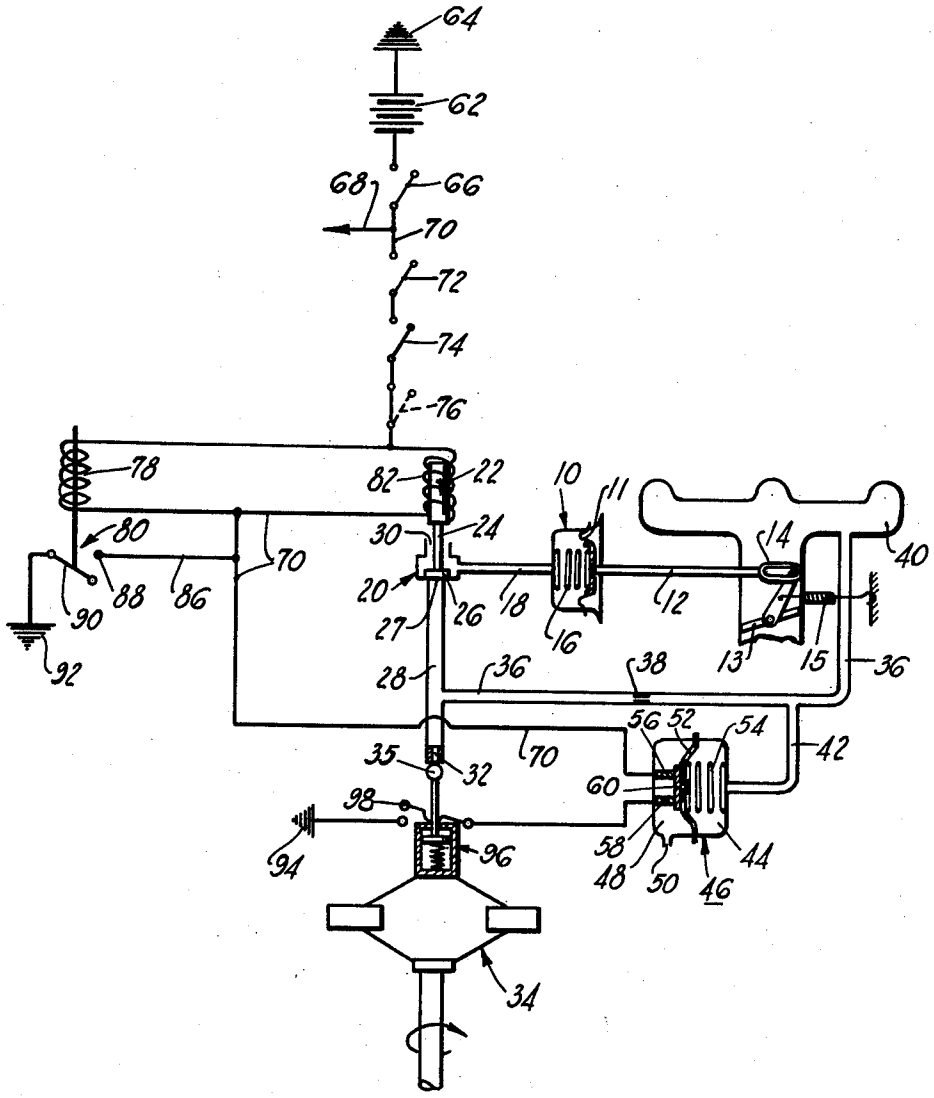
June 15, 1965 J. D. BOHL 3,189,120

AUTOMOTIVE CRUISE CONTROL

Filed June 24, 1963



INVENTOR.

JOHN D. BOHL

BY

William N. Antonis

ATTORNEY

United States Patent Office 3,189,120
Patented June 15, 1965

3,189,120

AUTOMOTIVE CRUISE CONTROL

John D. Bohl, South Bend, Ind., assignor to The Bendix Corporation, South Bend, Ind., a corporation of Delaware

Filed June 24, 1963, Ser. No. 290,048
5 Claims. (Cl. 180—82.1)

This invention relates to a cruise control system for automatically controlling the speed of an automotive vehicle and more particularly to improvements in a cruise control system of the type disclosed in copending application Serial No. 184,073, now abandoned.

An object of this invention is to provide a cruise control system which includes means for insuring that the cruise control system will be rendered inoperable simply by momentarily applying the brakes.

More specifically, this invention relates to the use of an electrical circuit in combination with a pneumatic system wherein the electrical circuit includes a plurality of switches in series, one of which is a brake switch and another of which is a vacuum switch which is normally closed but which will open when manifold vacuum increases to a predetermined value. Thus, momentary application of the brakes will open the brake switch and render the pneumatic system of the cruise control inoperable. With the pneumatic system rendered inoperable the throttle will be closed and manifold vacuum will rise. This increase in vacuum to a predetermined value will cause the vacuum switch to open and will insure that the cruise control system has become nonfunctional.

