C. A. CLARK.

GAS ENGINE.

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900,083.

Patented Oct. 6, 1908.

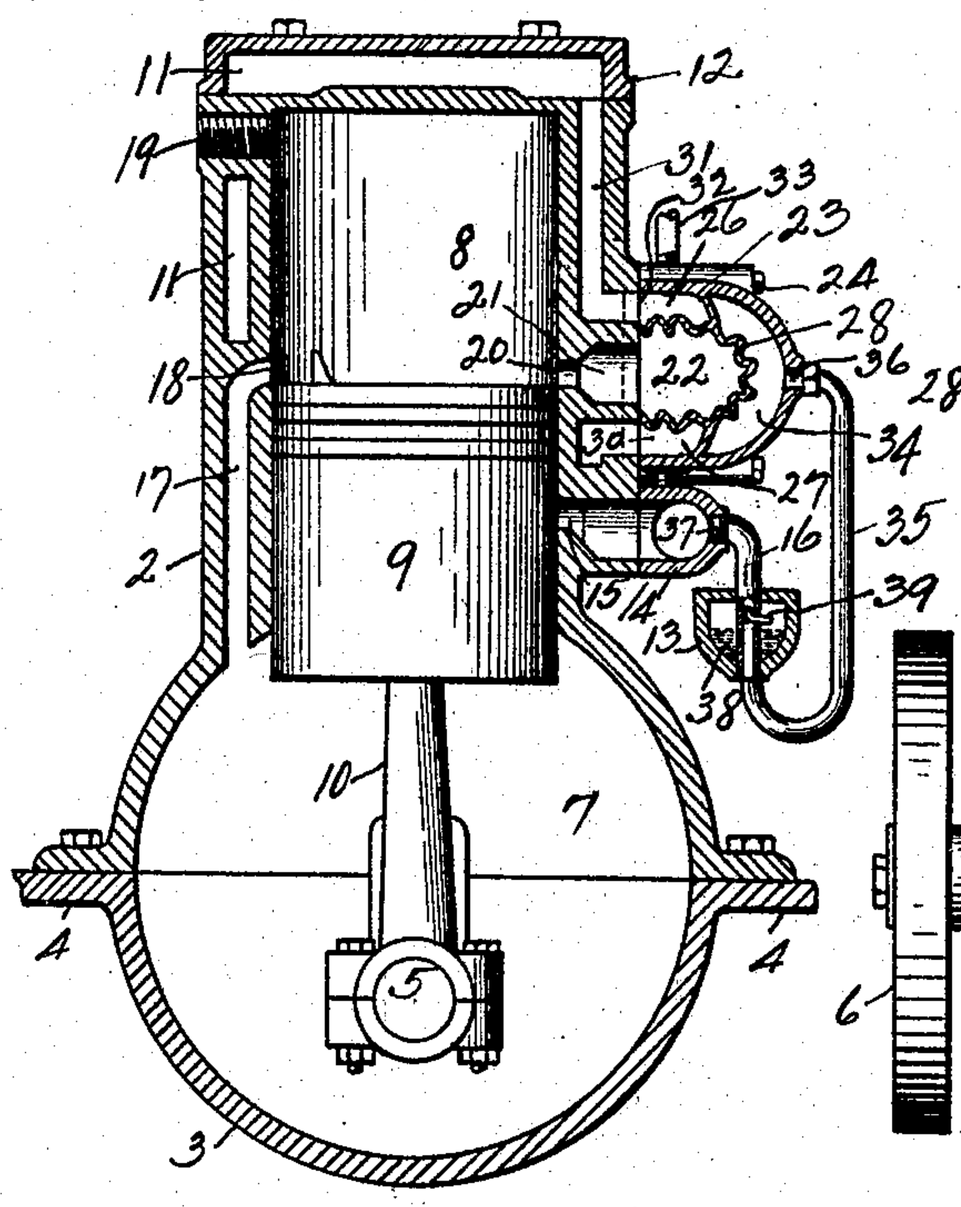

Fig. 2.

