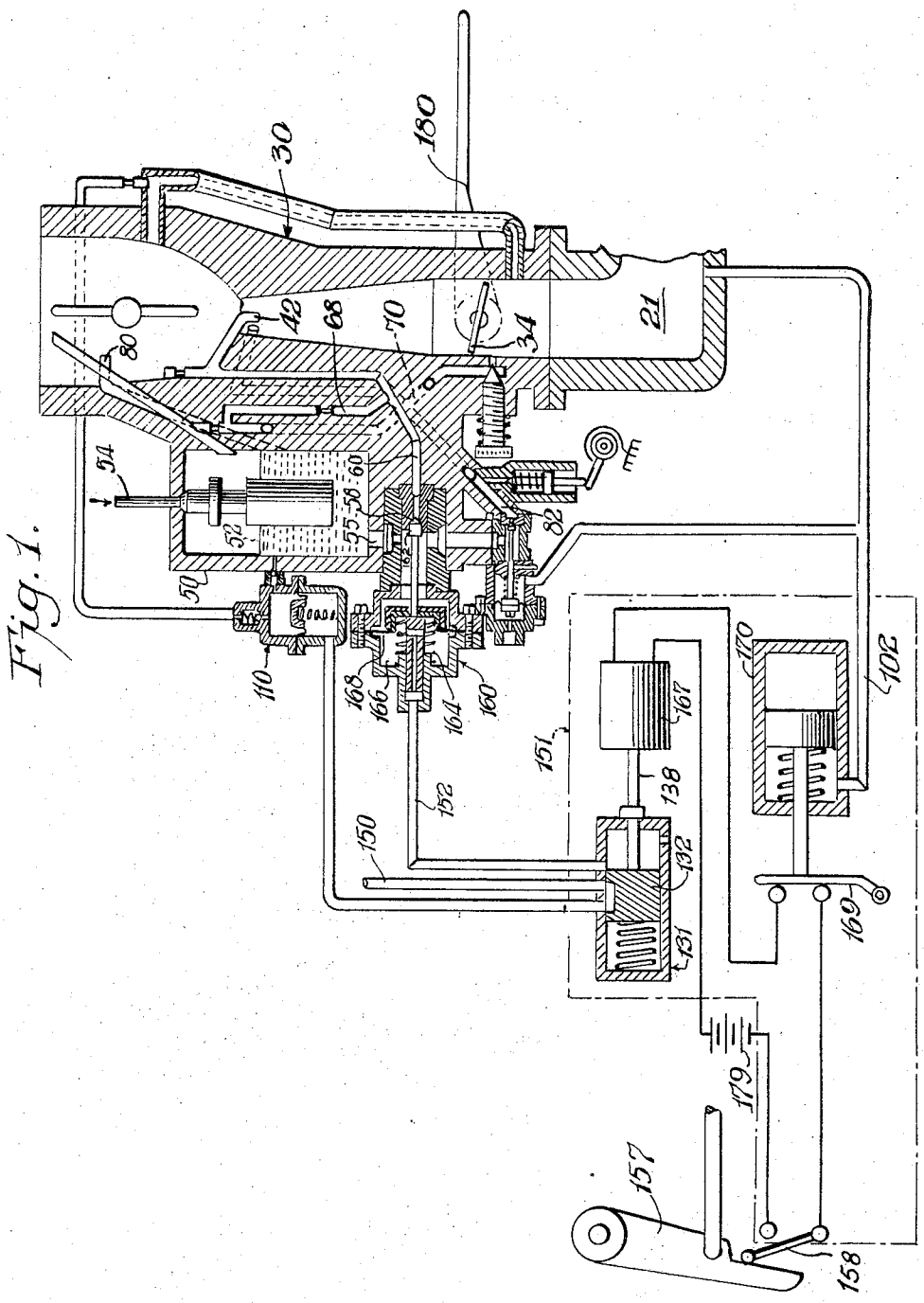
Oct. 31, 1967 R. GISH 3,349,644

VEHICLE ENGINE CONTROL

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Fig. 1.



