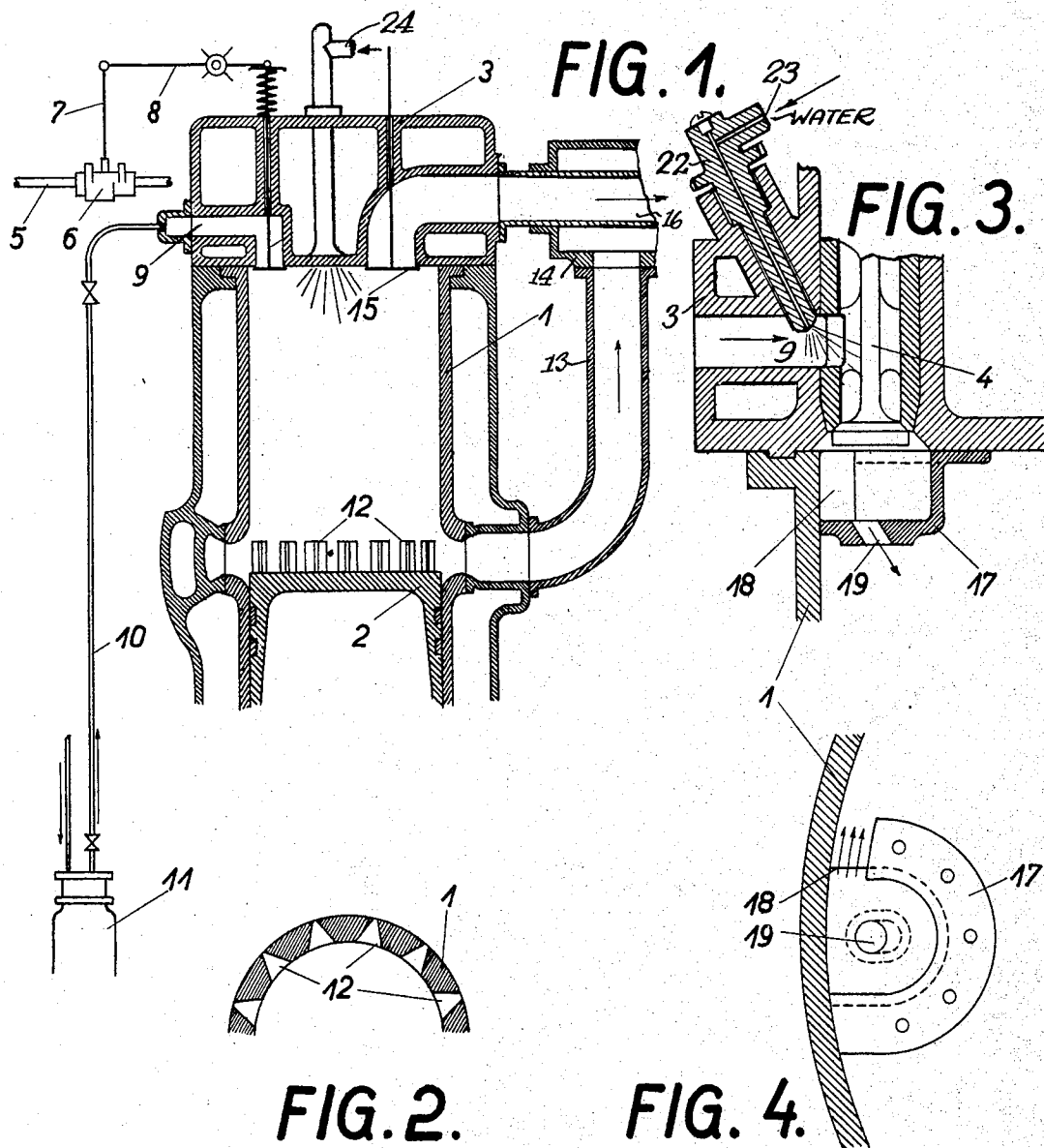


Sept. 27, 1938.

