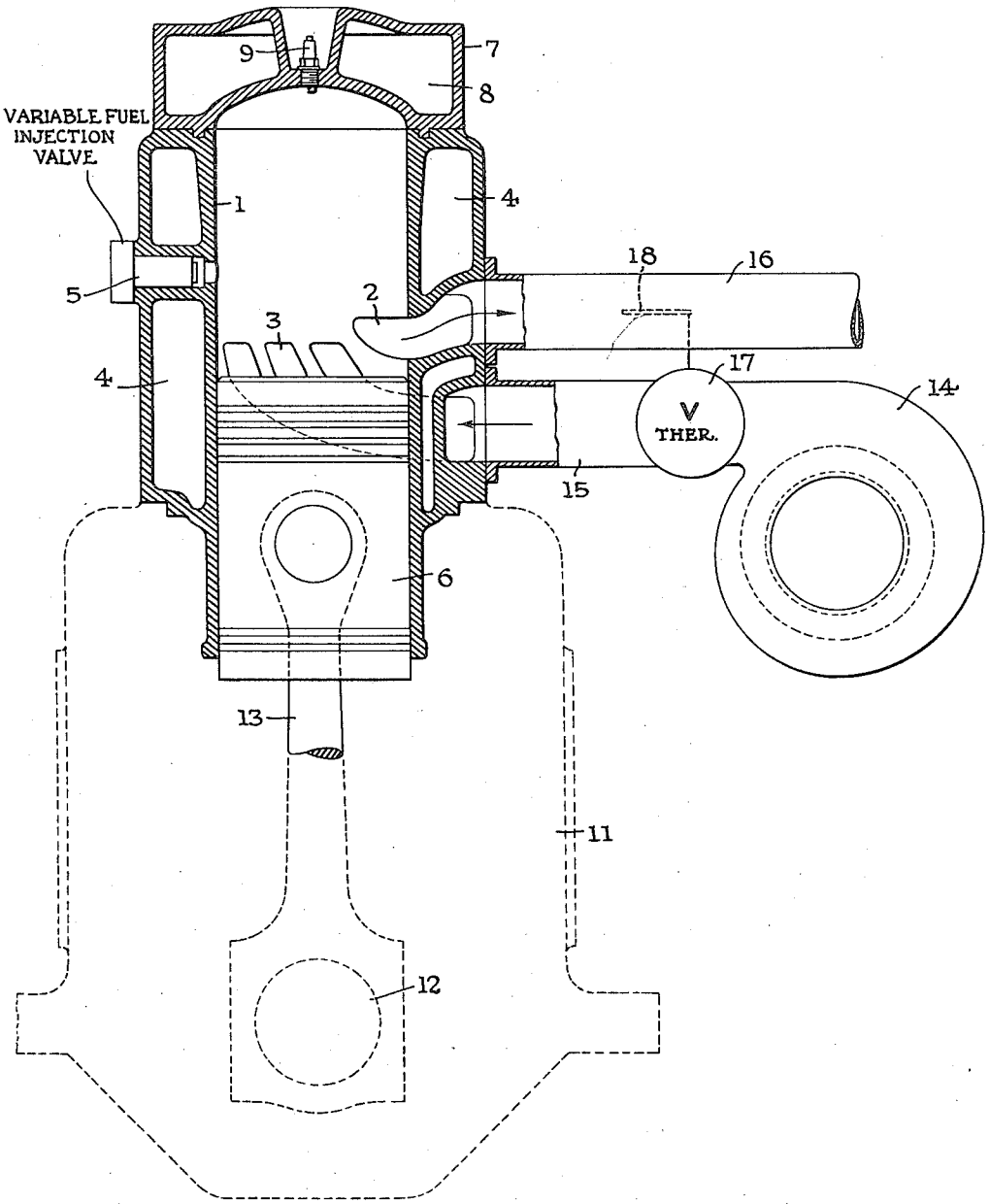
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CONTROL FOR INTERNAL-COMBUSTION ENGINES

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CONTROL FOR INTERNAL-COMBUSTION ENGINES

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This invention relates to two cycle internal combustion engines of the type in which fuel (either gaseous or liquid) is injected and combustion air is delivered under pressure by a blower or the like. The air so delivered may or may not effect supercharging.

Engines of this type operate erratically at part load, particularly when the quantity of fuel is controlled by a governor. Below ¾ load the mixture tends to be unduly weak and burn erratically. If combustion is weak (even though the quantity of fuel be correct) the governor will respond and increase fuel. The engine speed rises and the governor cuts down the fuel causing a repetition of the weak combustion. Thus the engine speed is irregular and the performance of the engine unsatisfactory.

The present invention is based on the discovery by applicant that exhaust temperature is very sensitive to the richness of the mixture and that a correct mixture has a characteristic exhaust temperature for any given engine. The invention involves the control of air in response to exhaust temperature.

Thus the output of the engine is controlled by controlling the fuel and the appropriate quantity of air is controlled by exhaust temperature. A governor responsive to load, for example a speed responsive governor, may be used to vary fuel quantity, and the thermal control independently corrects the air quantity in response to exhaust temperature changes resulting from too much or too little air. The temperature responsive control can be made sufficiently sensitive to assure satisfactory operation of the engine over a wide range of load.