INVENTOR.
Rollin Gish
BY
Donald L. Johnson
ATTORNEY

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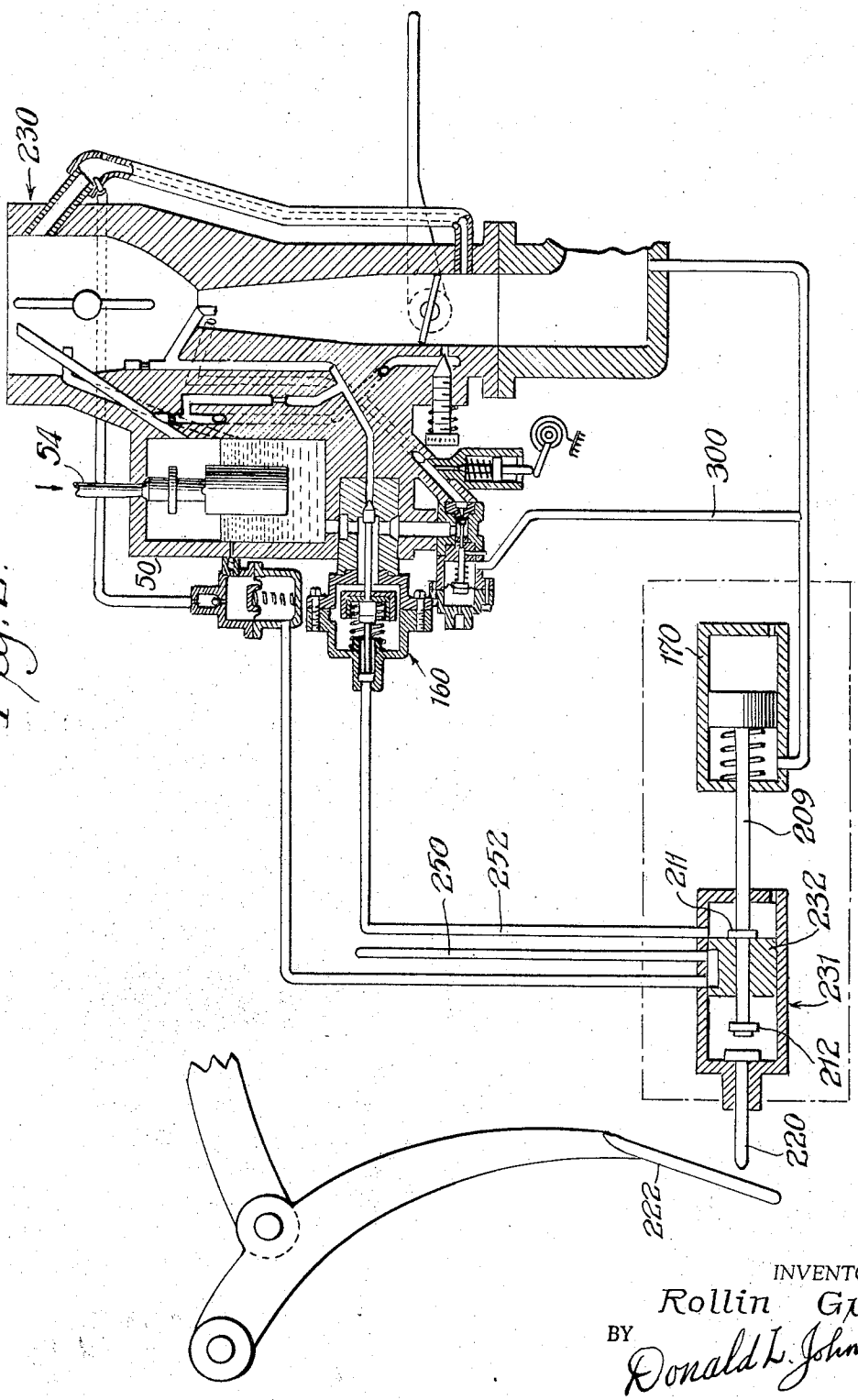


Fig. 2.

INVENTOR.
Rollin Gish
BY
Donald L. Johnson
ATTORNEY.