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WORKING PROCESS FOR INTERNAL COMBUSTION ENGINES AND
APPARATUS FOR CARRYING THE SAME INTO EFFECT
Filed April 23, 1935

2,131,384

2 Sheets-Sheet 1



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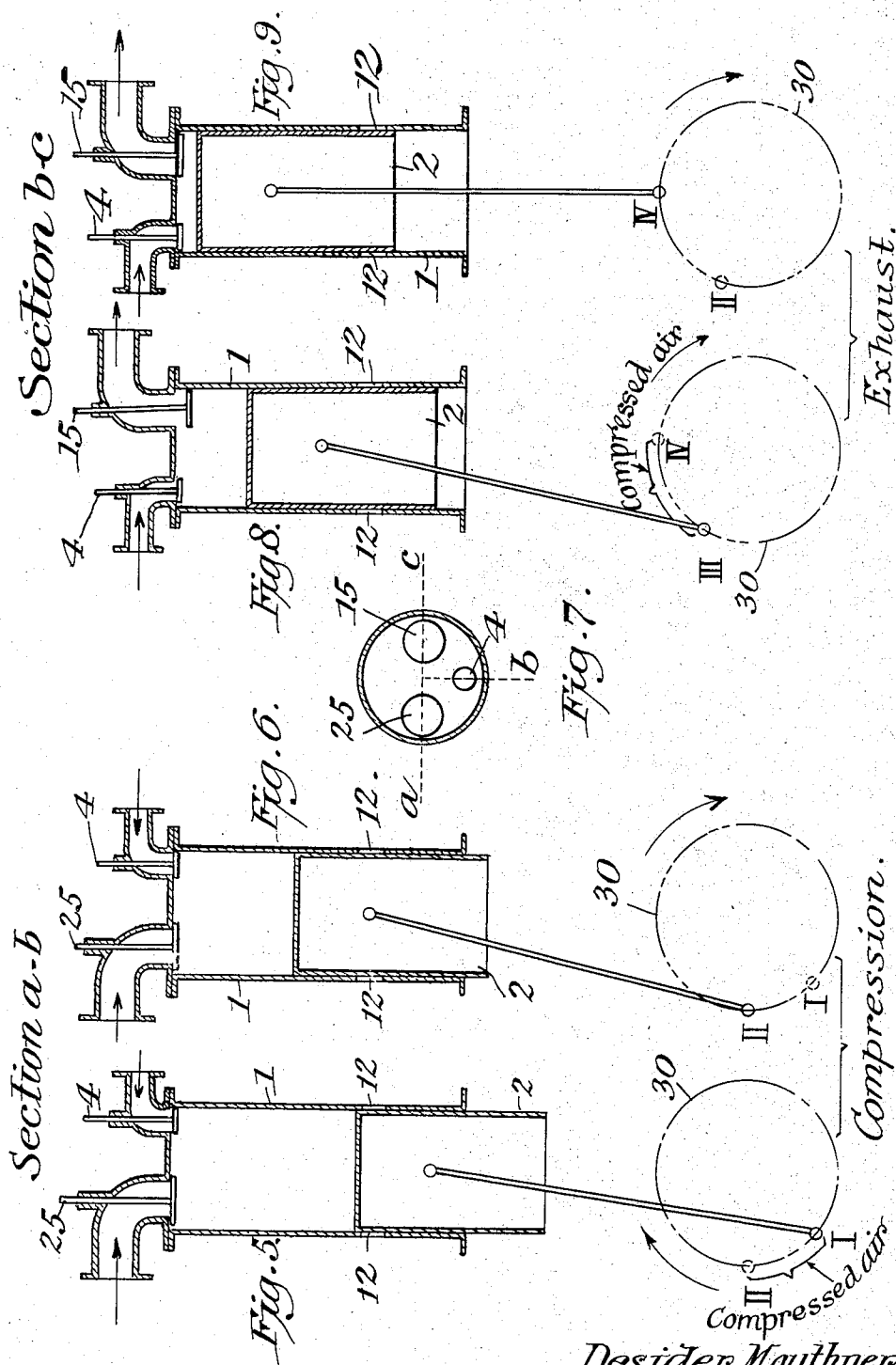
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UNITED STATES PATENT OFFICE

2,131,384

WORKING PROCESS FOR INTERNAL COMBUSTION ENGINES AND APPARATUS FOR CARRYING THE SAME INTO EFFECT

Desider Mauthner, Budapest, Hungary

Application April 23, 1935, Serial No. 17,762

In Hungary May 2, 1934

9 Claims. (Cl. 123-75)

In the case of internal combustion engines, the most economical way of effecting the combustion of the fuel in the working cylinder is obtained if in addition to ensuring perfect combustion, means are provided for reducing to a minimum the heat losses caused by the water-cooling and by the products of combustion.

This purpose is achieved by means of the working process according to my invention in such a manner that at the end of the suction stroke compressed air is admixed preferably through an air valve to the air or gas mixture drawn in by the working piston, in such a manner that the air entering into the cylinder in a tangential direction performs a rotary circling motion sweeping along the internal wall surface of the cylinder and thus forms an isolating layer on the said internal wall surface, so that the temperature produced by the process of combustion is influenced in an advantageous sense, while at the same time the cylinder wall is efficiently protected against excessive temperature rises.

