

[54] TRANSMISSION CONTROLLED POWER
ENRICHMENT OVERRIDE APPARATUS

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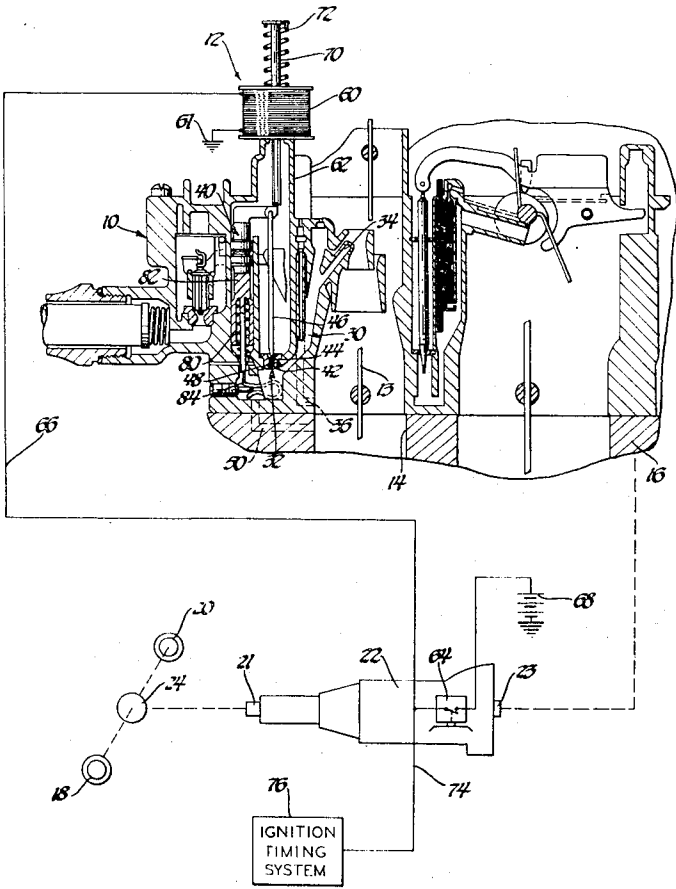
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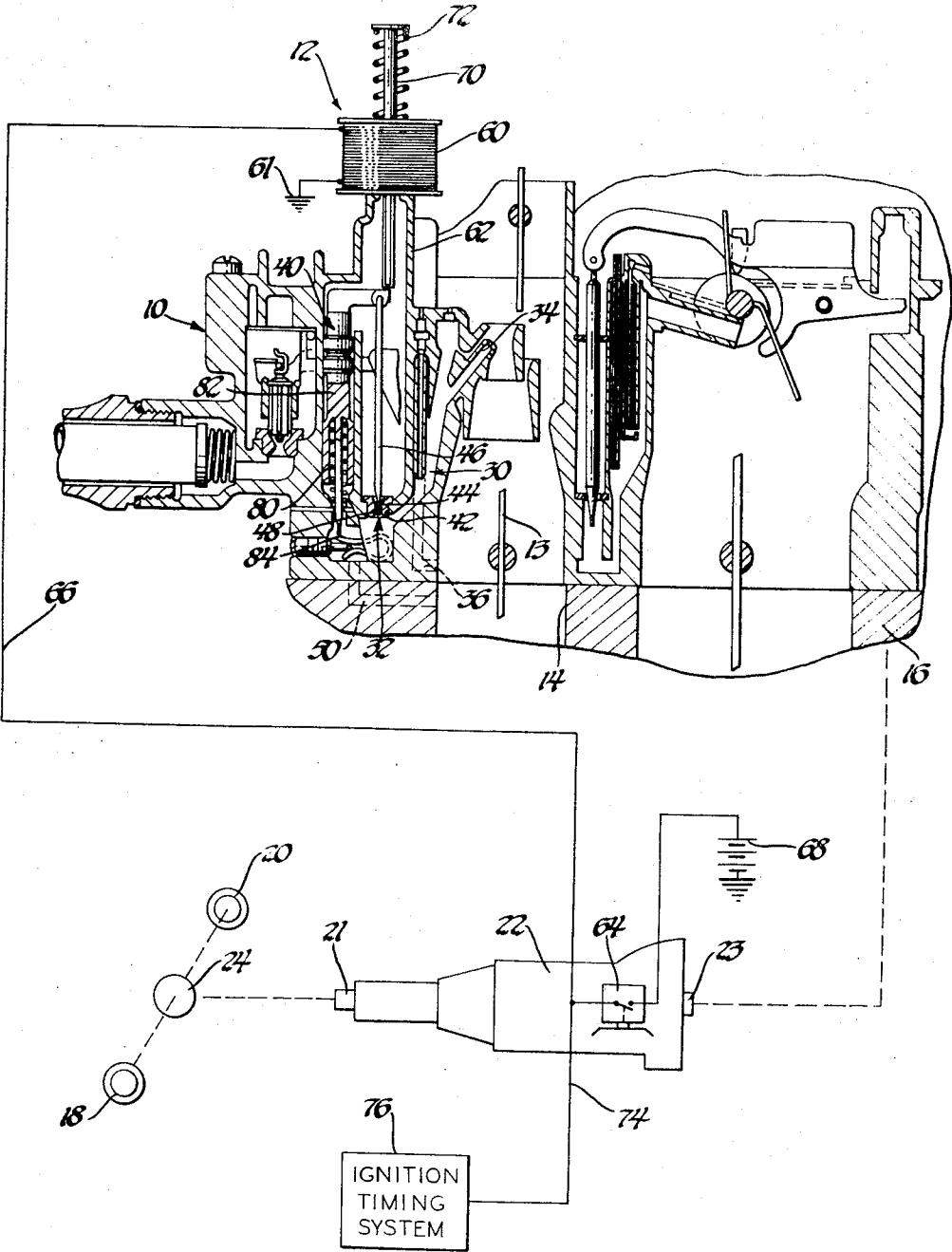
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[57] **ABSTRACT**