United States Patent Office

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VEHICLE ENGINE CONTROL

Rollin Gish, Birmingham, Mich., assignor to Ethyl Corporation, New York, N.Y., a corporation of Virginia

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ABSTRACT OF THE DISCLOSURE

Fuel cutoff, for diminishing smog-contributing emission from vehicle's engine exhaust when decelerating, is restricted to taking place only when engine is connected in cruise drive ratio, as by transmission linkage.

The present invention relates to engines of the internal combustion type such as used to propel wheeled vehicles. Engines of this type have been equipped with fuel cut-off devices to cut off the supply of fuel to the engine when it decelerates from certain predetermined speeds. U.S. patent application Ser. No. 301,249 filed Aug. 12, 1963, describes such constructions and explains how they reduce the discharge of undesirable emission from the exhaust. That application has been abandoned but its disclosure has been carried forward to application Ser. No. 445,856 filed Mar. 29, 1965, now U.S. Patent 3,250,264 granted May 10, 1966.

Among the objects of the present invention is the provision of a control system that improves the operation of the foregoing fuel cut-off devices.

The above as well as additional objects of the present invention will be more fully understood from the following description of several of its exemplifications, reference being made to the accompanying drawings wherein:

FIG. 1 is a detail view partly in section showing the essential components of a control system typifying the present invention; and

FIG. 2 is a view similar to FIG. 1 of a modified control system of the present invention.

According to the present invention an internal combustion vehicle engine with a deceleration-responsive fuel cut-off control as described above, has a supplementary control connected to the cut-off control to disable the cutting off when the deceleration is effected with the engine decoupled from driving connection.

The foregoing engines are usually combined with transmissions that have selectable drive ratios, and in such combinations the supplementary control can be connected to disable the cutting off of fuel when deceleration is effected with the transmission not in a cruise ratio.

Turning now to the drawings, FIG. 1 illustrates a carburetor having a fuel cut-off control as in the above-identified prior patent application. The carburetor as a whole is indicated at **30** and receives fuel from line **54** into a float chamber **50** where it is kept at a substantially constant level **52**. The fuel is withdrawn from the float chamber principally through a passageway **55** in its floor, which passageway leads to a main fuel-metering conduit **60** by way of a cut-off valve generally indicated at **160**. The valve has a valve body **162** that engages against a seat **58** under the influence of a spring **164** to close the conduit **60**. The spring **164** is pneumatically controlled from a line **152** that opens into a pneumatic cylinder **166** surrounding the

spring and sealed by a diaphragm **168** carried by the valve body **162**. The application of suction through line **152** acts to pull the valve body away from seat **58**, and compresses spring **164**.

Conduit **60** supplies fuel to the high-speed jet outlet **42** as well as to the idle jet systems **68**, **70** so that a shut-off at valve **160** cuts off fuel delivery to both of these systems. Cut-off of the idle fuel is the important aspect inasmuch as the cut-off is effected during deceleration when the throttle (shown at **34**) is essentially closed and only idle fuel is being delivered by the carburetor to the intake manifold **21** of the engine, for instance. However, the throttle is desirably provided with a checking device, as for example by way of a dash-pot connected to arm **180**, so that abrupt manipulation of the engine's controls to cause deceleration only gradually moves the throttle through the last ten degrees or so of its closure travel. In such arrangements fuel delivery through the high-speed jet may be maintained during a portion of the deceleration, and the cut-off of fuel would not be complete without the cut-off of such high-speed fuel.

As explained in the above-identified earlier application, the carburetor of FIG. 1 also has other fuel supply conduits **80** and **82**, but these only supply supplementary fuel for power demands well above any existing during deceleration, so that they need not be included in the cut-off assembly, although it does no harm to so include them if desired.

