

[54] **INTEGRATED SPARK ADVANCE AND
CARBURETOR VALVE CONTROL
MECHANISM**

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[58] Field of Search..... **123/99, 98, 108,**
123/117 R; 74/471

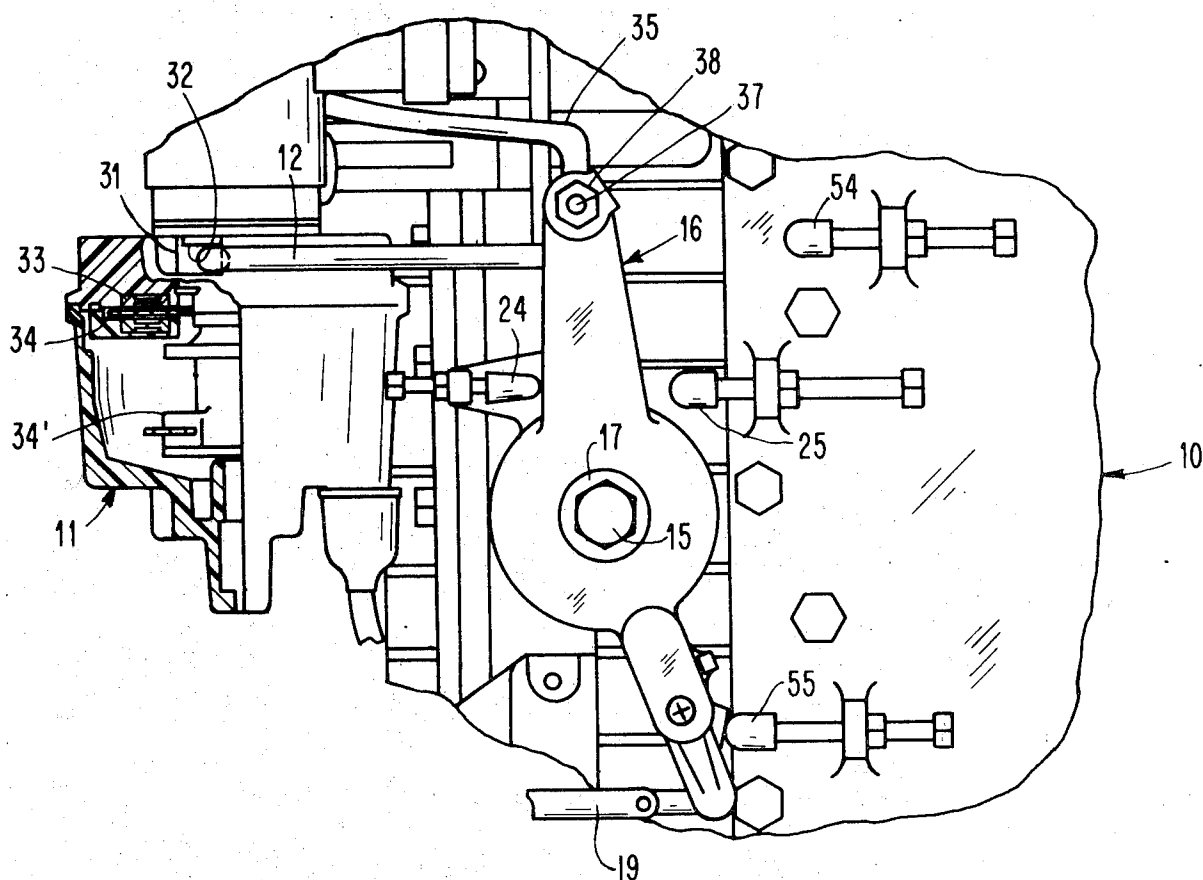
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[57] **ABSTRACT**

A dual control linkage simultaneously advances the spark, through rotation of the distributor housing, and opens the carburetor valve by means of a rotating cam. Spark advance is stopped at some predetermined carburetor valve setting; however, further cam rotation continues to increase the carburetor valve opening.