The above and other objects, features, and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawing which forms a part of this invention.

Referring to the drawing in which the pneumatic and electrical components of the speed control system are schematically and diagrammatically illustrated, it will be seen that the system includes a vacuum power unit **10** having a throttle actuator diaphragm **11** therein which is linked to the engine throttle **13** by rod **12** through a suitable lost motion connection **14**. It will be noted that movement of rod **12** to the left will cause the throttle **13** to open and increase the fuel supply to the engine, such movement being against spring **15** which urges the throttle towards a closed position. A spring **16** urges the actuator diaphragm **11** to a throttle released position. The actuator diaphragm **11** has one side thereof continually open to atmosphere while the other side thereof is connected by a conduit **18** to a three-way solenoid valve, indicated generally by the numeral **20**. The solenoid valve includes an armature **22** connected to a valve stem **24** on which is mounted a valve head **26**. This valve has a vacuum port **27** connected to conduit **28** and an air port **30**. Conduit **28** leads to a variable orifice **32** which is controlled by the wheel-driven all speed governor **34** and the modulating valve **35** attached thereto. A conduit **36** branches from conduit **28** and leads through a fixed orifice **38** to the engine intake manifold **40**.

Solenoid valve **20** is designed so that when it is deenergized the valve head **26** closes the vacuum port **27** (as shown) and opens air port **30** to conduit **18** and the power unit **10**. When the solenoid is energized the valve head **26** opens the vacuum port **27** and closes air port **30**, thereby communicating the power unit **10** with vacuum from the intake manifold. When the solenoid is deenergized, no pressure differential exists across actuator diaphragm **11**, and the spring **16**, therefore, urges rod **12** to the throttle closed position. At such times manual operation of the throttle **13** is not impeded due to the lost motion connection on the link.

It will be noted that the servo control system comprising fixed orifice **38**, conduit **36**, conduit **28** and governor variable orifice **32** will remain functional at all times during vehicle operation and the pressure in conduit **28** will be regulated in accordance with the existing governor setting, said governor setting being adjustable in the manner disclosed in copending application Serial No. 184,073. Thus, whenever the vehicle speed is below the governor setting, the variable orifice **32** will be closed by modulating valve **35** and manifold pressure will exist in conduit **28**. If the speed of the vehicle increases and passes the governor preset speed setting, the modulating valve **35** will move away from the variable orifice **32** and the pressure in conduit **28** will increase (vacuum will decrease) since this conduit will be put in communication with the atmosphere. At some speed slightly above the governor setting, the governor valve will be wide open and the pressure in conduit **28** will approach atmospheric pressure and will be substantially higher than manifold pressure. However, these variations in pressure will not affect the throttle as long as solenoid valve **20** is not energized. When the solenoid valve **20** is energized, it will open vacuum port **27** to the power unit **10** and will close the air port **30**. In this condition, the system will regulate the vehicle speed in a manner to be subsequently described.

The control for the previously described pneumatic system includes a conduit **42**, one end of which communicates with a chamber **44** of a differential pressure switch (vacuum switch) **46** and the other end of which communicates with conduit **36** at a point between fixed orifice **38** and the intake manifold **40**. The other chamber **48** of the vacuum switch is open to atmosphere through port **50**. A diaphragm **52** separates the chambers **44** and **48** and is urged by a spring **54** towards electrical switch contacts **56** and **58** which are positioned in the wall of chamber **48** and are adapted to be interconnected by contact with the diaphragm support plate **60** when the force of the spring **54** is sufficient to overcome any pressure difference existing across the diaphragm.

Referring now to the electrical circuit of the drawing, it will be noted that it includes a battery **62** having one terminal grounded at **64** and having the other terminal connected to an ignition switch **66**. Other circuits lead from the ignition switch and are indicated generally by line **68**. A cruise control circuit line **70** also leads from the ignition switch **66** to an "on"-"off" switch **72** located in the driver's compartment and conveniently made a part of the speed setting control so that it will be in an "on" position when the speed selector is moved to any given selected speed position. Circuit **70** continues in series through a shift interlock switch **74** which is open in the park, neutral, and reverse positions but is closed in the drive positions, and a brake switch **76** which is normally closed but is opened upon application of the brakes. Although the shift interlock switch is defined in terms of automatic transmission gear shift settings, it will be understood by those skilled in the art that certain adaptations in the control circuit would permit the use of the invention in an automobile which does not have an automatic transmission.

