adjusting the same angularly about said cam, to advance or retard the spark, said mechanism comprising a diaphragm, a conduit for applying suction to the diaphragm from the gas and air intake conduit of the engine, and a second conduit for applying suction to the diaphragm from the discharge side of the throttle valve in partly open position, said last named conduit being connected to the first named conduit through a check valve whereby suction from the discharge side of the throttle valve is relieved by reverse flow from the intake conduit through the first conduit, but reverse flow through the second conduit is prevented.

6. In a circuit breaker for spark distributors for internal combustion engines, said circuit breaker including a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, and mechanism connected to said supporting means for adjusting the same angularly about said cam, to advance or retard the spark, said mechanism comprising a pressure responsive diaphragm connected with the intake of the carburetor of the engine at two different points at which the velocity flow of the gas and air differs so as to cause substantially different suction effects on the diaphragm at the different points, the connection through which the greater suction effect is exerted on the diaphragm with the parts in idling position being provided with a check valve adapted to prevent flow therethrough from the intake.

7. In a circuit breaker for spark distributors for internal combustion engines, said circuit breaker including a cam, a contact carrying breaker arm and a relatively fixed contact, movable supporting means for said breaker arm and said relatively fixed contact, said means being adjustable angularly about said cam, and mechanism connected to said supporting means for adjusting the same angularly about said cam, to advance or retard the spark, said mechanism comprising a pressure responsive diaphragm from which the connection is made to said adjustable supporting means, a conduit for applying suction on said diaphragm from the throat of the carburetor, a second conduit for applying suction on the diaphragm from the discharge side of the throttle valve in partly open position, and a check valve in said second conduit opening toward the carburetor.

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