A switch is closed by an automatic transmission when in a high drive ratio to operate a solenoid that positions a fuel metering rod in the fuel delivery passage of a carburetor to effect a minimum flow area through a metering orifice. This overrides the normal operation of the carburetor power enrichment system that otherwise increases the flow area as the engine vacuum falls.

7 Claims, 1 Drawing Figure





TRANSMISSION CONTROLLED POWER ENRICHMENT OVERRIDE APPARATUS

This invention relates to internal combustion engine carburetors and particularly to carburetors having power enrichment systems.

One common method of improving fuel economy in a vehicle powered by an internal combustion engine has been to lower the axle ratio, thereby in effect lowering the ratio of engine speed to road speed, such ratio being commonly referred to as the N/V ratio. Other methods of further lowering the N/V ratio to effect fuel economy have involved transmission overdrive arrangements to reduce the number of engine revolutions per wheel revolution. While lowering the N/V ratio usually improves fuel economy, it has been found that significant improvements in fuel economy are not readily obtainable in vehicles as the N/V ratios drop below 30.

The present invention recognizes that one reason for this loss of extra economy is that, in comparable driving conditions, the engine vacuum is normally raised as the N/V ratio is lowered and that the power enrichment system in the usual commercial carburetor, since it normally increases fuel flow with falling engine vacuums, is therefore used for a larger proportion of the time in normal driving maneuvers. Such greater use of the power enrichment system in such normal cruise driving thus prevents the attainment of potential fuel economy that might otherwise be realized by lowering the N/V ratio. The present invention further recognizes that adequate vehicle performance is usually obtained in normal expressway or open highway driving without requiring the use of the power enrichment system.

According to the present invention, a carburetor having a conventional power enrichment system is augmented by a solenoid for overriding the normal operation of the power enrichment system when the automatic transmission is in a high drive ratio. The carburetor has a fuel delivery passage which includes a fuel metering orifice and a tapered metering rod that is displaceable therein to increase the flow area through the orifice as the engine vacuum falls. When the solenoid is energized, its plunger positions the metering rod to establish a minimum flow area through the orifice permitting sufficient fuel to be drawn therethrough in accordance with engine vacuum to sustain non-fuel enriched operation. The solenoid is energized through a switch that is closed when the automatic transmission is shifted to a high drive ratio, the switch being the same as already available for controlling the application of engine vacuum to a vacuum advance unit on the engine timing system distributor to permit vacuum advanced ignition timing in high transmission drives.

It is an object of the present invention to provide a vehicle speed controlled apparatus for overriding the normal operation of the power enrichment system of a carburetor.

