June 24, 1958 M. MALLORY 2,839,888

STEAM ENGINE

Filed Dec. 10, 1953 2 Sheets-Sheet 1

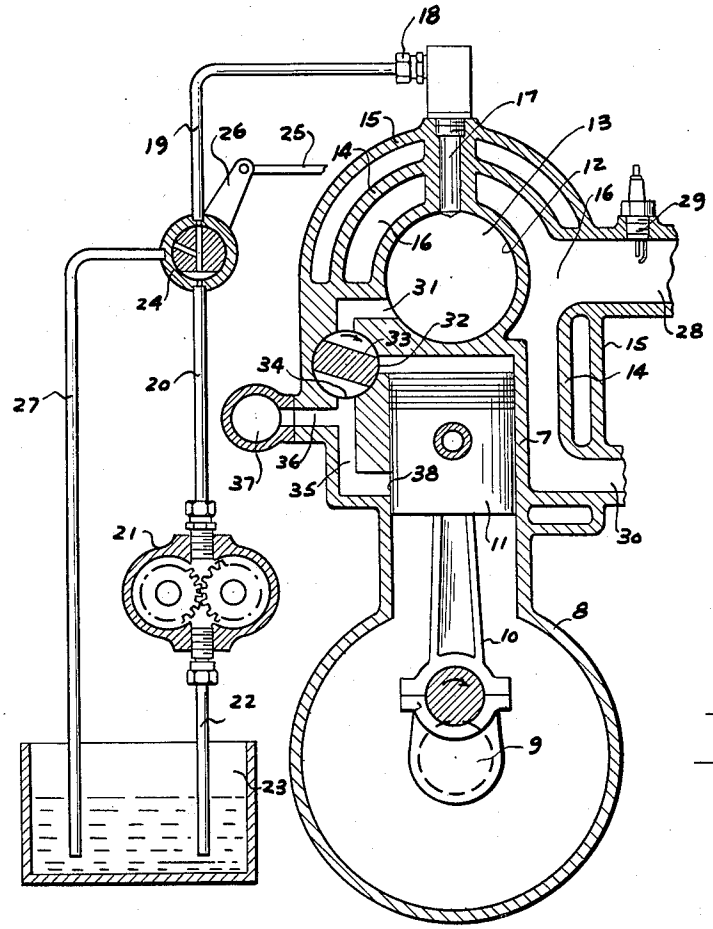


Fig. 1

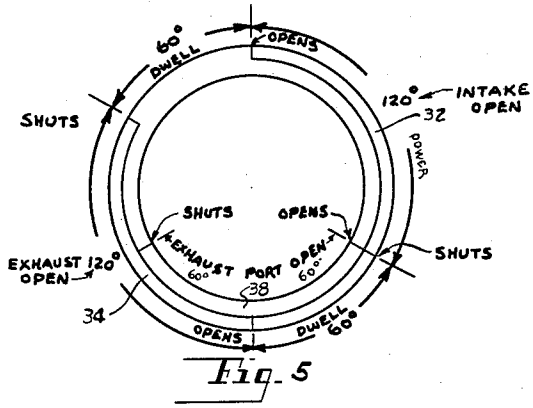


Fig. 5

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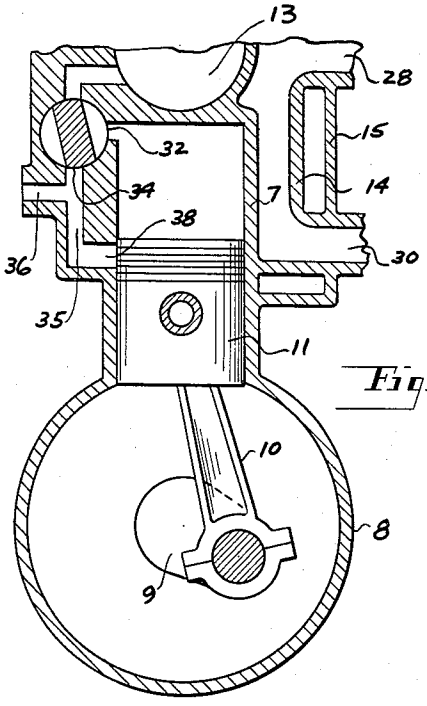


