

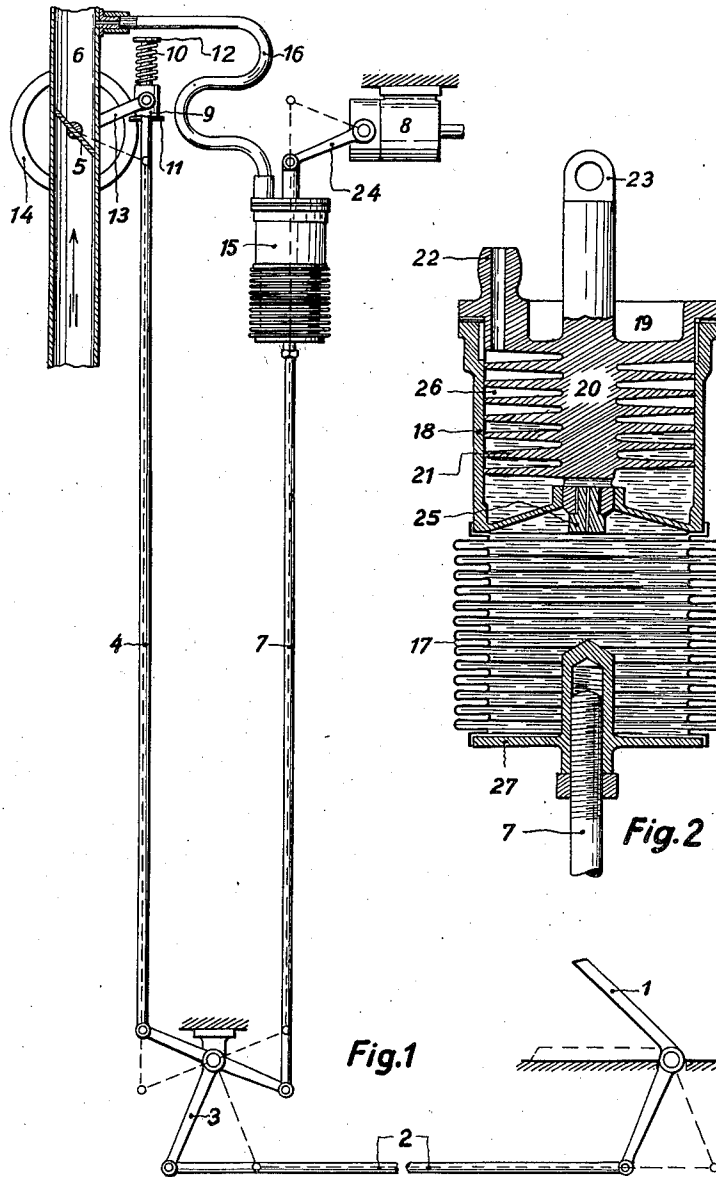
March 23, 1937.

E. L. MÜLLER

2,074,514

CONTROL OF INTERNAL COMBUSTION ENGINES

Filed March 18, 1936.



Inventor:
Eugen Ludwig Müller
By *Emil Bömelcke*
Attorney

UNITED STATES PATENT OFFICE

2,074,514

CONTROL OF INTERNAL COMBUSTION
ENGINES

Eugen Ludwig Müller, Berlin, Germany

Application March 18, 1936, Serial No. 69,581
In Germany April 17, 1935

3 Claims. (Cl. 123—139)

Many methods have been proposed for controlling internal combustion engines in which fuel is supplied in determined amount by a pump driven by the engine and is admitted to the cylinder together with the air required for its combustion prior to or during the compression stroke.

For example the quantity of air and fuel have been controlled simultaneously by coupled control devices, but that method is not suitable for the engines of vehicles for these are required to be highly flexible; engines so controlled would get too poor a mixture when climbing hills at moderate speeds and too rich a mixture at high speeds on the flat.