It is another object of the present invention to provide, in an internal combustion engine having a power enrichment system, power enrichment override apparatus for preventing normal operation of the power enrichment system and including a solenoid operated by the automatic transmission of the vehicle when in a high speed drive.

It is another object of the present invention to provide power enrichment override apparatus of the fore-

going type in which the solenoid is operated by a transmission controlled switch.

It is another object of the present invention to provide power enrichment override apparatus of the foregoing type wherein the transmission controlled switch also controls vacuum advanced ignition timing.

It is another object of the present invention to provide, in a vehicle in which an internal combustion engine drives a transmission having a high speed drive and in which a carburetor provides fuel to the engine through a fuel passage including an orifice and a metering rod displaceable therein to normally increase flow area to the engine as the engine vacuum falls, apparatus to prevent such normal operation of the power enrichment system when the transmission is in the high speed drive, the apparatus including a switch operated when the transmission is in high drive to energize a solenoid for positioning the metering rod to effect a minimum flow area through the orifice, such minimum flow area permitting a sufficient fuel flow for sustaining engine operation in the high speed drive.

These and other objects and features of the present invention will become more apparent with reference to the following description taken in conjunction with the single drawing wherein there is shown a cross-section of a carburetor having apparatus for normally providing power enrichment and incorporating apparatus in accordance with the present invention for overriding the normal operation of the power enrichment apparatus.

With reference now to the drawing, there is shown partly in outline a commercial carburetor 10 incorporating a power enrichment override apparatus 12 provided in accordance with the present invention and described in further detail below.

Carburetor 10 provides an air fuel mixture under the control of a throttle valve 13 to an induction passage 14 of an internal combustion engine 16 connected to drive vehicle wheels 18 and 20 through an automatic transmission 22 and an axle 24. To provide fuel to meet the demands of engine 16, carburetor 10 has a fuel delivery passage denoted generally at 30 that includes fuel metering means 32, a primary fuel delivery channel 34, and an idling channel 36.

Fuel metering means 32 is controlled by a power enrichment system 40 and includes a valve seat 42 having a central orifice 44 therethrough and a metering rod 46 having a tapered end 48 extending through orifice 44. Power system 40 is normally operative to position tapered end 48 in orifice 44 in accordance with engine vacuum communicated from induction passage 14 through a vacuum channel 50 shown dotted. When the engine vacuum is below a predetermined magnitude, rod 46 positions end 48 to effect a minimum flow area through orifice 44, sufficient fuel flowing through such minimum flow area to meet normal engine demands under substantially constant loads. As the engine vacuum decreases above the predetermined vacuum, that is, as the absolute pressure in induction passage 14 increases, power enrichment system 40 causes tapered end 48 to be raised and retracted out of orifice 44 to effect a flow area therethrough intermediate the minimum flow area and some maximum flow area when rod 46 is fully retracted to its upper limit. Power enrichment is then provided by the increased flow of fuel drawn through the increased flow area. The above described power system 40 may be of the conventional

type and operation described on page 64-47 of the "1971 Buick Chassis Service Manual:" published by the General Motors Corporation.

It has been found that as the engine 16, transmission 22, and axle 24 are sized to require fewer engine revolutions per mile per hour of vehicle speed, thereby lowering what is called the N/V ratio, the engine vacuum in induction passage 14 is normally raised in comparable driving conditions. It has also been found that adequate vehicle performance is obtained under normal expressway or open highway driving conditions, where the N/V ratio of a given vehicle is usually the lowest, without requiring power enrichment. Unless its normal operation is prevented under these cruise conditions, power enrichment system 40 would provide increased fuel flow merely because of the vacuum lowering effect of the lowered N/V ratio and not because the operator of the vehicle desired the increased performance associated with power enrichment. Therefore, to obtain the fuel economy associated with preventing power enrichment system 40 from operating when it would otherwise operate even though not desired by the operator, the normal operation of power enrichment system 40 is prevented by power enrichment override apparatus 12 when the vehicle is operating in its high speed range. Since this range is usually effected when the drive ratio between the revolutions of output shaft 21 of transmission 22 to the revolutions of input shaft 23 thereof is the highest, power enrichment override apparatus 12 is caused to override the normal operation of power enrichment system 40 when transmission 22 is shifted into its high drive ratio from a lower drive ratio. For this purpose, override apparatus 12 includes a solenoid 60 mounted on a boss 62 upstanding from carburetor 10 directly above valve seat 42 and metering rod 46, a transmission control switch 64 mounted on and operated by transmission 22, and a conductor 66 for energizing solenoid 60 with power from a vehicle battery 68. Solenoid 60 is grounded at 61 and is normally de-energized, and transmission control switch 64 is normally open when transmission 22 is not in a high drive ratio. Solenoid 60 has an armature plunger 70 that, when solenoid 60 is de-energized, is normally retracted by a spring 72 out of engagement with power enrichment system 40 to allow normal operation thereof. When in a high drive ratio, transmission 22 closes transmission control switch 64 thereby energizing solenoid 60. Plunger 70 is thereby extended downward to position power enrichment system 40 so that tapered end 48 of metering rod 46 effects the minimum flow area through orifice 44.

