Oct. 5, 1943. H. G. CAMNER 2,330,866

TWO CYCLE ENGINE SCAVENGING CONTROL

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Fig. 1.

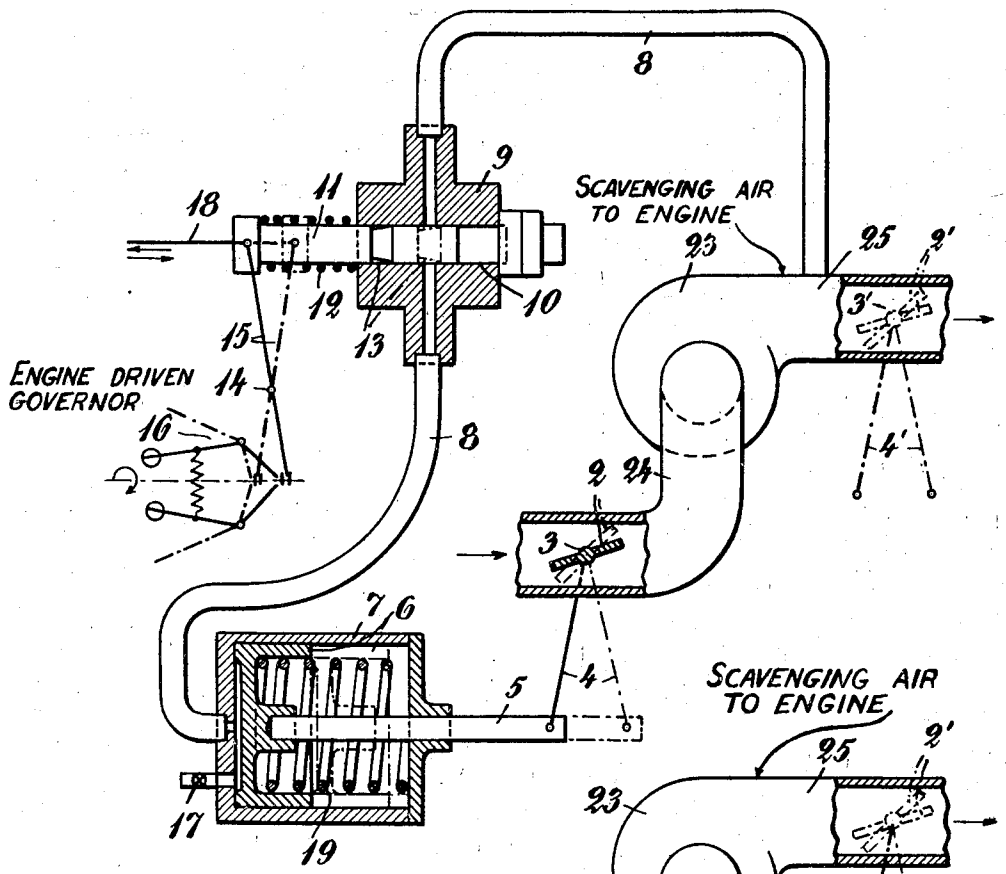
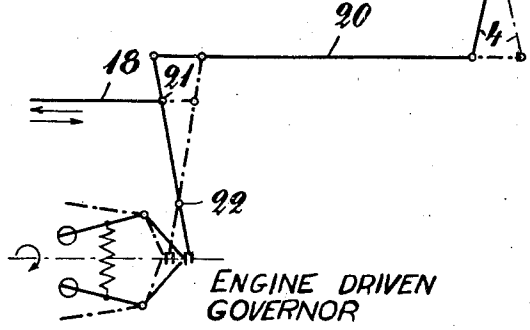


Fig. 2.



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TWO CYCLE ENGINE SCAVENGING CONTROL

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4 Claims. (Cl. 123—65)

In two-stroke-cycle internal combustion motors having a centrifugal compressor or centrifugal fan as a scavenging pump, some operating difficulties are met with continuous operation at idling speed or at full speed with low load. These difficulties, for which the characteristics of the scavenging fan are partly responsible, have been obviated through the present invention, while the fuel consumption of the motor under such operating conditions has also been reduced by the invention.

When a two-stroke motor is running at a constant speed, the pressure in the scavenging air receiver varies in a certain relation with the load, depending on the pressure prevailing in the working cylinder, when the exhaust and scavenging ports are opened. Thus the scavenging pressure is lower at idling speed or low load running than when under full load.

