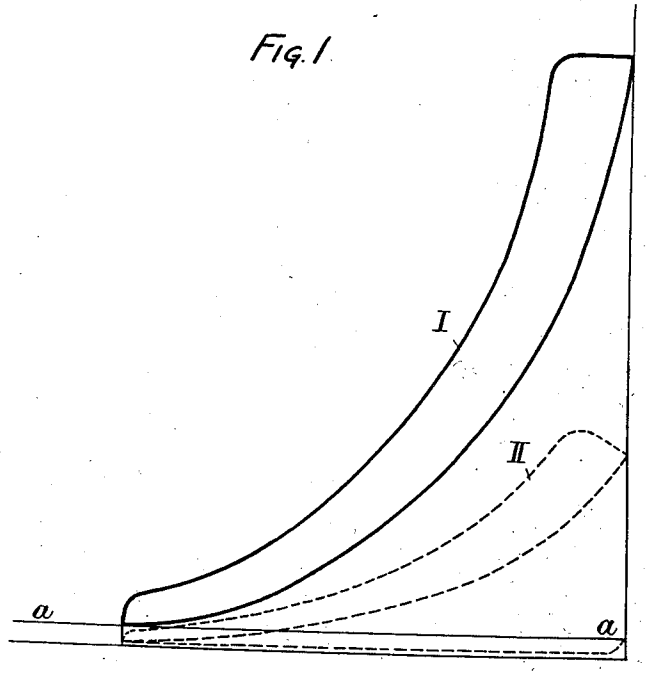
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METHOD FOR STARTING DIESEL ENGINES

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FIG. 1



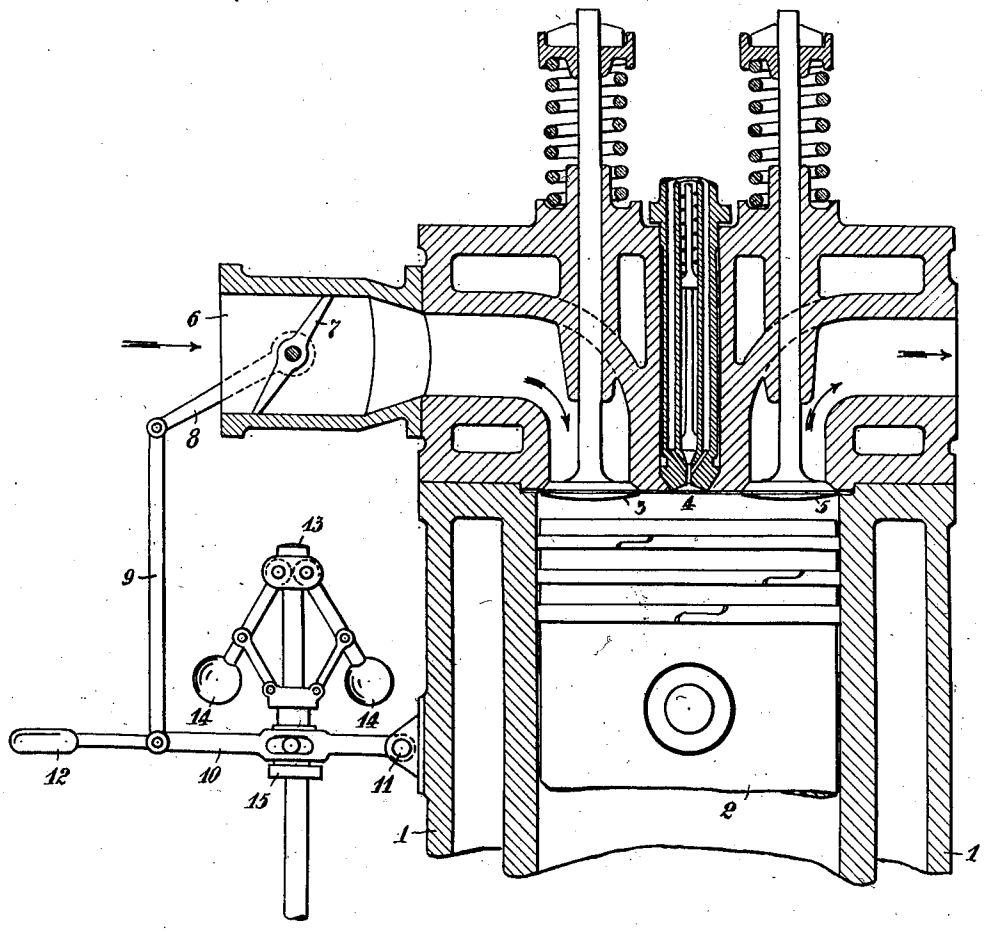
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FIG. 2



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UNITED STATES PATENT OFFICE

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METHOD FOR STARTING DIESEL ENGINES

Emil Schimanek, Budapest, Hungary

Application November 4, 1929, Serial No. 404,665
In Austria November 5, 1928

2 Claims. (Cl. 123—27)

This invention relates to Diesel engines and the like, and in this category are to be understood all those internal combustion engines in which the fuel is introduced into combustion air which has been highly heated by compression. Such motors, in order that the ignition temperature of the fuel may be reached at the end of the compression, work with a high degree of compression, amounting to at least from 20 to 30 atmospheres. The work necessary for this compression must be furnished even when starting the engine.

The object of the present invention is to reduce considerably the compression work necessary for starting the engine, without thereby diminishing the final compression temperature.