8 Claims, 6 Drawing Figures



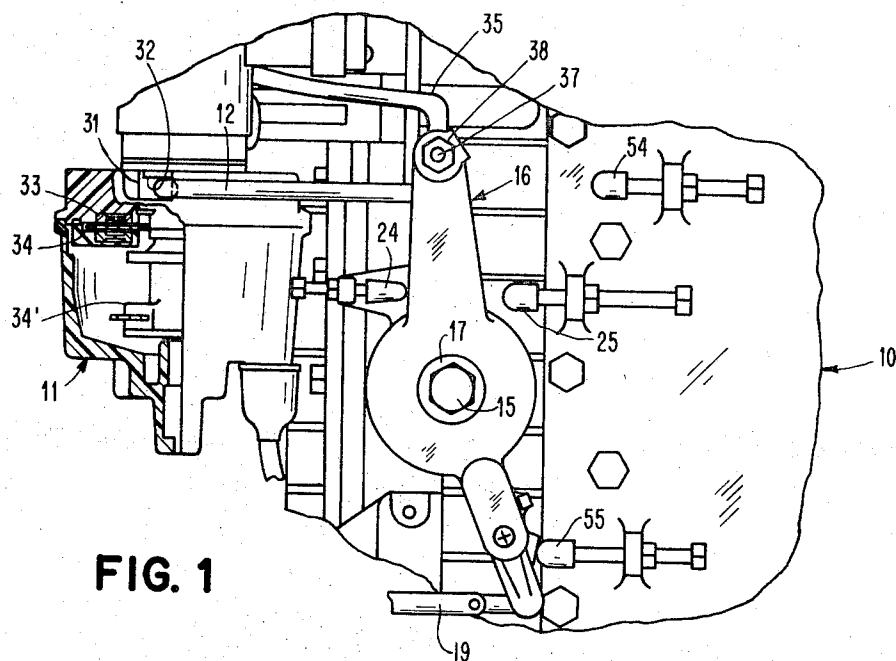


FIG. 1

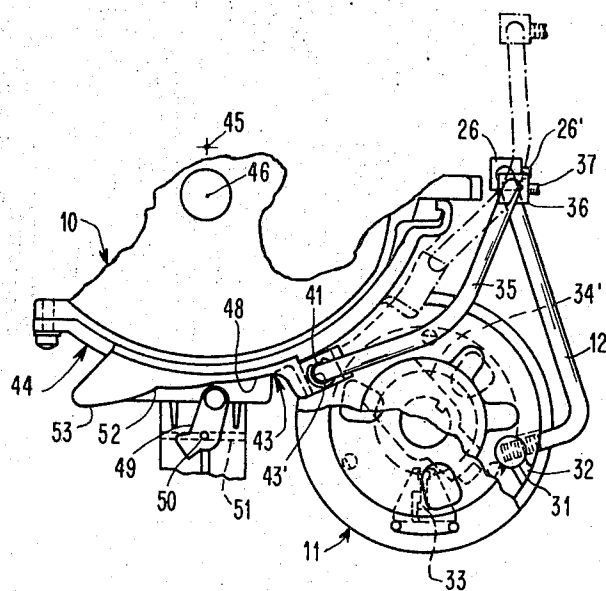
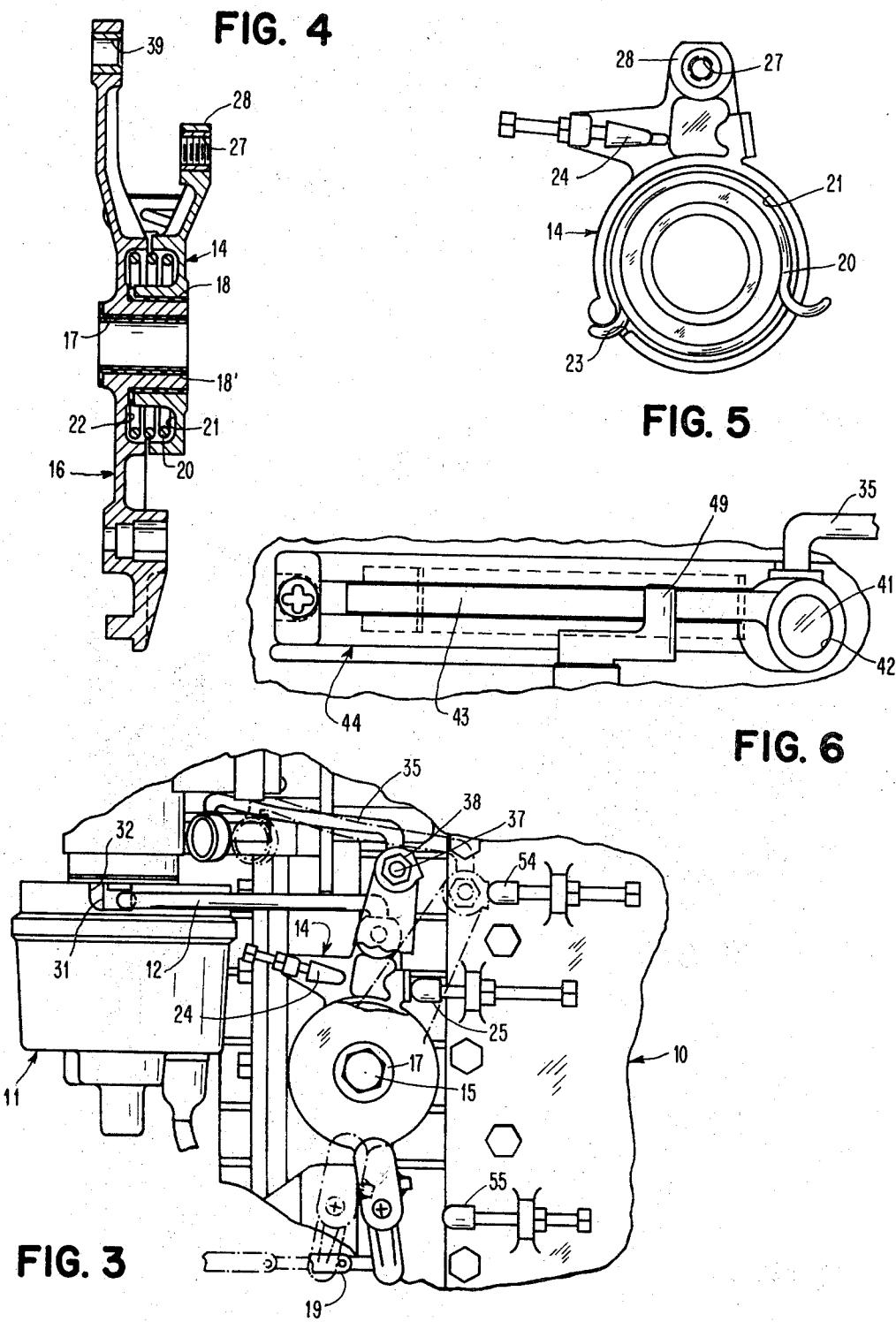


FIG. 2



INTEGRATED SPARK ADVANCE AND CARBURETOR VALVE CONTROL MECHANISM

In two-cycle internal combustion engines, the spark is advanced as the engine speed is advanced from idle to maintain high engine performance. There is a maximum amount of advance for the spark. After the spark has been advanced its maximum, the speed of the engine can still be increased substantially. Accordingly, the means for advancing the spark has been previously connected to a throttle lever so that advance of the spark has occurred simultaneously with advance of the opening of the carburetor valve by the operator actuated throttle lever to increase the engine speed from idle.

In one previously suggested arrangement for controlling the advance of the spark and the opening of the carburetor valve, a throttle lever has been connected through a swivel and link rod assembly to a rotatably mounted economizer collar, which has been spring connected to a distributor housing having the same axis of rotation as the economizer collar. Thus, whenever the throttle lever has been advanced, the distributor housing has been rotated therewith until a stop, which cooperated with the distributor housing, has prevented further rotation of the distributor housing.