In motors fitted with positive scavenging pumps, these variations in the scavenging pressure do not cause any great inconveniences inasmuch as such scavenging pumps deliver an approximately constant quantity of scavenging air, independently of the back pressure against which they are operating. In scavenging fans, on the other hand, a decrease in the scavenging pressure results in an increase in the quantity of air delivered by the scavenging fan, and this increase of the air quantity becomes considerable if the pressure characteristic of the scavenging fan is very flat, which is desirable for other reasons.

Because of the increased quantity of scavenging air at idling speed and at low load, the motor will be greatly cooled down, partly on account of the smaller quantity of fuel consumed and partly by reason of the increased quantity of scavenging air supplied by the fan. In addition hereto the fuel consumption of the motor increases by reason of the increased power demand of the scavenging fan.

According to the present invention, which relates to such controlling means intended for two-stroke-cycle internal combustion motors having a controllable throttle member arranged either in the conduit between the fan and the motor cylinders, or on the suction side of the fan, or in both of these places at the same time, said difficulties have been obviated, while improved operating properties of the motor have also been obtained. The characteristic feature of the invention substantially resides in the throttle member being adapted to be controlled automatically from the governor of the fuel pump or from some other controlling or regulating member which is indicative of the torque of the motor.

Preferably, the throttle member is arranged in the suction conduit of the scavenging fan, inasmuch as the best efficiency of the scavenging fan will be obtained thereby, while at the same time it is avoided that the scavenging fan will operate under the pumping limit.

However, throttling of the suction conduit brings about a vacuum on the suction side of the scavenging fan, whereby inconveniences with increased axial pressures from the fan wheel and drawing in of lubricating oil may result. In such cases it will then be found advantageous to place throttle members both in the suction conduit and in the pressure conduit.

Preferably, the control may take place from the governor of the fuel pump, either directly through motion transmitting members, or by means of a servo-motor which is actuated by the pressure of the scavenging air, or by some other pressure medium.

By performing this in a manner such that the passage area for the scavenging air is increased or decreased successively, the piston of the servo-motor and thus the throttle member may be kept in different intermediate positions depending on the ratio between the area of the passage opening of the slide valve and the area of an opening in the servo-motor through which the pressure fluid escapes therefrom.

The invention is illustrated by way of a few examples of embodiment in the accompanying drawing, wherein Fig. 1 is a diagrammatic representation of a throttling means on the suction side of the fan, which is controlled automatically by the governor of the motor through a servo-motor, while Fig. 2 shows an embodiment where the control of the throttle member takes place through a direct connection between the controlling means of the fuel pump and the operating means of the throttle member.

In Fig. 1, **24** designates the suction pipe of the scavenging fan **23** and **2** a throttle member built into the same in the form of a damper which may be adjusted to different positions to control the passage area of the pipe **24**. The damper is arranged on a shaft **3** which is connected by means of a lever **4** with the piston rod **5** of a piston **6** which is movable within a cylinder **7** of a servo-motor. One side of the piston communicates through a pipe **8** with a conduit for supplying pressure medium to the piston. According to the drawing, the pressure medium consists of scavenging air, for which purpose the

pipe 8 extends from the pressure conduit 25 of the scavenging fan, said latter conduit conveying scavenging air to the motor cylinders. At a certain point in the pipe 8 there is provided a control valve comprising a bushing 9, the bore 10 of which has a piston 11 arranged therein, said piston being under the pressure of a spring 12. At a point of its circumference the piston 11 is provided with a circumferentially extending groove 13, which is preferably conically shaped so that the passage area will increase or decrease successively at the movements of the piston. When the piston 11 takes a position wherein the groove 13 registers with the conduit 8, pressure medium will be supplied to the cylinder 7, such pressure medium then acting upon the piston 6. In another position (that shown by full lines in Fig. 1) the piston closes the conduit 8.

The piston 11 is connected to the governor 16 of the motor by means of a two-armed lever 15 pivoted as at 14. Provided in the bottom of the cylinder 7 is a controllable opening 17 of a comparatively small passage area.

The damper may also be arranged in the pressure conduit, as shown at 2', or, use may be made of one damper in the suction conduit and another damper in the pressure conduit.