I, moreover, also spray water into the cylinder at the end of the exhaust stroke, with the aid of the compressed air, in the same way and manner in which the compressed air is introduced, this mixture of cooling water and air will produce an efficient internal cooling effect in the cylinder, resulting in a reduction of the temperature set up in the working cylinder, as well as of the heat loss caused by the cooling water.

According to my invention the mixture of the combustion gases with the scavenging air and the water, which mixture becomes heated in the cylinder, and is under considerable pressure, is removed and the energy contained in it employed and utilized for some useful purpose, particularly in a gas producer in combination with the internal combustion engine to which my invention has been applied.

The main object of my invention is to entirely eliminate, or at least reduce to a possible minimum, the heat losses at present arising in internal combustion engines, like the excessive heat taken up by the cooling water and by the exhaust gases, and for this purpose I use the agents in my invention for the internal cooling of the engine, like air and water to take up said heat, and those agents as well as the exhaust gases will then be led through a gas producer where their heat as well as their chemical properties and kinetic energy may be used to produce more and better gas, and the gas so produced may be introduced back into the motor and there used.

As it is known, of the heat introduced into an

internal combustion engine, in the best cases, only about thirty-three to thirty-five per cent can be used, while the rest of the heat energy is lost mainly through the cooling water and through the hot exhaust gases. If, therefore, we eliminate the cooling water entirely, or to a great extent, and employ the energy of the exhaust gases in a useful manner, again entirely or to a large extent, it will be seen that we will succeed to greatly improve the efficiency of the internal combustion engines. The methods and construction of the present invention have for their main purpose to improve the efficiency of internal combustion engines in the manner explained hereinbefore.

In the drawings forming a part of this application and accompanying the same:

Fig. 1 is a semi-diagrammatic fragmentary sectional elevation of an internal combustion engine to which my invention has been applied;

Fig. 2 is a fragmentary sectional detail showing the exhaust ports arranged at the bottom of the working cylinder of the engine;

Fig. 3 is a somewhat enlarged sectional detail of an air and water inlet valve and chamber used with my invention, while,

Fig. 4 is a plan view of said chamber;

Figs. 5 and 6 are diagrammatic sections on the line *a-b* of Fig. 7 to indicate the positions of the piston in an engine embodying my invention, while compressed air is admitted into the cylinder at the beginning of the compression;

Fig. 7 is a diagrammatic cross section showing the arrangement of the valves;

Figs. 8 and 9 are diagrammatic sectional views on the line *b-c* of Fig. 7 indicating the positions of the piston during the admission of compressed air towards the end of the exhaust stroke.

Referring now to the drawings by characters of reference, in Fig. 1 a vertically arranged four-stroke cycle producer gas engine is illustrated by way of example in longitudinal section. 1 denotes the working cylinder, 2 the piston, 3 the cylinder head and 4 an air inlet valve. The engine is provided with a usual fuel inlet valve and ignition device (not shown). The operation of the air inlet valve 4 is effected by means of the rod 7 and of the lever 8 by a cam 6 which is capable of displacement in the axial direction on the cam shaft. The space 9 behind the air inlet valve 4 communicates through a pipe-line 10 with a compressed air tank 11.

For producing the necessary quantity of compressed air, a turbo-pump or piston pump (not shown in the drawings), driven by the four-

stroke cycle engine or by any other means, is provided.

The water to be vaporized and turned into steam in the engine is provided by any appropriate pump (not shown), well understood by those versed in this art, and it will be pressed into the engine at the desired moments through the bore 23 of the water valve 22 (Fig. 3), and it will be delivered in a vaporized form into the space 9, as indicated, from which it will be carried into the cylinder by the compressed air, through the chamber 17, upon the opening of the valve 4.

The fuel may be injected into said cylinder through any appropriate valve, one form of which is indicated at 24, in Fig. 1.

At the beginning of the compression, secondary air is introduced in a tangential manner into the cylinder providing an isolating layer around the walls thereof so that the heat transferred to the cylinder walls will be greatly reduced and the cooling means for said walls may also be reduced to a corresponding degree.

During the first part of the exhaust stroke scavenging air and water vapor will be introduced into the cylinder in a tangential direction and as an internal cooling agent it will intensively cool the cylinder walls and the transforming of the water into steam will also reduce the temperature of said walls so that the cooling of said walls by the usual cooling water can be entirely eliminated in case of small cylinders, while in case of cylinders of large diameters a milder air cooling system may be sufficient.