The economizer collar had a throttle actuator plate fixed thereto for rotation therewith and carried a throttle cam thereon. Accordingly, when the economizer collar has been rotated due to movement of the operator actuated throttle lever, the throttle cam has been advanced to engage a throttle cluster, which was connected to the carburetor valve to open the valve as the profile of the cam moves along a first finger of the cluster.

At the time that rotation of the distributor housing was stopped, a surface of the throttle actuator plate engaged a surface of a throttle actuator, which was rotatably mounted on the economizer collar, to cause rotation thereof about the axis of rotation of the distributor housing. When the throttle actuator was rotated a slight amount by the throttle actuator plate, it engaged a second finger of the throttle cluster to form a mechanical connection therebetween so that opening of the carburetor valve after the distributor housing ceased to rotate was no longer under control of the throttle cam.

While this arrangement enabled the spark to be advanced to its maximum by the throttle lever while simultaneously advancing the speed of the engine, the mechanical connection between the throttle actuator and the throttle cluster produced a non-smooth increase in speed of the engine. This was because the mechanical connection did not give a smooth movement of the throttle cluster in the same manner as could be obtained from a cam profile. Thus, the engine tended to have a somewhat jerky performance as its speed was being increased until the throttle lever ceased to be advanced.

Additionally, the previously suggested linkage arrangement produced a rather quick rise along the profile of the throttle cam during the advancement of the spark. This was necessitated by the design, but it is preferred that there be a slow rise, which would produce a small increase in the speed of the engine, until the spark is advanced to its maximum.

The present invention satisfactorily overcomes the foregoing problems by providing an improved linkage arrangement in which the entire opening of the carburetor valve is under the control of a cam surface. Thus, smooth control of opening of the carburetor valve from engine idle to maximum speed is obtained with the present invention so that there is no jerky engine performance after the spark has been advanced to its maximum.

Additionally, the present invention enables opening of the carburetor valve to be controlled so that there is only a small amount of movement of the carburetor valve from its idle position until the spark has been advanced to its maximum. Then, the carburetor valve is opened at a faster rate after the spark has been advanced to its maximum so that more efficient performance of the engine is obtained.

An object of this invention is to provide an improved linkage arrangement between a throttle control and a distributor spark advance.

Another object of this invention is to provide a mechanism for controlling the relation of the spark advance and engine speed.

Other objects of this invention will be readily perceived from the following description, claims, and drawings.

This invention relates to an internal combustion engine of the type used in outboard motors including a distributor housing having a trigger or means to produce sparks to cause firing of the engine and throttle means movable to control the speed of the engine. The throttle means includes a throttle arm, a cam, a link connecting the arm to the cam, and a throttle cluster connected to a carburetor valve and in contact with the cam. A link connects the arm to the distributor housing to advance the time when the trigger produces sparks as the throttle arm is moved to increase the speed of the engine. A throttle cluster controls the position of a carburetor valve and cooperates with a profile of a cam, which is connected to the throttle arm by a second link to change the position of the profile of the cam relative to the control cluster in accordance with the position of the throttle arm to change the position of the carburetor valve. Movement of the distributor housing by the throttle arm is stopped by suitable means after the spark producing means has been advanced a predetermined distance by movement of the throttle arm to increase the speed of the engine. The cam means is positioned to have its profile continue to cooperate with the control means to provide a cam control change of the position of the carburetor valve as the throttle arm is moved to increase the speed of the engine after movement of the distributor housing has been stopped by the stop means.