Also connected by a conductor 74 to transmission control switch 64 is an ignition timing system 76 which may be of the type described in U.S. Pat. No. 3,584,521, entitled "Ignition Timing Arrangement," issued to Richard Tooker and James Dawson on June 15, 1971, assigned to the assignee of the present invention and hereby incorporated herein by reference. As further described in the Tooker patent, timing system 76 has a valve operated by a switch such as switch 64 for controlling the communication of engine vacuum to a vacuum advance unit on the vehicle ignition timing distributor to permit vacuum advance timing during vehicle operation when the transmission is in a high drive. Such advance timing has been found advantageous in reducing automotive exhaust emissions, unburned hydrocarbons and oxides of nitrogen. As also shown in

the Tooker patent, transmission control switch 64 may be controlled according to vehicle speed through a governor on the output shaft of the transmission or may be controlled by a drive ratio shift valve in the transmission.

In normal operation of power enrichment system 40, metering rod 46 is either held down to effect a minimum flow area through orifice 44 or is raised in accordance with falling engine vacuums to increase the flow area to some area intermediate the minimum flow area and a maximum flow area. Metering rod 46 is held down to effect minimum flow area when the magnitude of the vacuum in induction passage 14 is sufficient to overcome the upward bias of a piston spring 80 on piston 82 comprising enrichment system 40 so that piston 82 is held against a clip 84. When in this minimum flow area position, metering means 32 still permits fuel to flow at a rate determined by the pressure drop between the substantially atmospheric pressure on the upstream side of orifice 44 and the downstream pressure in either primary passage 34 when throttle valve 13 is open or in idle passage 36 when throttle valve 13 is closed. With throttle valve 13 open, the rate of fuel flow through metering means 32 when in the minimum flow area position is normally sufficient to sustain nonenriched vehicle operation under constant loads, and, with throttle valve 13 closed, the rate of fuel flow through metering means 32 is normally sufficient to sustain idle operation of the engine 16.

Should the vacuum in induction passage 14 fall as the absolute pressure therein increases, the pressure differential on the opposite sides of piston 82 decreases to a point where the effect of vacuum on piston 82 is overcome by the upward bias of spring 80. As the vacuum falls below that required to hold piston 82 in the position to effect minimum flow area, spring 80 moves piston 82 upwards to retract tapered portion 48 of metering rod 46 to increase the flow area through orifice 44 above the minimum flow area. The resulting increase in the fuel flow causes engine 16 to increase its power output.

To prevent the above-described normal mode of power enrichment system operation while also permitting vacuum advanced timing in ignition timing system 76, the normally-open transmission control switch 64 is closed by transmission 22 when in a high drive ratio. Solenoid 60 is thereby energized so that plunger 70 thereof holds metering rod 46 down in a position effecting a minimum flow area through orifice 44. While the normal operation of power enrichment system 40 is thereby prevented, the minimum flow area through orifice 44 permits fuel to flow therethrough at a rate determined by the pressure in primary passage 34 or idle passage 36. Therefore, even though solenoid 60 is energized to maintain a minimum flow area through orifice 44, the fuel supplied to primary passage 34 through metering means 32 in this minimum flow area condition is sufficient to permit normal non-enriched vehicle operation as might be required for normal expressway or open highway driving.