The combustion gases and the mixture of scavenging air and water vapor are removed from the cylinder in two stages and through two different exhaust pipe-lines.

At the end of the expansion stroke, the first and substantially greater part of the combustion gases will, owing to the pressure existing in the working cylinder, pass into the atmosphere through the ports 12 provided in the bottom part of the cylinder and through the pipe-lines 13 and 14. The smaller part of the combustion gases, left over in the working cylinder, the pressure and temperature of which part are lower than those of the first part, is exhausted after the controlled exhaust valve 15 has been opened. Before being exhausted, however, this last-named part of the combustion gases becomes mixed with the scavenging air forced into the working cylinder and with the water vapors produced.

In view of the fact, that the mixture exhausted through the pipe-line 16 and consisting in its preponderant part of air and water vapor possesses a relatively higher specific weight as well as a relatively higher specific heat and a relatively higher heat transmission capacity than the usual combustion gases produced in such engines, it is possible to conduct it to greater distances and to utilize it in various ways. A particularly favorable possibility of utilization of this mixture of air and water vapor is available especially in the case of suction gas producers.

If the exhaust pipe 16 is arranged inside a pipe-line 14 the mixture of air and water vapor exhausted in the exhaust pipe 16 can be superheated by means of the hot combustion gases flowing in the pipe-line 14, by which arrangement a favorable utilization of the heat energy of the hot combustion gases is obtained.

The cross-sectional area of the exhaust ports 12 gradually diminishes in the outward direction (Fig. 2) in order that at the end of the suction stroke, any flowing back of the combustion gases

into the cylinder, or any flowing-out of the fresh air or gas mixture should be retarded and reduced, as far as possible, to a minimum.

A particular device is provided for introducing the air into the working cylinder, an embodiment shown by way of example of the said device being illustrated in vertical section on Fig. 3 and in plan view on Fig. 4. Below the air inlet valve 4 a chamber 17 open on one side, joins the internal wall surface of the cylinder 1, and forms a closed space communicating with the cylinder space through the lateral port 18 and the hole 19 only. When the air inlet valve 4 is opened, the air flows into the chamber 17, from which it passes through the hole 19 and the port 18 into the working cylinder. During this movement a rotary motion is imparted to the air resulting in an effective sweeping of the internal wall surface of the cylinder. The air circling round, drives the gas mixture towards the centre of the cylinder and at the same time forms an isolating layer between the gas mixture and the cylinder wall.

That part of the fresh air and water vapor mixture blowing through the hole 19 will effectively cool the top of the piston. A larger part of the exhaust gases with the scavenging air and steam will pass through the pipe line 16 and this mixture will be further heated by the hot combustion products passing through the pipe line 13 and 14. I propose to use the heat obtained through the internal cooling of the cylinder walls and contained in the air steam mixture of pipe line 16 as well as the inherent energy of the parts of this mixture itself (air steam combustion gases), and thereby to eliminate a greater part of the losses caused by the usual water cooling and by the combustion gases.

For a useful employment of the mixture of air, steam and combustion gases, a gas producer is best adapted where all the three constituents of this mixture may be used as important elements of the process of gas production; by my method, namely, the engine will feed into the producer pre-heated hot air, over-heated steam and pre-heated carbon dioxide, CO_2 , which later will be reduced in the producer to carbon monoxide, CO.

Even the kinetic energy of the mixture may be used. The mixture namely will flow into the producer with a pressure larger than the atmospheric, which pressure may be automatically regulated by regulating the amount of the scavenging air before its introduction into the engine, and in this manner a new automatic connection and cooperation results between the engine and the gas producer whereby the performance of the gas producer will be dependent on the engine not only through the suction effect of the latter, but also through the amount of pressure of the air, steam and combustion gas mixture reaching the gas producer and thereby the gas producer will be in a position to follow the sudden changes in the performance of the engine.

Since a complete realization of my working process is obtained through the aid of a gas producer, this working process is primarily employable in the case of suction gas motors using solid fuels.

To better illustrate the admission of compressed air and water into my engine, I have shown the respective phases of its operation, in connection with the showing of the arrangements of the valves taking a part therein, in Figs. 5 to 9.

In said figures the intake valve is designated 75

by the numeral 25, the auxiliary air valve by the numeral 4, and the exhaust valve by the numeral 15.