The attached drawings illustrate a preferred embodiment of the invention, in which:

FIG. 1 is a side elevational view of a portion of the linkage arrangement of the present invention;

FIG. 2 is a top plan view of another portion of the linkage arrangement of the present invention;

FIG. 3 is an elevational view, similar to FIG. 1, but showing the linkage arrangement with the spark advanced to its maximum position and showing the throttle at its maximum speed position in phantom;

FIG. 4 is a sectional view of the spark advance arm and the throttle arm;

FIG. 5 is an elevational view of the spark advance arm with the spring supported thereon; and

FIG. 6 is a front elevational view of a portion of the linkage arrangement of FIG. 2.

Referring to the drawings and particularly FIGS. 1 and 2, there is shown a two-cycle internal combustion engine 10 having a distributor housing 11 supported thereby. The distributor housing 11 is rotatable about its central axis to change the spark advance.

The distributor housing 11 is connected by a link 12 to a spark advance arm 14, which is pivotally mounted on the cylinder block of the engine 10 by a screw 15. The screw 15 also pivotally supports a throttle arm 16 for pivotal movement about the same axis as the spark advance arm 14.

A bushing 17 (see FIG. 4) surrounds the screw 15 and supports the throttle arm 16 for pivotal movement. A bushing 18 fits over a cylindrical portion 18' of the throttle arm 16 to support the spark advance arm 14 for pivotal movement.

The lower end of the throttle arm 16 is connected by a Bowden wire 19 to a throttle control lever (not shown) for actuation by the operator. A spring 20 (see FIGS. 4 and 5) resiliently connects the throttle arm 16 to the spark advance arm 14 so that pivotal movement of the throttle arm 16 by movement of the Bowden wire 19 is transmitted to the spark advance arm 14.

The spring 20 fits within an annular recess 21 in the spark advance arm 14 and an annular recess 22 in the throttle arm 16. One end of the spring 20 is bent (see FIG. 5) for disposition within a slot 23 in the spark advance arm 14 for connection of the spring 20 thereto while its other end is bent (see FIG. 5) for disposition within a slot (not shown) in the throttle arm 16 for connection thereto.

The spring 20 continuously urges the spark advance arm 14 clockwise (as viewed in FIG. 1) about the axis of the screw 15 so that a pick-up adjustment screw 24 is urged into engagement with a surface of the throttle arm 16 as shown in FIG. 1. Accordingly, whenever there is clockwise (as viewed in FIG. 1) pivoting of the throttle arm 16 about the axis of the screw 15, there is also clockwise (as viewed in FIG. 1) pivoting of the spark advance arm 14 until pivotal movement of the spark advance arm 14 is prevented by a stop 25, which is carried by the exhaust manifold cover of the engine 10. After the spark advance arm 14 engages the stop 25 as shown in FIG. 3, the spark advance arm 14 can no longer pivot clockwise (as viewed in FIG. 1) with the throttle arm 16, but the throttle arm 16 can continue to pivot clockwise (as viewed in FIG. 1) if the Bowden wire 19 is continued to be moved to the left (as viewed in FIGS. 1 and 3) by the operator.

One end of the link 12 is connected to the spark advance arm 14 through a swivel 26 (see FIG. 2). The end of the link 12 is threaded for disposition in a threaded opening in the head of the swivel 26 so that the link 12 can pivot with respect to the swivel 26 about a first axis; the swivel 26 can pivot with respect to the spark advance arm 14 about a second axis, which is perpendicular to the first axis, since the swivel 26 has a threaded stud 26' for disposition within a threaded opening 27 (see FIGS. 4 and 5) in an ear 28 of the spark advance arm 14. Thus, there are two degrees of freedom of the link 12 with respect to the spark advance arm 14.

The other end of the link 12 is connected to the distributor housing 11 by means of a barrel 31 (see FIGS. 1 to 3). The other end of the link 12 is threaded and disposed within a threaded opening in the barrel 31, which is formed of a suitable material such as acetal resin sold under the trade name Delrin, for example.

The barrel 31 is disposed within an L-shaped slot 32 in the distributor housing 11. Accordingly, the link 12 has its other end pivotal about two axes, which are 90° to each other, so that there are two degrees of freedom of this end of the link 12 with respect to the distributor housing 11.