It has also been proposed to control the fuel mixture by the suction or partial vacuum in the induction pipe. But this method, too, does not give satisfactory results on vehicles since the adjustment of the fuel pump by the suction is effected through devices which take a certain time to act, while the variation of the quantity of air follows instantly upon change in throttle position. Hence the fuel control lags behind the air control and engines so controlled have poor acceleration.

In the method forming the subject of this application also the suction in the induction pipe is used to control the fuel supply, but according to the invention, as distinguished from the proposal above described, the action of the suction extends over only a fraction of the range of control of the fuel pump; on every change of engine output effected by hand the air throttle and the fuel control are adjusted in the same sense through a suitable linkage, and only then does the suction modify the output of the fuel pump should the load conditions so require.

A further feature of the invention is the coupling of the control means, (herein designated the accelerator pedal) with the throttle through a yielding connection so that at the act of regulating for higher load on movement of the control means to increase the engine output,—at any rate when the movement is rapid—the throttle movement lags behind the fuel pump control, causing the mixture to be momentarily enriched during acceleration.

Other features of the invention are the employment of the suction to effect automatically a lengthening or shortening of the pump control rod; and a brake or dash-pot which prevents such changes of length occurring quickly.

By way of example a construction according to the invention is illustrated in the accompanying drawing, to show how the various control de-

vices may be arranged and how they co-operate. The drawing shows such control devices as might for instance be used for a vehicle engine.

Figure 1 shows the general assembly of the control devices with the induction pipe of the engine in section.

Figure 2 shows a longitudinal section through the device which lengthens or shortens the pump control rod.

The control devices are shown adjusted for idling; the broken lines show their position when the throttle is fully open and the pump giving maximum output, a position which they retain on full load on a steep incline, or may take up momentarily during acceleration.

The accelerator pedal 1 is connected by a link 2 with a three-armed lever 3 turning on a fixed pivot; and to this lever are linked the control rod 4 of the throttle 5 in the induction pipe 6, and the control rod 7 for the fuel pump 8. The drawing does not show the fuel pipes; there can be a common pressure pipe leading to the induction pipe 6 or separate pipes leading to the several branches of the induction pipe or direct to the several cylinders.

On the rod 4 slides a sleeve 9 which is pressed towards a pin 11 set in the rod 4 by a spring 10 located between the sleeve and a disc 12 fastened to the end of the rod. To the sleeve 9 is pivoted the arm 13 which turns the throttle 5.

If the pedal 1 is depressed slowly, spring 10 keeps the sleeve 9 in contact with the pin 11, but if quickly the spring is compressed transiently and there results a lag of the movement of the throttle 5, since the parts connected with the throttle tend to retain their position by their inertia. The amount of lag may be determined by mechanical, pneumatic or hydraulic brakes. In the construction illustrated the inertia of throttle is increased by a weighty ring 14 attached to its spindle.

A part of the rod by which the pump output is controlled is constituted by a device 15 which contracts lengthwise under the suction and which is connected to the suction pipe 5 by a flexible pipe 16. This device 15 is shown in section on a larger scale in Figure 2. Its lower part is an elastic vessel 17 closed by an end plate 27 into which the control rod 7 is screwed. At its upper end the vessel 17 is closed by the nearly closed end of a container 18, which is closed at its other end by a cover 19 screwed into it. Below the cover projects a central integral stem 20 on which is formed a helical web 21 closely fitting the container 18. The elastic vessel 17 is filled and the container 18

partly filled with a non-volatile liquid. The flexible pipe 16 is attached to the tubulure 22, and the control arm 24 of the fuel pump is pivotally connected to the eye 23.

5 The same partial vacuum exists in the device 15 as in the induction pipe 6. The greater the suction the more the elastic vessel 17 contracts under atmospheric pressure; on the suction lessening the elastic vessel tends to resume its original
10 length; so it has a definite length corresponding with any particular pressure in the induction pipe. But its changes of length can occur only slowly, since change of length involves change of interior volume and necessitates liquid being expelled or drawn in through the narrow passage
15 in the interchangeable plug 25 which is screwed into the stem 20, its passage opening into a transverse channel through the stem. The long helical channel 26 formed by the web 21 ensures that only
20 liquid and never air has access to the plug 25 notwithstanding vigorous jolting of the vehicle.