As shown in Figs. 5 and 6, after the finishing of the suction stroke, the piston 2 will start in its return upward direction until it will cover the exhaust ports 12, and the air valve 4 will open at this position of the piston and will remain open as long as the pressure of compression in the cylinder 1, caused by the further travel of the piston in an upward direction, will be equivalent to the pressure of the compressed air admitted into the cylinder through the valve 4.

When this condition is reached, the air valve will close, and a check valve (not shown) may also be inserted into the air line to immediately stop the further movement of the air.

The beginning of the admission of the compressed air is shown in Fig. 5 and the end of it in Fig. 6, and the positions I and II indicate the beginning and the end of this admission of compressed air on the circle 30 of the crank pin. The length of the period between the positions I and II depends on the clearance space in the cylinder head and on the pressure of the compressed air admitted thereinto.

With engines having larger clearance space, this period will be longer than with engines having smaller clearance space, like the Diesel motor.

In Figs. 8 and 9 is illustrated the second period of admission of compressed air which is towards the end of the exhaust stroke. The admission begins approximately in the position indicated in Fig. 8 and at the position of III of the crank pin, and will be terminated in the position illustrated in Fig. 9 and at the position of the crank pin indicated by IV.

What I claim is:

1. In a working process for internal combustion engines the steps of introducing compressed air at the end of the suction period in a tangential direction to the cylinder walls causing the same to execute a whirling rotary motion therearound; and similarly introducing compressed air and water vapor towards the end of the exhaust stroke.

2. In a working process for internal combustion engines the steps of introducing compressed air at the end of the suction period in a tangential direction to the cylinder walls causing the same to execute a whirling rotary motion therearound; and similarly introducing compressed air and water vapor towards the end of the exhaust stroke, removing a part of the combustion products separately at the end of the expansion and beginning of the exhaust stroke, and removing the rest of the combustion products separately during the rest of the exhaust stroke.

3. In a working process for internal combustion engines the steps of introducing compressed air at the end of the suction period in a tangential direction to the cylinder walls causing the same to execute a whirling rotary motion therearound; and similarly introducing compressed air and water vapor towards the end of the exhaust stroke, removing a part of the combustion products separately at the end of the expansion and beginning of the exhaust stroke; removing the rest of the combustion products separately during the rest of the exhaust stroke, and heating the

second part of the combustion products by the part removed at first.

4. In a working process for internal combustion engines the steps of introducing compressed air at the end of the suction period in a tangential direction to the cylinder walls causing the same to execute a whirling rotary motion therearound, and similarly introducing compressed air and water vapor towards the end of the exhaust stroke, removing a part of the combustion products separately at the end of the expansion and beginning of the exhaust stroke; removing the rest of the combustion products separately during the rest of the exhaust stroke, and heating the second part of the combustion products by the part removed at first, the heating of said second part being done through the first part surrounding said second part during their removal from the engine.

5. In a working process for internal combustion engines the steps of introducing compressed air at the end of the suction period in a tangential direction to the cylinder walls causing the same to execute a whirling rotary motion therearound; and similarly introducing compressed air and water vapor towards the end of the exhaust stroke, and leading the exhaust products through a gas producer to utilize their energy therein.

6. In a working process for internal combustion engines, the steps of introducing compressed air at the end of the suction period in a tangential direction to the cylinder walls causing the same to execute a whirling rotary motion therearound; similarly introducing compressed air and water vapor towards the end of the exhaust stroke; removing a part of the combustion products separately at the end of the expansion and beginning of the exhaust stroke and removing the rest of the combustion products separately during the rest of the exhaust stroke; heating the second part of the combustion products by the part removed at first, and leading said second part through a gas producer to utilize its energy therein.

7. In an internal combustion engine of the type described, an auxiliary valve at the outer end of the cylinder for introducing compressed air into the cylinder of the motor, means to normally close said valve; means to open the same for a desired length of time at the end of the suction stroke, and means to again open it for a desired length of time towards the end of the exhaust stroke.

8. In an internal combustion engine of claim 7, said auxiliary valve being combined with a water inlet mechanism injecting vaporized water into the cylinder when the air is injected.

9. In an internal combustion engine of claim 7, said auxiliary valve being combined with a water inlet mechanism injecting vaporized water into the cylinder when the air is injected, means to conduct the preheated mixture of water vapor air and combustion gases so produced in the cylinder through a separate exhaust pipe, and means to heat said mixture in said pipe through another portion of the exhaust gases, thereby making it adapted to be conducted to larger distances and there to be used for an appropriate purpose.

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