The cut-off control of the construction of FIG. 1 includes a control panel **151** that carries a pneumatic cylinder **170**, switches **158**, **169**, a solenoid **167** and a suction-control valve **131**. Cylinder **170** is connected by line **102** to the intake manifold **21** of the engine, and directly operates switch **169** by closing it when the pressure in the manifold is sufficiently low. Switch **158** is operated by a lever **157** in the ratio-selecting linkage of the transmission in the vehicle which the engine propels. Where the transmission is of the manually selectable variety having three forward speeds, only the highest forward speed is generally intended for cruising, and lever **157** can then be the selector for such highest forward speed and can be connected to close switch **158** only when the transmission is in that speed ratio. Where the transmission has more than one cruising ratio, as for example in those that have four forward speeds, switch **158** can be arranged to be closed when the transmission is in any cruising speed.

Switches **158** and **169** are connected in series to close an electric circuit from battery **179** that energizes the winding of solenoid **167** and thereby causes it to move its armature **138** to the left as in the position illustrated in FIG. 1. A slide **132** in suction control valve **131** is thus actuated to open line **152** to the atmosphere, permitting spring **164** to close the cutoff valve **160**. The pneumatic cylinder, switches **158** and **169**, solenoid **167** and suction-control valve are each biased as by springs to move them to their deactivated position so that when either of these switches is opened the solenoid armature is automatically moved to the right (as compared to its position shown in FIG. 1) withdrawing it from the suction-control valve, and the slide **132** in that valve is also moved to the right, connecting line **152** with a suction-supply pipe **150**. Suction is thereby applied to cut-off valve **160** lifting its valve body **162** away from seat **58** and permitting fuel to flow into the main fuel conduit **60**.

The fuel cut-off of the present invention accordingly operates when the control for carburetor throttle **34** is closed and the engine is operating at a speed high enough to cause the pressure in intake manifold to be reduced to the level that is sufficient to trip pneumatic cylinder **170**, providing switch **158** is kept closed by the transmission selector. The cut-off of fuel terminates when the pressure in the intake manifold rises sufficiently to permit the pneumatic cylinder to open switch **169**. The pneumatic cylinder can be adjusted so that it is activated by pressures from about 22 to 23 inches of mercury below atmospheric, and deactivated at pressures about 21 inches of mercury below atmospheric. Such adjustment will cause fuel cut-off when an automobile or the like having the illustrated engine is decelerated from speeds higher than about 30 miles per hour while the transmission is in cruise ratio. The fuel supply will be restored when the automobile speed reaches about 15 miles per hour, or when the throttle is opened. This operation is achieved whether or not a throttle check is used, but it is preferred to have a throttle check and to have it slow down the throttle closure rate to about 5 to 10% per second after it closes to the point that the air flow into the carburetor is about 0.4 pound per hour per cubic inch of displacement.

Further details as to the construction and operation of the apparatus of FIG. 1 are given in the above-identified patent application Ser. No. 301,249 to which reference can be made.

Instead of having the hysteresis or pressure difference between activation and deactivation of the fuel cut-off built into the pneumatic cylinder alone, it can be spread between the cylinder and its switch **169**, or built entirely into that switch.

The construction of FIG. 2 is one that does not require a supply of electricity, and also has activation hysteresis that can be more readily adjusted. This construction has a carburetor **230** very similar to that of FIG. 1 and it is equipped with a fuel cut-off valve **160** identical to that of FIG. 1. This valve is suction-operated with a suction-control valve **231** that is actuated directly by pneumatic cylinder **170** and has substantial hysteresis. Piston rod **209** of cylinder **170** extends loosely through a passageway in slide block **232**, and has two collars **211**, **212** that are further apart than the length of the block. These collars extend out radially far enough to engage and push the block when rod **209** is operated.

A supplementary control for the fuel cut-off is shown in the form of a plunger **220** slidably held alongside the slide block **232** or aligned with piston rod **209**. This plunger is in the path of travel of a clutch pedal **222** or other linkage in the clutch mechanism of the proulsion system that includes the engine having carburetor **230**. Depressing the clutch not only disengages the engine from driving connection in the conventional manner, but it also causes the slide block **232** to move to the right from the position illustrated in FIG. 2 so as to apply suction from suction source **250** to line **252**. This opens the fuel cut-off valve **160**, and prevents it from closing so long as the clutch is disengaged. When the clutch is engaged the plunger **220** does not interfere with the operation of slide block **232** by the pneumatic cylinder, and such operation is essentially like that of the construction of FIG. 1. The extra spacing between collars **211** and **212**, as compared with the length of slide block **232**, provides a convenient actuating hysteresis which can be easily adjusted to a wide range of differences in the pressures that operate pneumatic cylinder **170**.