The invention utilizes the fact that the final temperature of compression depends on the one hand upon the initial temperature, that is, the temperature before compression, and on the other hand on the degree of compression, that is to say the ratio of the volumes before and after compression; the invention being based on the fact that a final compression temperature corresponding to normal operation can be obtained with different compression pressures and even in the case of pressures which are considerably less than the compression pressure corresponding to normal operation. Thus, according to the present invention, the work of compression is reduced during starting up without reducing the compression temperature. While maintaining the ratio of compression, the quantity of air admitted during the suction is reduced by throttling it down to a quantity which is only slightly greater than that required to support the combustion of the quantity of fuel necessary for idle running, so that by introducing slightly more fuel than is necessary for idle running, acceleration of the engine can be produced. The starting method according to the invention is so devised that proportionately as the engine is speeded up, the compression pressure in the working cylinder is gradually increased by reducing the amount of throttling until, on the engine attaining its normal speed of revolution, the normal compression pressure will also have been attained.

If, for example, in a four-stroke engine, the cylinder, instead of being filled with air at a pressure of one atmosphere without throttling, is only filled with air at a pressure of half an atmosphere for instance, then

(1) the air contained in the cylinder at the end of the suction stroke, that is, at the beginning of the compression stroke, would be of the same temperature as it would have been if no throttling had occurred;

(2) the work of compression only amounts to half the work of compression that would have been necessary without throttling;

(3) since the degree of compression, that is to say, the ratio of the volumes before and after compression, is not influenced by the throttling, the temperature at the end of compression must be the same as it would have been without throttling.

The characteristic feature of the present invention consists in that the throttling is effected in such a manner that, when starting the engine, the pressure is reduced to an extent which will enable the necessary air to be introduced into the cylinder for idle running, and above that a small acceleration, the degree of throttling being varied with the speed in such a manner that the quantity of air supplied to the cylinder increases with the speed of revolution. Thus, in the case of the present invention, the throttling is reduced as the speed increases and this is effected in such a manner that at the moment when the engine has attained its normal speed the throttling is discontinued.

In order to prevent the engine from being changed over from running under starting up conditions to normal running before the engine has reached that speed of revolution at which the flywheel can store up the necessary energy to produce the normal compression pressure, the method of starting according to the invention is carried out in such a way that the throttling effect becomes less and less as the speed of revolution becomes greater, varying from a maximum at the commencement of the starting operation to zero as soon as the engine has reached its normal speed.

This diminution in the throttling effect according to the increasing speed of the motor may be obtained automatically, by means of a centrifugal governor and a throttling valve for instance, which are so connected that when the engine is at rest or running quite slowly the throttling effect is a maximum, this throttling effect then being continuously diminished by the governor as the speed increases, until finally at full speed the throttling ceases.

The valve gear of the engine may be so constructed as to carry out this process.

In the drawings, illustrating diagrammatically and by way of example one form of the present invention,

Fig. 1 is a diagrammatic illustration of the results obtained by the method, and

Fig. 2 is a vertical cross-section of a part of an engine embodying the present invention.

In Fig. 1 of the drawings the diagram illustrating the normal running of the engine is denoted by I and the diagram illustrating the starting of the engine by II, *a*, *a* is the line of atmospheric pressure. The dotted horizontal line indicates the minimum pressure of the starting diagram.

The comparison of diagrams I and II shows the economy of work when starting the engine.

Fig. 2 shows in section the upper portion of a motor cylinder fitted with a throttling device according to the invention. 1 is the cylinder, 2 the piston, 3 the inlet valve, 4 the fuel nozzle, and 5 the outlet valve. In the inlet canal 6 a throttling valve 7 is arranged which is rigidly connected with an arm 8. This arm 8 is connected by means of the articulate rod 9 with the lever 10 which is jointed to the jacket of the cylinder at 11 and is actuated by the centrifugal governor 13.

When the motor is at rest or running slowly, the balls 14 and the ring 15 of the centrifugal governor are in low position and therefore, also the lever 10, whereby the throttle valve is kept closed or only little opened. Thus, strong throttling of the air flowing during the suction stroke through canal 6 and valve 3 into the power cylinder takes place, so that the air fills the cylinder at lower pressure than the atmospheric pressure.—With rising speed of the machine, the balls 14 and the ring 15 of the centrifugal governor rise and by the latter the lever 10 is raised too, which, by means of the rod 9, operates the arm 8 of the throttle valve in such a manner that this valve is more and more opened and permits the air to flow more and more unimpeded into the power cylinder.

I claim:

1. In a Diesel engine, an air inlet valve, a throttle valve for throttling air supplied to said inlet valve, fuel injections means, and engine driven means operable automatically in accordance with engine speed for automatically controlling said throttle valve as the engine speed increases, from a limiting position in which the air supplied to the engine is slightly greater than that required to support the combustion of the quantity of fuel necessary for idling to a fully open position.

2. The method of starting a Diesel engine comprising throttling the admission of combustion air to the working cylinder during the suction stroke while maintaining the compression temperature at substantially the normal value when loaded, such throttling providing a quantity of air which is only slightly greater than that required to support the combustion of the quantity of fuel necessary for idling, and gradually accelerating the engine up to the lower limit of operating speeds by gradually reducing the degree of throttling to a minimum, in accordance with the speed of rotation.

EMIL SCHIMANEK.

CERTIFICATE OF CORRECTION.

Patent No. 1,959,041. **May 15, 1934.**

EMIL SCHIMANEK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 47, after "engine," insert the words the air is so throttled during the suction stroke,; page 2, line 84, claim 1, for "injections" read injection; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of June, A. D. 1934.

Bryan M. Battey

(Seal) **Acting Commissioner of Patents.**