Having described one embodiment of the present invention, it is understood that the specific terms and examples are employed in a descriptive sense only and not for the purposes of limitation. Other embodiments of the present invention, modifications thereof and alternatives thereto may be used. I therefore aim in the appended claims to cover such modifications and

changes as fall within the true spirit and scope of my invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with an internal combustion engine and a carburetor providing an air fuel mixture thereto:
 - a. fuel metering valve means having a member movable in response to engine vacuum to normally provide a variable metered fuel rate to said engine in response to varying fuel enrichment demands,
 - b. fuel metering valve stop means having a first position out of the path of travel of said member permitting unrestrained movement of the same and a second position in the path of travel of said member so as to limit the fuel enrichment of said first means irrespective of the vacuum signal; and
 - c. means responsive to vehicle speed operative to position said stop means in said first position under low speed conditions and in said second position under higher speed conditions.
2. In combination with an internal combustion engine and a carburetor for providing an air fuel mixture thereto:
 - a. fuel metering valve means operable to normally provide a variable metered fuel rate to said engine in response to varying fuel enrichment demands, said fuel metering valve means being positionable to provide a flow area condition intermediate a minimum flow area condition and a maximum flow area condition; and
 - b. fuel metering valve override means responsive to a signal indicating vehicle speed and including energizable solenoid means and transmission controlled switch means for energizing said solenoid, said transmission controlled switch means having a first condition to cause said solenoid to normally allow said metering valve means to be positioned in said intermediate flow area condition and a second condition to cause said solenoid means to position said metering valve means in said minimum flow area condition.
3. In combination with an internal combustion engine for providing a source of vacuum and a carburetor for providing an air fuel mixture to said engine:
 - a. a vacuum unit for advancing the timing of ignition in said engine when said vacuum is communicated to said vacuum unit;
 - b. fuel metering valve means operable to normally provide a variable metered fuel rate to said engine in accordance with varying fuel enrichment demands, said fuel metering valve means being positionable to provide a flow area condition intermediate a minimum flow area condition and a maximum flow area condition;
 - c. solenoid means operable to normally allow said metering valve means to be positioned in said intermediate flow area condition and to otherwise override said fuel metering valve means by positioning said fuel metering valve means in said minimum flow area condition; and
 - d. control means responsive to a signal indicating vehicle speed for controlling said solenoid and said vacuum advance unit and having a first condition operable to normally prevent said vacuum from being communicated to said vacuum unit while also causing said solenoid means to normally allow said metering valve means to be positioned in said

intermediate flow area condition and a second condition for permitting said vacuum to be communicated to said vacuum unit while also causing said solenoid to position said metering valve means in said minimum flow area condition.

4. In combination with an internal combustion engine for providing a source of vacuum signals and a carburetor for providing an air fuel mixture to said engine:
 - a. a transmission with an input connected to said engine and an output connected to a load, said transmission having variable drive ratio means for varying the ratio of the speed of the output to the speed of the input from a high drive ratio to lower drive ratios;
 - b. fuel metering valve means operable to normally provide a variable metered fuel rate of said engine in accordance with varying fuel enrichment demands, said fuel metering valve means being positionable to provide a flow area condition intermediate a minimum flow area condition and a maximum flow area condition;
 - c. solenoid means operable to normally allow said fuel metering valve means to be positioned in said intermediate flow area condition and to otherwise override said fuel metering valve means by positioning said metering valve means in said minimum flow area condition; and
 - d. transmission controlled switch means having a first condition for causing said solenoid means to normally allow said fuel metering valve means to be positioned in said intermediate flow area condition and a second condition when said transmission is in said high drive ratio to cause said solenoid means to position said fuel metering valve means in said minimum flow area condition.
5. In combination with an internal combustion engine providing a source of vacuum, said engine connected with the input of an associated transmission the output of which is connected to a load, said transmission having a variable ratio drive means for varying the ratio of the speed of the output to the speed of the input from a high drive ratio to lower drive ratios:
 - a. fuel delivery means for providing fuel to said engine and including a fuel delivery passage, a fuel flow orifice in said passage and a fuel metering rod translatable in said orifice to effect a flow area intermediate a minimum flow area and a maximum flow area, said minimum flow area allowing sufficient fuel to be provided to said engine for normally operating said transmission in said high drive ratio;
 - b. fluid motor means connected with said metering rod and communicating with said source of vacuum for positioning said fuel metering rod to effect said minimum flow area when said vacuum is above a predetermined vacuum and for positioning said metering rod to effect said intermediate flow area as said vacuum drops below said predetermined vacuum while said transmission drive ratios are less than said high drive ratio;
 - c. transmission controlled switch means responsive to said variable drive ratio means and having a first condition when said transmission is in said high drive ratio and a second condition when said transmission is in said lower drive ratios; and
 - d. metering rod positioning means responsive to said conditions of said transmission controlled switch