From the brake switch, circuit **70** branches and passes in parallel through coil **78** of a normally open holding relay switch **80** and the coil **82** of the solenoid valve **20**. A branch circuit **86** leads from circuit **70** to contact **88** of the relay switch and from pole **90** of the relay switch to ground at **92**. Circuit **70** continues in series beyond coils **78** and **82** to contact **56** of the vacuum pressure switch **46** and thence from contact **58** to switch **98** which is suitably connected to governor **34**. Switch **98** is connected to ground at **94**.

It will be noted that the structure of governor **34** includes a lost motion element **96** between the governor weight structure and the governor valve **32**. This lost motion connection is utilized to mechanically close switch **98**, which is connected into circuit **70**, when a predetermined vehicle speed is reached. It will be obvious that this lost motion connection will permit overtravel in the governor so that control switch **98** will close before governor valve **35** will open.

Operation of the speed control system will be as follows: After a governor speed setting is made and the "on"-"off" switch **72** is closed, the vehicle is set in motion in forward drive so that the ignition and interlock switches **66** and **74** are also closed. When the vehicle has been accelerated under manual control to a given predetermined vehicle speed, the switch **98** will close, as a result of movement by the governor weights, thereby completing circuit **70**. It should be understood, however, that circuit **70** will be completed only if the vacuum switch is closed and that this will normally be the case except when manifold vacuum reaches approximately 18 in. Hg. The throttle position for such a vacuum reading will be a relatively closed one. Complete closure of the throttle will cause the manifold vacuum to rise to approximately 24 in. Hg.

With the circuit **70** completed solenoid valve **20** will become energized and thus permit communication of vacuum from the intake manifold to the power unit **10** via vacuum port **27**. This will create a pressure differential across actuator diaphragm **11** of sufficient magnitude to permit regulation of the throttle and maintenance of a substantially uniform vehicle speed until the circuit is broken. The holding relay switch **80** is energized simultaneously and closes contacts **88** and **90** to provide a permanent ground for circuit **70** regardless of subsequent opening and closing of switch **98**. Thereafter, if at any time the driver operates his brakes or turns off the ignition or moves the shift control out of forward drive, the relay switch **80** will open and the solenoid valve **20** will shift, so as to admit air to the actuator unit **10** and permit closure of the throttle **13**.

If the invention disclosed herein is not utilized in this type of cruise control system, it should be noted that when the vehicle is moving at or above the set controlling speed a monentary application of the brake pedal may not permanently disengage the cruise control system. Unless the brake application slows the vehicle approximately 2–3 m.p.h. below the set controlling speed, switch **98** may still be closed in which event circuit **70** would be completed once again when the brake switch closes after the monentary application of the brakes. Thus, with the circuit completed solenoid coil **82** will be reenergized, and the cruise control system will still be functioning. However, by inserting vacuum switch **46** in series into the circuit, and by utilizing a spring **54** which will maintain the vacuum switch in a closed position until manifold vacuum reaches a predetermined value (e.g. 18 in. Hg.), it is possible to insure that a momentary application of the brakes will be sufficient to cause deenergization of solenoid coil **82** and consequently render the cruise control system nonfunctional until the driver performs the necessary steps to render it functional once again. Thus, with the vehicle traveling under cruise control at the set speed, or above the set speed by manually accelerating to such higher speed, a momentary application of the brake pedal will break circuit **70** and will cause solenoid coil **82** to momentarily become deenergized. Such deenergization will permit throttle **13** to close and as a result manifold vacuum will rise to approximately 24 in. Hg. This rise in vacuum will cause the vacuum switch to also open so that even if the vehicle has not slowed below the set speed and switch **98** is still closed, release of the brake pedal and subsequent closure of the brake switch will not result in reenergization of solenoid coil **82** since the vacuum switch will be open.

It should be understood that the driver may subsequently energize solenoid coil **82** and render the cruise control system operable simple by accelerating the vehicle to the set speed at which time switch **98** will close and vacuum switch **46** will have closed because of the drop in manifold vacuum.

Although this invention has been described in connection with a power unit which utilizes vacuum as a power source, any fluid pressure source may be used which varies as a function of the movement of the throttle control member. Accordingly, when the term "fluid pressure" is referred to in the claims, it is intended that such expression be broad enough to cover any suitable fluid pressure which is available in vehicles of this character and to include vacuum.

Furthermore, even though this invention has been described in connection with a specific embodiment, it will be obvious to those skilled in the art that various changes may be made in the form, structure, and arrangement of parts without departing from the spirit of the invention. Accordingly, I do not desire to be limited to the specific embodiment disclosed herein primarily for purposes of illustration, but instead desire protection falling within the scope of the appended claims.