Thus, pivotal movement of the spark advance arm 14 about the axis of the screw 15 is transmitted by the link 12 to cause rotation of the distributor housing 11 about its central axis, which is perpendicular to the axis of the screw 15, because of the link 12 having two degrees of freedom at each end and the ends of the link 12 being perpendicular to each other. Thus, the link 12 transmits the pivotal motion of the spark advance arm 14 to the distributor housing 11 to advance the spark when the spark advance arm 14 pivots clockwise (as viewed in FIG. 1) about the axis of the screw 15.

When the distributor housing 11 is rotated, a ferrite core 33 (see FIG. 1), which is carried by the distributor housing 11, also is rotated therewith. Thus, this advances the spark since this alters the time when a slot in the rotor disc 34 passes between the parts of the ferrite core 33 to change when firing of each of the cylinders of the engine 10 occurs. The rotor disc 34 is mounted on a rotor 34', which is driven clockwise (as viewed in FIG. 2) by the engine 10. Thus, each time that a slot in the rotor disc 34 passes between the parts of the ferrite core 33, a spark is produced to cause firing of one of the cylinders of the engine 10.

The upper end of the throttle arm 16 has one end of a link 35 connected thereto through a swivel 36 (see FIG. 2). The link 35 has its end threaded for disposition in a threaded opening in the swivel 36, which has its threaded stud 37 secured by a nut 38 to the upper end of the throttle arm 16 after passing through an opening 39 (see FIG. 4) in the throttle arm 16. Thus, there are two pivotal axes, which are perpendicular to each other, for connecting the link 35 to the throttle arm 16 so that there are two degrees of freedom at this end of the link 35.

The link 35 also has its other end threaded and disposed in a threaded opening in a barrel 41 (see FIGS. 2 and 6). The barrel 41 is preferably formed of the same material as the barrel 31.

The barrel 41 is supported within an opening 42 in a throttle actuator cam 43. The axis of the opening 42 in the throttle actuator cam 43 is perpendicular to the axis of the threaded opening in the barrel 41, and the actuator cam 43 receives the threaded end of the link 35 through an opening 43' (see FIG. 2), which has its axis coaxial with the axis of the threaded opening in the barrel 41. Accordingly, the barrel 41 is retained in the cam 43, and the link 35 has two degrees of freedom relative to the cam 43.

The cam 43 is rotatably supported within a housing 44, which is secured to the cylinder block of the engine 10. The cam 43 is rotatably mounted in the housing 44 so that the cam 43 may rotate about an axis 45, which is closer to axis 46 of rotation of the crankshaft of the engine 10 than to the axis of rotation of the distributor housing 11.

Accordingly, when the throttle arm 16 is pivoted clockwise (as viewed in FIG. 1) about the axis of the screw 15, the link 35 causes the cam 43 to rotate counterclockwise (as viewed in FIG. 2) about the axis 45. The cam 43 is shown in its engine idle position in solid

lines in FIG. 2 and in its full throttle position in phantom lines in FIG. 2.

The cam 43 has its profile 48 cooperate with a throttle cluster 49, which is fixed to a rotatably mounted shaft 50. The shaft 50 has carburetor valves (one shown at 51) connected thereto. Accordingly, when the throttle cluster 49 is moved by the cam 43 being rotated counterclockwise (as viewed in FIG. 2), the throttle cluster 49 rotates clockwise (as viewed in FIG. 2) about the axis of the shaft 50. Accordingly, this turns the carburetor valve 51 to increase the fuel-air mixture supplied to the engine 10 whereby the engine speed is increased.

The profile 48 of the cam 43 has a slow rise until a point 52 is reached. The rise of the profile 48 of the cam 43 is such that no rotation of the throttle cluster 49 occurs during initial pivoting of the throttle arm 16 from its idle position. During this time, the spark advance arm 14 causes rotation of the distributor housing 11 so that there is some advance of the spark before there is any opening of the carburetor valves 51. The pick-up adjustment screw 24 is adjusted to insure that the desired amount of spark advance has occurred before the throttle cluster 49 begins to rotate due to engagement of the rise of the profile 48 of the cam 43 with the throttle cluster 49.