Fig. 2

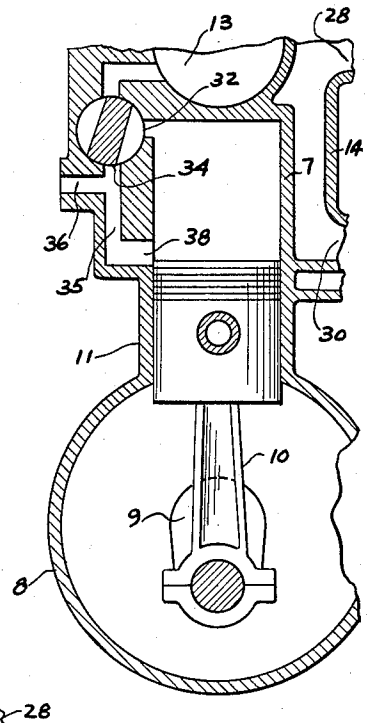


Fig. 3

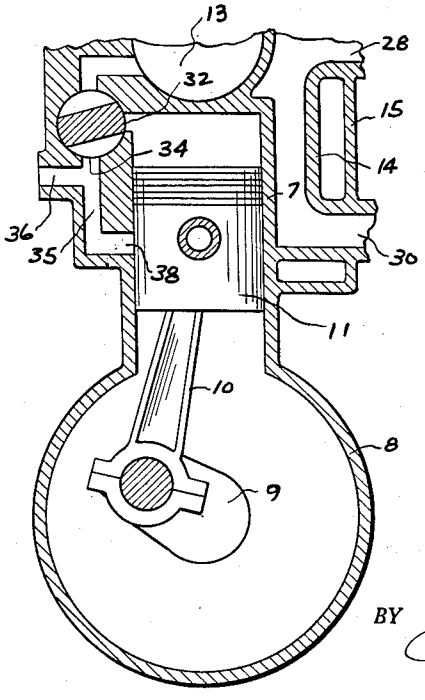


Fig. 4

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STEAM ENGINE

Marion Mallory, Detroit, Mich.

Application December 10, 1953, Serial No. 397,294

6 Claims. (Cl. 60—1)

This invention relates to steam engines of the type disclosed in my co-pending application, Serial No. 388,124, filed October 26, 1953, of which this application may be considered a continuation in part.

An object of the invention is to improve the steam engine disclosed in my said co-pending application. In that disclosure, I illustrate an engine which is constructed and arranged so that steam is generated in the engine only during a portion of the travel of the piston on each revolution of the crank. I now propose an improved form of the engine, which is constructed and arranged so that steam can be generated continuously during the operation of the engine, while the intensity of the fire and the volume of water injected may be varied in accordance with the demands of the engine, as in the original disclosure.

The invention, therefore, resides in the particular combination and arrangement of parts as hereinafter described.

I am aware of the fact that others have used valves to control the admission of steam to the work cylinder and to release the steam from the work cylinder on the power stroke, but to my knowledge, no one has ever employed a self contained, externally heated work cylinder, with a steam generating compartment therein, having a valve between the two compartments arranged to permit the generation of steam during a complete revolution of the engine crank shaft.

It is, therefore, one of the objects of the invention to provide an engine with an externally heated work cylinder, and a piston therein, with means for continuously injecting an expandible liquid into the cylinder, and means for retaining said expandible liquid in a compartment of said cylinder, during a predetermined portion of the travel of said piston, and then releasing the expandible liquid to said piston during another portion of the travel of said piston, and then to partially release the pressure of said expandible liquid from said piston during another portion of travel of said piston.

A further object of the invention is to provide a device of the character indicated, which is constructed and arranged so that steam is continuously and increasingly generated during substantially the entire distance of travel of the piston on the power stroke.

Another object of the invention is to provide a device of the character indicated, which is constructed and arranged so that steam pressure may be developed in one compartment of the work cylinder and released to another compartment of the work cylinder during the power stroke of the piston, and after said release the engine continues to generate steam throughout both compartments of said work cylinder during a substantial portion of the power stroke of the piston.

Another object of the invention is to provide an engine of the character indicated, comprising an externally heated work cylinder with a piston therein, and means for generating steam in the cylinder during the full 360 degrees of travel of the crank.

The foregoing and other objects of the invention will become more apparent as the description proceeds, reference being made from time to time to the accompanying drawing forming part of the within disclosure, in which drawing:

Fig. 1 is a vertical section taken through the device embodying the invention, and illustrating the position of the moving parts as the intake opens.