Having thus described the various features of the invention, what I claim as new and desire to secure by Letters Patent is:

1. In an automotive vehicle having an engine and a driver operated throttle control member for controlling the fuel supply to the engine, fluid pressure means for regulating and controlling movement of said throttle control member to a position for maintaining said vehicle at a predetermined speed, said fluid pressure varying as a function of the movement of the throttle control member, valve means having first and second positions for controlling the application of fluid pressure to said fluid pressure means, solenoid means operatively connected to said valve means for causing movement thereof from said first to said second position upon energization of said solenoid means, and an electrical circuit for energizing said solenoid means, said circuit including a plurality of switches in series, one of which is a normally closed fluid pressure safety switch which is operatively connected to said fluid pressure means and controlled by a predetermined variation of fluid pressure therefrom, said safety switch being opened to insure deenergization of said solenoid means when said fluid pressure reaches a predetermined value as a result of temporary opening of one of said other switches.

2. The combination defined in claim **1** wherein said fluid pressure means comprises vacuum from the intake manifold of the engine and said switch which may be temporarily opened is a brake switch which is normally closed but is opened upon application of the brakes.

3. In an automotive vehicle having an internal combustion engine and a driver operated throttle control member for controlling the fuel supply to the engine, a pressure responsive element operatively connected to said throttle control member for regulating and controlling movement thereof, passage means for communicating vacuum from the intake manifold of said engine to said pressure responsive element, valve means located in said passage means and having first and second positions for controlling the application of vacuum to said pressure responsive element, solenoid means operatively connected to said valve means for causing movement thereof from said first to said second position upon energization of said solenoid means, and an electrical circuit for energizing said solenoid means, said circuit including a plurality of switches in series, one of which is a normally closed vacuum safety switch which is operatively connected to the intake manifold of said engine, said safety switch being opened to insure deenergization of said solenoid means when manifold vacuum increases to a pre-

determined value as a result of temporary opening of one of said other switches.

4. In an automotive vehicle having an internal combustion engine and a driver operated throttle control member for controlling the fuel supply to the engine, a pressure responsive element operatively connected to said throttle control member for regulating and controlling movement thereof, passage means for communicating vacuum from the intake manifold of said engine to said pressure responsive element, valve means located in said passage means and having first and second positions for controlling the application of vacuum to said pressure responsive element, solenoid means operatively connected to said valve means for causing movement thereof from said first to said second position upon energization of said solenoid means, and an electrical circuit for energizing said solenoid means, said circuit including a plurality of switches in series, one of which is a speed selector switch which can be manually moved to a closed position, another of which is a brake switch which is normally closed but is opened upon application of the brakes, a third of which is a speed responsive switch which is open at vehicle speeds below a predetermined valve but is automatically closed at vehicle speeds above a predetermined value, and a fourth of which is a normally closed vacuum safety switch which is operatively connected to the intake manifold of said engine, said safety switch being opened to insure deenergization of said solenoid means when manifold vacuum increases to a predetermined value as a result of opening of said brake switch.

5. In an automotive vehicle having an internal combustion engine and a driver operated throttle control member for controlling the fuel supply to the engine, a vacuum power unit having a pressure responsive element located therein, said pressure responsive element being operatively connected to said throttle control member for regulating and controlling movement thereof, first passage means for communicating vacuum from the intake manifold of said engine to one side of said pressure responsive element, said vacuum varying as a function of the movement of the throttle control member, first valve means located in said first passage means, said valve means having a first position for communicating atmosphere pressure to the vacuum side of said pressure responsive element and a second position for preventing communication therebetween, solenoid means operatively connected to said first valve means for causing movement thereof from one position to the other independently of vehicle speed, second passage means for communicating atmospheric pressure to the vacuum side of said pressure responsive element when said first valve is in said second position, modulating valve means interposed in said second passage means for regulating the degree of communication between the atmosphere and the vacuum side of said pressure responsive element via said second passage means, means responsive to vehicle speed operatively connected to said modulating valve for controlling movement thereof, a second vacuum unit having a pressure responsive member located therein, passage means for communicating one side of said pressure responsive member with vacuum from the intake manifold of said engine and the other side thereof with atmosphere, and an electrical circuit for energizing and deenergizing said solenoid means, said circuit including an ignition switch which is closed upon turning of the ignition key, a shift interlock switch which is open in the park, neutral and reverse positions but is closed in the drive positions, a speed selector switch which is open when the selector is in an "off" position but is closed when the selector is moved to any given selected speed position, a brake switch which is normally closed but is opened upon application of the brakes, a speed responsive switch which is open at vehicle speeds below a predetermined value but is automatically closed at vehicle speeds above a predetermined value, a holding switch for holding said solenoid means energized after said speed responsive switch has opened, and a normally closed safety switch operatively connected to the pressure responsive member of said second vacuum unit, said safety switch being opened when manifold vacuum increases to a predetermined value and causes movement of said pressure responsive member away from its normally closed position.

References Cited by the Examiner

UNITED STATES PATENTS

2,990,825 7/61 Fuller et al. ---------- 180—82.1 X

A. HARRY LEVY, *Primary Examiner.*