A feature of the present invention is that it reduces the frequency with which the fuel cut-off valve is operated without reducing its effectiveness, so that its life is lengthened and it requires less maintenance. Moreover, the eliminated cutoff operations are those that tend to be annoying. For example, when starting an automobile having manually shifted transmission, and taking it through

the transmission stages to cruise ratio, fuel cut-off can frequently occur during the deceleration that accompanies each shift in the transmission. The acceleration following such a shift is then accompanied by a restoration of the fuel supply under conditions that cause annoying fluctuations of the engine torque. Such fluctuation does not appear when accelerations are effected without disengaging the clutch.

Racing the engine while it is decoupled from the wheels may also be carried out with the combination of Ser. No. 301,249 in such a way that fuel cut-off takes place when the racing terminates. This is another type of situation where fuel cut-off is not needed and may cause the engine to die. Such misoperation is also avoided by the constructions of the present invention.

The combinations of the present invention can have fuel cut-off valves of any desired types and these valves can be operated in response to the throttle controls rather than the intake manifold pressure. A speed-responsive unit can thus be arranged to cause the fuel to be cut off whenever the throttle controls are set for closing and the engine speed is at or above the minimum value at which such cut-off is helpful.

The clutch and shift selector controls of the present invention can be used together if desired, as by separately connecting them so as to operate separate electrical switches connected in series in a circuit that controls the fuel cut-off.

The cut-off disabling can be effected electrically as in FIG. 1 even when the disabling is responsive to clutch position, or mechanically in response to transmission selection. Magnetic cut-off control can also be accomplished as by using a control member to open and close the magnetic circuit of a cutoff actuating solenoid, or to move the slide block of a slide valve. Alternatively, fluid pressure can be used to effect disabling of the fuel cut-off as by having the disabling control operate a valve connected to by-pass or override valve **131** in FIG. 1. The cut-off valve itself can be of the electric or magnetic type instead of the fluid type illustrated, and can be biased to either the open or closed position.

Other types of carburetors can also be used in accordance with the present invention, and the fuel supply to the engine can even be of the injection type without detracting from the advantages the invention provides. The carburetor of FIG. 2 is a modified construction more fully described in U.S. patent application Ser. No. 314,814, filed Oct. 8, 1963, now U.S. Patent 3,198,187 granted Aug. 3, 1965.

Automatic transmissions, such as used to automatically shift drive ratios in automotive propulsion systems, generally operate to automatically hold or shift into cruise ratio during deceleration. However, such automatic systems frequently have a selectable down-shift control that can be operated during deceleration to override the automatic shifting. According to the present invention such down-shift control is connected to disable the fuel cut-off.

The emission of undesirable materials such as unburned or partially burned fuel and carbon monoxide from engine exhausts during deceleration is sharply reduced when the engine operates an automobile or the like and the deceleration is from speeds of more than 30 miles per hour with the transmisison in cruise ratio as a result of the fuel cut-off. Undesired emissions during such decelerations with the transmission in a speed lower than cruise, or in neutral, are not particularly serious, and they are not significantly affected by fuel cut-off.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed:

1. In an internal combustion vehicle propulsion system

having a selectable ratio transmission and a carburetor fuel cut-off control that cuts off the supply of fuel to the engine in response to engine deceleration from predetermined speeds in order to reduce the exhausting of smog-contributing emission, the improvement according to which the vehicle has a supplementary automatic control connected between the transmission and the cut-off control to disable the cutting off when the deceleration is effected with the transmission not in a cruise ratio.

2. The combination of claim 1 in which the transmission is a manual 3-forward-speed transmission and the supplementary control is connected for preventing fuel cut-

off when the transmission is not in the highest forward speed.

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DONLEY J. STOCKING, *Primary Examiner.*

DAVID J. WILLIAMOWSKY, *Examiner.*

H. S. LAYTON, *Assistant Examiner.*