and including a solenoid having an armature that when said switch means is in said first condition is translatable between a first position in which said metering rod effects said minimum flow area and a second position in which said fluid motor is allowed to position said metering rod to effect said intermediate flow area in response to said vacuum.

6. In combination with an internal combustion engine providing a source of vacuum, said engine connected with the input of an associated transmission the output of which is connected to a load, said transmission having a variable ratio drive means for varying the ratio of the speed of the output to the speed of the input from a high drive ratio to lower drive ratios:

- a. a carburetor for providing said air fuel flow to said engine and having a fuel delivery passage, a fuel flow orifice in said passage and a fuel metering rod translatable in said orifice to effect a flow area intermediate a minimum flow area and a maximum flow area, said minimum flow area allowing sufficient fuel to be provided to said engine for normally operating said transmission in said high drive ratio;
- b. fluid motor means in said carburetor connected with said metering rod and communicating with said source of vacuum for positioning said fuel metering rod to effect said minimum flow area when said vacuum is above a predetermined vacuum and for positioning said metering rod to effect said intermediate flow area as the vacuum drops below said predetermined vacuum while said transmission drive ratios are said lower drive ratios;
- c. transmission controlled switch means connected with a source of electrical energy and responsive to said transmission drive ratios, said switch means having a closed condition when said variable drive ratio is said high drive ratio and a normally open condition when said drive ratio is said lower drive ratios; and
- d. metering rod positioning means mounted on said carburetor and responsive to said conditions of said transmission controlled switch, said metering rod positioning means including a solenoid that is normally de-energized when said transmission controlled switch is in said normally-open condition and that is energized when said switch is in said closed condition, said solenoid having an armature that when said switch is in said first condition is translatable between a first position in which said metering rod effects said minimum flow area and a second position in which said fluid motor is allowed to position said metering rod to effect said intermediate flow area.

7. In combination with an internal combustion engine for providing a source of vacuum, said engine connected to the input of an associated transmission the

output of which is connected to a load, said transmission having a variable ratio drive means for driving said output from said input and for varying the ratio of the speed of said output relative to the speed of said input from a high drive ratio to lower drive ratios; a vacuum unit for advancing the timing of ignition in said engine when vacuum signals are applied thereto, a vacuum conduit connected between said vacuum unit and said engine and valve means in said vacuum conduit movable between a closed position wherein transmission of vacuum to said vacuum unit is prevented and an open position wherein transmission of vacuum to said vacuum unit is permitted:

- a. fuel delivery means including a fuel delivery passage, a fuel flow orifice in said passage and a fuel metering rod translatable in said orifice to effect a flow area intermediate a minimum flow area and a maximum flow area, said minimum flow area allowing sufficient fuel to be provided to said engine for normally operating said transmission in said high drive ratio;
- b. fluid motor means connected with said metering rod and communicating with said induction passage for positioning said fuel metering rod to effect said minimum flow area when said vacuum is above a predetermined vacuum and for positioning said metering rod to effect said intermediate flow area as said vacuum drops below said predetermined vacuum while said transmission is in said lower drive ratios;
- c. metering rod positioning means translatable between a first position in which said metering rod effects said minimum flow area and a second position in which said fluid motor is allowed to position said metering rod to effect said intermediate flow area; and
- d. transmission controlled switch means connected with said metering rod positioning means and with said valve means in said vacuum conduit, said switch means having a high drive ratio condition when said transmission is in said high drive ratio for causing said metering rod positioning means to be translated to said first position from said second position while also shifting said valve means to said closed position from said open position and said switch means also having a low drive ratio condition when said transmission is in said lower drive ratios for causing said metering rod positioning means to be normally positioned in said first position and for causing said valve means to be normally positioned in said closed position, whereby with said switch means in said high ratio condition said vacuum advance unit advances the timing of ignition in said engine while said fuel delivery means effect said minimum flow area.

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