Fig. 2 is a view similar to Fig. 1, but showing the position of the moving parts as the intake closes.

Fig. 3 is a vertical section taken through the device embodying the invention, and illustrating the position of the moving parts as the exhaust opens.

Fig. 4 is a view similar to Fig. 3, but showing the position of the moving parts as the exhaust closes.

Fig. 5 is a timing chart of the engine during one complete revolution of the crank.

Referring now more particularly to the drawing, it will be understood that in the embodiment herein disclosed, the reference character 7 indicates the cylinder wall of an engine having a crank case 8, a crank 9, piston rod 10, and piston 11. The cylinder wall 7 has an extension 12 which defines a spherical compartment 13, which serves as a steam generating compartment. The cylinder 7 and the compartment 13 are enclosed within walls 14 and 15, which define a fire chamber 16, which substantially surrounds the cylinder 7 and the chamber 13. A vacuum is preferably maintained between the walls 14 and 15 for insulation purposes. Water is injected into the compartment 13 through the nozzle 17, which in turn is connected through the fitting 18, and pipes 19 and 20, to a high pressure pump 21 which may be driven by the engine or by individual means (not shown). The pump 21 communicates through a pipe 22 with a water supply 23. Interposed in the water lines 19 and 20 is a throttle valve 24, which is manually controlled through the throttle lever 25 and linkage 26. The pressure through the throttle valve 24 is controlled by by-passing water back to the reservoir 23 through the line 27.

A fuel and air mixture is admitted to the fire chamber 16 through the opening 28, where it is ignited by a spark plug 29. The products of combustion in the fire chamber 16 are exhausted through the opening 30 and the fire is controlled as is more particularly described in my co-pending application, to which reference is made.

Steam generated in the compartment 13 is admitted into the cylinder 7 above the piston 11 through the passageway 31 and port 32, which passageway and port are controlled by a rotary valve 33, which is preferably driven at one half of the speed of the crank 9 through suitable speed reduction means connected to the shaft 9 (not shown). Steam is exhausted from the cylinder 7 through the port 32 and the exhaust port 34 which is also opened and closed by the valve 33. The exhaust port 34 communicates with exhaust passageways 35, 36, and 37. A relief port 38, which also communicates with the passageways 35, 36, and 37 may be provided whereby to partly reduce the pressure on the piston 11. This obviates any tendency of any excess residual steam trapped in the cylinder above the piston to buck the smooth operation of the engine on the compression stroke. I do not intend to be limited to exhausting part of the steam pressure through the port 38 for the reason that in small, low speed engines, such a port would not be necessary.

The timing of the opening and closing of the intake port 32, the exhaust port 34, and the relief port 38 is shown on the timing chart (Fig. 5).

It is also within the contemplation of the invention to inject live steam into the steam chamber 13, instead of water, in which event the steam chamber 13 would serve as a super-heating chamber for the steam. Such an arrangement would only be necessary where great engine output was required.

The operation of the engine is as follows:

The engine is started and the heat is developed and controlled, as more particularly described in my co-pending application to which reference is hereby made for greater

certainty. The starting of the engine also starts the operation of the pump 21 and the operation of the rotary valve 33 which, as previously described, turns at one half of the speed of the crank 9 so that all of the functions of the valve 33 may be properly timed on one revolution of the crank 9. Upon the introduction of water to the heated chamber 13, steam is generated in the chamber 13. Because of the constant and uninterrupted injection of water into the chamber 13 during 360 degrees rotation of the crank 9, and because of the intense heat surrounding the chamber 13 and cylinder 7, there will be an increasing pressure developed in the chamber 13 until the rotary valve 33 opens to permit the entry of steam into the cylinder 7. The valve 33 opens the port 32 when the piston 11 is in the position as shown in Fig. 1, and it remains open as shown in Fig. 5 for 120 degrees, at which point it closes, and at which point the piston 11 is in the position shown in Fig. 2. During the 120 degrees which the intake remains open there is communication between the steam compartment 13 and the cylinder 7, during which time steam continues to be generated in the chamber 13 and in the cylinder 7, because of the continued injection of water. This generation of steam causes increased pressure on the piston 11 throughout substantially the entire power stroke of the piston.