The contrivance operates in the following manner:

When the motor is started, the damper 2 is kept approximately closed until the motor has been brought up to its full speed. When the load on the motor diminishes or ceases, the deflection of the governor increases, the lever 15 being then turned into the position shown by chain-dotted lines, so that the piston 11 is moved into the bushing 9 (toward the right in Fig. 1). A greater or smaller portion of the groove 13 will then come to register with the extension of the pipe 8, so that pressure medium is supplied to the cylinder 7 of the servo-motor and forces the piston 6 toward the right in Fig. 1. By reason of the conical shape of the groove 13 in the control valve, the supply is then taking place successively. The damper 2 will then throttle the passage area of the suction pipe 24 to an extent corresponding to the decrease of the load, so that it will take the position shown by chain-dotted lines in Fig. 1, for example. As long as the motor is being operated at low load running or idling speed, the damper will be maintained in a position where it throttles the passage through the air suction pipe more or less. When the load increases, the governor 16 will make a smaller deflection, which results in the lever 15 being turned into the position shown by full lines in Fig. 1, such a movement being then transmitted to the fuel injection pump through the connecting link 18 that the fuel supply is increased. The piston 11 is at the same time moved toward the left in Fig. 1, so that the groove 13 is brought out of registry with the pipe 8 which latter is then throttled so that no pressure medium will be supplied to the cylinder 7. The piston 6 is then moved back from the chain-dotted to the full line position in Fig. 1 under the influence of the spring 19. The pressure medium which previously acted upon the piston 6 is then forced to escape through the aperture 17 in the bottom of the cylinder. The damper 2 is then opened and brought into a suitable position, for instance the position shown by full lines in Fig. 1. The position assumed is then determined by the ratio between the area of the passage opening 13 and the area of the exit opening 17.

By suitably selecting the ratio between the size of the openings 13 and 17 the throttling may be caused to vary within the desired limits, for instance between a maximum of throttling at idling speed and a minimum of throttling at about half load running.

The invention also includes an arrangement whereby movement is transmitted directly from the governor of the motor to the damper without the use of the auxiliary members shown in Fig. 1.

Fig. 2 shows an example of such an embodiment.

Here, the lever 4 of the damper 2 is connected by means of the rod 20 to a lever 21 actuated by the motor governor, said lever being pivoted at the point 22 and having the link 18 extending to the fuel pump connected thereto. In the connection between the lever 21 and the lever 4 there are preferably arranged leverage members which are not shown in the drawing, however.

This arrangement operates in an analogous manner to that shown in Fig. 1, the full line positions corresponding to an increased load on the motor and the chain-dotted lines to a decreased load.

The arrangement shown in Fig. 2 may obviously also be made use of in the case that the lever 21 is operated manually, which, however, will be found to be inferior, since for the reasons stated hereinbefore the automatic control offers great advantages.

In controlling the load and the speed of the motor from a distance, the shifting of the throttle member in the suction pipe or the pressure pipe of the fan may be effected by an electric or pneumatic remote control means which may either actuate the controlling means of the fuel pump, the throttle member being then shifted automatically, or may actuate the throttle member directly.

I claim:

1. In a two-stroke internal combustion engine having a fan for supplying scavenging air and a throttle member for controlling the quantity of scavenging air supplied by the fan, means responsive to variations in position of a regulating member indicative of the torque developed by the engine for automatically controlling said throttle member.

2. In a two stroke internal combustion engine having a scavenging fan and a throttle member for controlling the quantity of scavenging air supplied by the fan, a fuel injection pump, an engine driven governor for controlling said pump, a servo motor having an actuating member operatively connected to said throttle member, means for energizing said servo motor to move said actuating member and means automatically responsive to decrease in the torque developed by the engine below a predetermined value for operating said energizing means to cause said servo motor to move said throttle member toward closed position.

3. In a two-stroke internal combustion engine having a scavenging fan and a throttle member for controlling the quantity of scavenging air supplied by the fan, a fuel injection pump, an engine driven governor for controlling said pump, a servo motor having a cylinder and a piston connected to said throttle member to move the throttle member toward closed position on admission of pressure fluid to said cylinder, a conduit for supplying pressure fluid to said cylinder, a control valve located in said conduit for controlling admission of said fluid to said cylinder,

and means for automatically opening said valve when the torque developed by the engine falls below a predetermined value.

4. In a two-stroke internal combustion engine having a scavenging fan and a throttle member for controlling the quantity of scavenging air supplied by the fan, a fuel injection pump, an engine driven governor for controlling said pump, a servo motor having a cylinder and a piston connected to said throttle member to move the throttle member toward closed position on admission of pressure fluid to said cylinder, a conduit for supplying pressure fluid to said cylinder, a control valve located in said conduit for controlling admission of said fluid to said cylinder, said control valve having a sliding control member provided with a conically shaped recess adapted to progressively open or close the valve opening as said control member is moved in one direction or the other, and means for automatically opening said valve when the torque developed by the engine falls below a predetermined value.

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