When the point 52 on the profile 48 of the cam 43 is engaging the throttle cluster 49, the distributor housing 11 will have been rotated the maximum by the spark advance arm 14 since the spark advance arm 14 will be contacting the stop 25 at this time as shown in FIG. 3. Thus, during the time that the distributor housing 11 is being rotated to advance the spark, the rise of the profile 48 of the cam 43 is first zero and then relatively small so that there is only a small amount of opening of the carburetor valves 51 by the time that the maximum advance of the spark has occurred.

Between the point 52 and a point 53, the profile 48 of the cam 43 has a rather fast rise. This is a smooth transition for opening the carburetor valves 51 to increase the flow of the fuel-air mixture to the engine 10. This produces a relatively smooth increase in the fuel flow to the engine 10 so that there is no jerky performance because the carburetor valves 51 are under the control of the cam profile 48. After the point 53, the rise of the profile 48 decreases as the speed of the engine 10 approaches its maximum.

The maximum movement of the throttle arm 16 by the Bowden wire 19 being moved to the left (as viewed in FIGS. 1 and 3) is shown in phantom in FIG. 3 wherein the upper end of the throttle arm 16 abuts against a stop 54, which is supported by the exhaust manifold cover of the engine 10. At this point, the carburetor valves 51 have been fully opened by clockwise (as viewed in FIG. 2) rotation of the throttle cluster 49 by the cam 43 about the axis of the shaft 50.

Considering the operation of the present invention, the Bowden wire 19 is moved to the left (as viewed in FIG. 1) to cause the throttle arm 16 to pivot clockwise (as viewed in FIG. 1) about the axis of the screw 15. Because of the spring 20 continuously urging the spark advance arm 14 against the throttle arm 16, the spark advance arm 14 also pivots clockwise (as viewed in FIG. 1) about the axis of the screw 15 with the throttle arm 16.

This results in the spark advance arm 14 pulling the link 12 to the right (as viewed in FIG. 1) to cause coun-

terclockwise (as viewed in FIG. 2) rotation of the distributor housing 11 to advance the spark. At the same time that the distributor housing 11 is rotating counterclockwise, the cam 43 also is rotating counterclockwise (as viewed in FIG. 2) to cause a slight clockwise rotation of the throttle cluster 49 after initial advance of the spark whereby the carburetor valves 51 open to increase the speed of the engine 10 beyond idle speed.

As the operator continues to cause movement of the Bowden wire 19 to the left (as viewed in FIGS. 1 and 3), the throttle arm 16 reaches the solid line position of FIG. 3 at which time the stop 25 engages the spark advance arm 14 to stop further pivoting of the spark advance arm 14 with the throttle arm 16. At this time, the distributor housing 11 is in its maximum spark advance position.

Continued movement of the Bowden wire 19 to the left (as viewed in FIGS. 1 and 3) results in the throttle arm 16 continuing to pivot clockwise (as viewed in FIGS. 1 and 3) about the axis of the screw 15. Since the spark advance arm 14 is held against the stop 25, the spark advance arm 14 cannot move with the throttle arm 16, but the spark advance arm 14 does not retard movement of the throttle arm 16 because of the resilient connection therebetween due to the spring 20. Accordingly, the throttle arm 16 is free to pivot clockwise until the upper end of the throttle arm 16 engages the stop 54 as shown in phantom in FIG. 3.

When it is desired to return the engine to idle from its maximum speed or any other speed, the Bowden wire 19 is moved to the right (as viewed in FIGS. 1 and 3). If the throttle arm 16 is in the phantom line position of FIG. 3, the initial movement of the Bowden wire 19 to the right causes counterclockwise (as viewed in FIGS. 1 and 3) pivoting of the throttle arm 16 about the axis of the screw 15. This also causes clockwise (as viewed in FIG. 2) rotation of the cam 43 whereby the throttle cluster 49 is rotated counterclockwise (as viewed in FIG. 2) about the axis of the shaft 50 to move the carburetor valves 51 toward their closed position due to a spring (not shown) continuously urging the shaft 50 counterclockwise (as viewed in FIG. 2).