When the piston 11 reaches the position shown in Fig. 2, it starts to uncover the port 38 to partially relieve the pressure in the cylinder 7. The port 38 remains open until the crank has passed lower dead center and until the crank has traveled upwardly approximately 60 degrees on the compression stroke (Fig. 5). At approximate lower dead center, the exhaust port 34 starts to open, as shown in Fig. 3, which port 34 remains open for 120 degrees of the travel of the crank on the compression stroke of the piston 11.

It will be noted from Fig. 5, that during approximately 60 degrees of travel of the crank on the compression stroke, both the ports 38 and 34 will be open. The exhaust port 34 closes 60 degrees before upper dead center, during which 60 degrees there is a dwell which permits increased pressure to be built up in the steam chamber 13, before the intake port 32 is again opened to permit communication between the steam chamber 13 and the cylinder 7. During the same 60 degrees dwell, the piston 11 is moving upwardly to compress and reheat any residual steam trapped in the cylinder compartment 7, which will give added impetus to the piston 11 on the next power stroke.

From the foregoing description, it will be understood that I have disclosed a steam engine which internally generates steam throughout the full 360 degrees travel of the engine crank, which is one of the novel features of the within invention. With this structure, I am provided with a much longer time for generating steam on each revolution of the crank than is possible with the structure disclosed in my co-pending application, wherein I disclosed an intermittent timed injection of water only during the power stroke.

As previously indicated, the control of the heat generated in the combustion chamber 16 and the amount of water injected into the chamber 13 and the cylinder 7 is controlled in the manner more particularly described in my co-pending application.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. An engine of the character described, comprising in combination, a cylinder surrounded in greater part by a passageway for receiving hot gases from an internal combustion mechanism, an internal combustion mechanism connected to said passageway, a piston reciprocable in said cylinder, a crank connected to said piston, means in the heat zone of said passageway for generating steam for said cylinder throughout 360° rotation of said crank, said means including a spherical compartment formed in the head of said cylinder and heated by the gases in said passageway, an injector is communication with said compartment for introducing a liquid to said compartment and a valve between said compartment and said cylinder, for intermittently introducing steam to said cylinder.

2. An engine of the character described comprising in combination, a cylinder having an auxiliary compartment in its head, an internal combustion passageway for heating the walls of said cylinder and said compartment, a piston reciprocable in said cylinder, means interposed between said cylinder and said compartment which permit intermittent communication therebetween, internal combustion means in said passageway to externally and simultaneously heat said cylinder and said compartment and injection means for introducing an expandible liquid into said compartment.

3. An engine of the character described comprising in combination, a cylinder having an auxiliary compartment in its head, an internal combustion passageway for heating said cylinder and said compartment, an exhaust port in said cylinder, a piston in said cylinder, a crank connected to said piston, means interposed between said cylinder and said compartment whereby to provide communication between them during approximately 120 degrees travel of said crank and to permit communication between said cylinder and said exhaust port during another 120 degrees travel of said crank, and means including a spark plug in said passageway for generating steam in the said auxiliary compartment throughout 360 degrees travel of said crank.

4. The structure defined in claim 3, in which said exhaust port in said cylinder is so positioned as to cause the exhausting of steam from said cylinder throughout 60 degrees travel of said crank on either side of lower dead center.

5. An engine of the character described comprising in combination, a steam cylinder having an auxiliary compartment in its head, a piston reciprocable in said cylinder, means for continuously injecting an expandible liquid into said auxiliary compartment, means interposed between said cylinder and said compartment and responsive to the speed of the engine for causing intermittent communication between said cylinder and said compartment, and internal combustion means for developing heat simultaneously in and about said cylinder and said auxiliary compartment.

6. An engine of the character described, comprising in combination, a work cylinder having an auxiliary compartment in its head, an exhaust port in said cylinder, a passageway surrounding a substantial part of said compartment and arranged to receive hot gases from an internal combustion mechanism, whereby to heat said compartment, an internal combustion mechanism in communication with said passageway a piston in said cylinder arranged to open and close said port, a crank connected to said piston, means for injecting an expandable liquid into said auxiliary compartment, and means interposed between said cylinder and said auxiliary compartment and responsive to the speed of the engine for causing intermittent communication between said compartment and said cylinder, said last named means including a rotary valve which establishes communication between said compartment and said cylinder during 120° rotation of the said crank.

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