To show how the method operates it is useful to consider four typical conditions of load of the vehicle engine, and also those changes from one
25 load to another that are of importance in practice.

(1) Low output on the flat: The throttle is only slightly opened, the cylinders receive but a small charge, the engine turns at moderate speed, and the length of the pump controlling rod is such
30 that the pump supplies a quantity of fuel proportionate to the small charge of air.

(2) Full output on the flat: The accelerator pedal 1 is pressed right down, the lever 3 and throttle arm 13 take the position shown in broken
35 lines, and the throttle is wide open; nevertheless there is a considerable vacuum in the induction pipe because the engine is turning at a high speed. As a result the cylinders do not get a full charge, and the device 15 is so far contracted
40 that the control arm 24 of the pump cannot reach the position shown in broken lines, and so the fuel supply is restricted to correspond with the less than full charge of air.

On rapid change from condition (1) to condition (2), i. e. on maximum acceleration of the vehicle without use of the change speed gear, the whole movement of the pedal 1 is transmitted to the pump control arm, the device 15 being substantially rigid for rapid movements, while the
50 throttle only slowly follows the pedal because of its inertia and the yield of the spring 10. Thus during acceleration, and only then, a much desired excess of fuel is present.

(3) Low output on an upward incline, and
55 change from condition (1) to condition (3): The throttle may be only opened a little as in condition (1), but the cylinders get a larger charge because the speed of the vehicle is checked by the incline; the device 15 extends because the suction
60 is less and pushes up the arm 24 so increasing the fuel supply to correspond with the greater charge of air.

(4) Maximum output on an upward incline, and change from condition (2) to condition (4): The
65 pedal is pressed right down, the throttle opened wide; the vehicle speed being checked by the in-

cline the cylinders get a full charge of air, the suction in the induction pipe is small, the device 15 extends, and the pump control arm is put to maximum delivery position, thus again establishing the proper proportion of air and fuel. On
5 changing from condition (3) to condition (4) the throttle lags, just as in the change from condition (1) to condition (2), and so the mixture is enriched as is desirable for any acceleration.

The essence of the invention is unaffected if
10 two control means are employed for the fuel pump, one operated by hand with the throttle and the other automatically by the partial vacuum in the induction pipe; it is obvious also that
15 instead of building an elastic vessel into the control rod directly as illustrated, other pneumatic auxiliaries may be employed which in any desired fashion bring about a lengthening or shortening of the pump control rod.

The method of control herein described may
20 be combined with known methods in which the length of the pump control rod is altered not automatically but by hand to correct the proportions of the mixture.

I claim:

1. In an internal combustion engine in which
25 air and fuel are admitted prior to or during the compression stroke, the combination of a fuel pump driven by the engine, means governed by the operator for regulating simultaneously the
30 air and the quantity of fuel delivered by said pump, including a pump control rod, and means for varying the length of said rod automatically in dependance on the suction in the induction
35 pipe to modify the setting of the pump control determined by the operator.

2. In an internal combustion engine in which
40 air and fuel are admitted prior to or during the compression stroke, the combination of a fuel pump driven by the engine, means governed by the operator for regulating simultaneously the
45 air and the quantity of fuel delivered by said pump, including a pump control rod, an elastic vessel included in the length of and forming an effective part of said rod, and means connecting the interior of said vessel with the induction
50 pipe of the engine to cause the vessel to contract and elongate under changes of pressure in said pipe.

3. In an internal combustion engine in which
55 air and fuel are admitted prior to or during the compression stroke, the combination of a fuel pump driven by the engine, means governed by the operator for regulating simultaneously the
60 air and the quantity of fuel delivered by said pump, including a pump control rod, an elastic vessel included in the length of and forming an effective part of said rod, means connecting the interior of said vessel with the induction pipe of the engine to cause the vessel to contract and elongate under changes of pressure in said pipe, and means for delaying such changes of length of said vessel.

EUGEN LUDWIG MÜLLER.