When the throttle arm 16 reaches the solid line position of FIG. 3, the pick-up adjustment screw 24 is engaged by a surface of the throttle arm 16 so that further counterclockwise (as viewed in FIGS. 1 and 3) pivoting of the throttle arm 16 about the axis of the screw 15 also causes similar counterclockwise (as viewed in FIGS. 1 and 3) pivoting of the spark advance arm 14. The movement of the Bowden wire 19 to the right (as viewed in FIGS. 1 and 3) continues to cause counterclockwise (as viewed in FIGS. 1 and 3) pivoting of the throttle arm 16 and the spark advance arm 14 until a lower portion of the throttle arm 16 engages against a stop 55, which is supported by the exhaust manifold cover of the engine 10, as shown in FIG. 1. When this occurs, the engine 10 is at its idle speed and there is no advance of the spark.

An advantage of this invention is that there is a smoother control of the carburetor valve in advancing the engine from idle to maximum speed. Another advantage of this invention is that the spark is advanced fully before there is any significant increase in engine speed so that increased performance of the engine is obtained.

For purposes of exemplification, a particular embodiment of the invention has been shown and described

according to the best present understanding thereof. However, it will be apparent that changes and modifications in the arrangement and construction of the parts thereof may be resorted to without departing from the spirit and scope of the invention.

What is claimed is:

1. In an internal combustion engine including a distributor housing having means to produce sparks to cause firing of the engine, a throttle movable to control the speed of the engine, first link means connecting said throttle to said distributor housing to advance the time when said spark producing means produces sparks as said throttle is moved to increase the speed of the engine, means to control the position of a carburetor valve, a cam having a profile cooperating with said control means, second link means connecting said cam to said throttle to change the position of the profile of said cam relative to said control means in accordance with the position of said throttle to change the position of the carburetor valve, means to stop movement of said distributor housing by said throttle after said spark producing means has been advanced a predetermined distance by movement of said throttle to increase the speed of the engine, and said cam being positioned to have its profile continue to cooperate with said control means to provide a cam controlled change of the position of the carburetor valve as said throttle is moved to increase the speed of the engine after movement of said distributor housing has been stopped by said stop means.

2. The engine according to claim 1 in which said throttle includes a first arm pivotally mounted on the engine and pivotal in response to operator movable means, a second arm pivotally mounted on the engine and having the same pivot axis as said first arm, means to transmit pivotal movement of said first arm to said

second arm, and said first connecting means connecting said second arm to said distributor housing.

3. The engine according to claim 2 in which said transmitting means comprises means to resiliently connect said first arm and said second arm to each other, said stop means including means to limit the amount of pivoting of said second arm with said first arm by stopping pivoting of said second arm with said first arm, and said resilient means allowing said first arm to continue to be pivoted after said second arm has been stopped by said stop means.

4. The engine according to claim 3 including means mounted on the engine to rotatably support said cam for rotation about an axis parallel to the axis of rotation of the engine crankshaft and further from the axis of the distributor housing than the axis of rotation of the engine crankshaft.

5. The engine according to claim 4 in which said second connecting means includes means to connect said first arm to said cam.

6. The engine according to claim 3 in which said cam is supported on said engine between said distributor housing and the axis of rotation of the engine crankshaft for rotation about an axis parallel to the axis of rotation of the engine crankshaft.

7. The engine according to claim 1 in which said cam is disposed for rotation about an axis parallel to the axis of rotation of the engine crankshaft.

8. The engine according to claim 1 including means mounted on the engine to rotatably support said cam means for rotation about an axis parallel to the axis of rotation of the engine crankshaft and further from the axis of the distributor housing than the axis of rotation of the engine crankshaft.

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