The invention is directed broadly to this concept. It will be described as applied to an engine of the port scavenged type, using combustible gas as fuel, and making use of spark ignition. This particular type of engine is selected because of its simplicity, and as a basis for disclosing the inventive concept. The invention is not limited to any specific type of engine but might be applied to any two cycle internal combustion engine to which scavenging air is supplied under pressure.

The single figure of the drawing illustrates an engine of the type just mentioned, chiefly in vertical section, with the invention applied. The thermostatic device is shown in diagram.

In the drawing the engine cylinder is indicated at 1. This cylinder has exhaust ports 2 and scavenging ports 3. The cylinder is water-jacketed as indicated at 4 and has a fuel injecting valve 5 located at a point overtraveled by the

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piston 6. The controlling and operating mechanism for the fuel inlet valve 5 is not illustrated, as it might be any device known in the art. Control by a governor would be the usual arrangement. The cylinder 1 is provided with a head 7 having a water jacket 8. The ignition sparkplug is mounted in the head and is indicated at 9. The cylinder is shown mounted in a crankcase indicated at 11. There is the usual crank 12 and connecting rod 13.

A scavenging air blower 14 of ordinary form is driven by any means known in the art. The drive for the blower 14 is conventional and is not illustrated. It is common in the art, for example, to drive the blower by an electric motor, or to connect it to be driven from the engine crank shaft. The blower delivers scavenging air through pipe 15 to the ports 3. The exhaust port 2 leads to an exhaust pipe 16.

Flow through the scavenging air pipe 15 is regulated by a thermostatically controlled valve diagrammatically illustrated at 17. The thermally responsive controlling element of the valve 17 is indicated at 18 and is located in the exhaust pipe 16 so as to be subject to the temperature of the exhaust gases. The element 18 and valve 17 are so related that on fall of temperature at 18 the valve 17 moves in its closing direction, and conversely.

Various actuating connections between a thermostat and a valve are known in the temperature control art, and any appropriate one may be selected.

The regulation should be such that if the temperature of the exhaust gases tends to rise above a chosen value the supply of air is increased and if the temperature falls below such value the supply of air is diminished. Thus the relationship of air quantity to exhaust temperature is direct as contradistinguished from inverse. This does not imply strict proportionality, however. As stated, a control of this type can be made effective to hold the proportions of the fuel and air mixture within a range close enough to assure good combustion.

The valve 17 with thermostatic control is selected as probably the simplest means for varying the rate of flow of scavenging air, but any means which would vary the effective output of the blower 14 might be substituted. In other words, the invention is not directed to any particular means of controlling the output of a particular form of blower. On the contrary, it is based on the concept of controlling the output of whatever means supplies scavenging air to the

engine and controlling it in response to the exhaust temperatures of that engine.

Various ways of availing of this broad principle will suggest themselves to persons skilled in the art, and no limitation to the particular construction illustrated in the drawing is implied. Moreover, the engine may be of various different types. It might have various valve arrangements and any known means for ignition.

What is claimed is:

1. The method of relating the supply of combustion air to variations of fuel fed to an internal combustion engine of the type to which combustion air is delivered under pressure to the combustion space, which method comprises sensing the temperature of exhaust gases discharging from the engine and varying the rate of combustion air flow in a direct relation thereto.

2. The method of relating the supply of combustion air to variation of fuel fed to an internal combustion engine of the type to which combustion air is delivered under pressure to the combustion space, which method comprises sensing the temperature of exhaust gases discharging from the engine and variably restricting the flow of combustion air in such relation to said temperature that the flow of said air is increased and decreased as exhaust temperature rises and falls.

3. The method of controlling an internal combustion engine of the type in which fuel is injected into the combustion space and combustion air is delivered under pressure to the combustion space, which comprises controlling the output of the engine by varying the quantity of fuel injected per cycle; and adjusting the quantity of air supplied per cycle in a direct relation to the temperature of exhaust gases from the engine.

4. The method of controlling an internal combustion engine of the type in which fuel is injected into the combustion space and combustion air is delivered under pressure to the combustion space, which comprises controlling the output of the engine by varying the quantity of fuel injected per cycle according to the load on the engine; and adjusting the quantity of air supplied per cycle in a direct relation to the temperature of exhaust gases from the engine.

5. The combination of an internal combustion engine having a variable fuel supply a combustion air passage and an exhaust passage; air compressing means for supplying scavenging air to the first named passage; a thermostat in the second named passage; and means actuated by said thermostat and controlling the rate of supply of air by said air compressing means in a direct relation to the temperature of exhaust gases flowing through the second named passage.

6. The combination defined in claim 5 in which the means actuated by the thermostat comprises a valve.

7. The combination of an internal combustion engine having a variable fuel supply a combustion air passage and an exhaust passage; a blower arranged to deliver air under pressure to the combustion air passage; a valve interposed between the blower and said passage; a thermostat subject to the temperature of exhaust gases flowing through said exhaust passage; and an operating connection between said thermostat and said valve so arranged that the thermostat moves the valve in an opening direction in response to rising temperature.

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