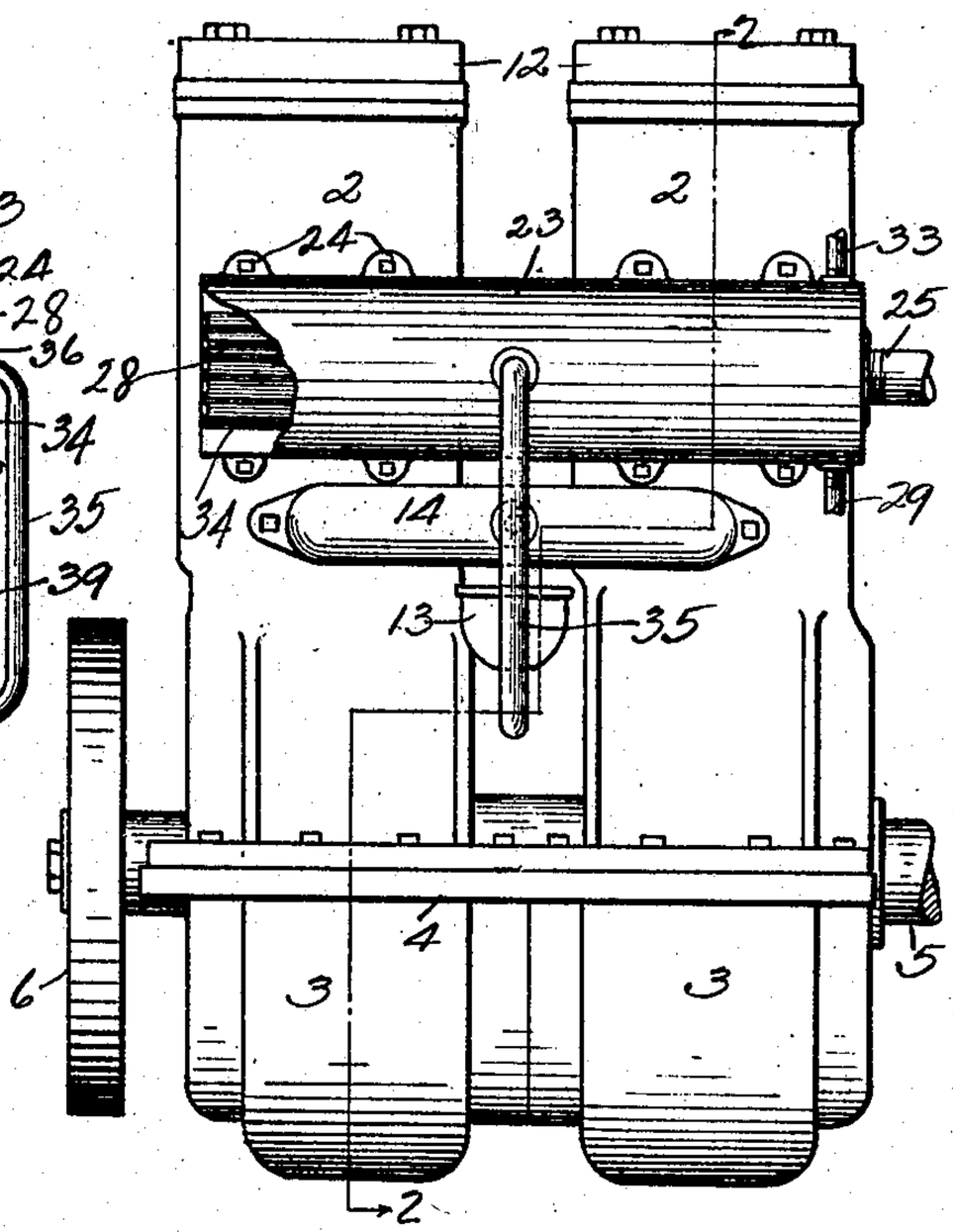

Fig. 1.

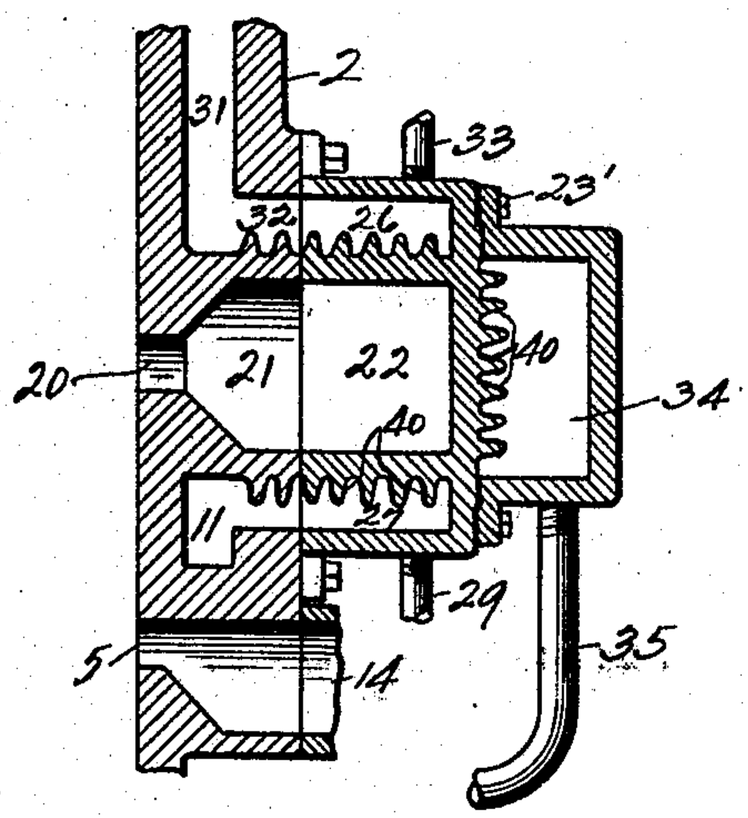

Fig. 3.

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GAS-ENGINE.

No. 900,083 Specification of Letters Patent. Patented Oct. 6, 1908.

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To all whom it may concern:

Be it known that I, CLAUDE A. CLARK, a citizen of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to improvements in gas engines of the class in which water is employed for cooling the cylinders and other parts, and the invention relates particularly to a gas engine in which the exhaust pipe is kept cool by the employment of both water and air under forced circulation.

The object of the invention is to provide an explosive engine for marine and other uses, of simple, compact and durable construction, and wherein the cylinders are provided with water-jackets in which the water is supplied and drawn off by indirect means, thereby eliminating a number of parts and saving considerable labor and expense for construction, as compared with the engines heretofore made.

A particular object of the invention is to provide a main exhaust part having water-jackets for cooling the same, consisting of separate compartments spaced apart and arranged to take the place of water pipes and related fittings commonly employed for supplying and carrying away the water used for cooling the cylinders and other parts of gasolene engines.

A further object of the invention is to provide an air cooling compartment to coöperate with the water-jackets for cooling the exhaust.

The invention consists principally of one or more cylinders each having a piston and other working parts common to engines of the explosive type.

The invention further consists of a carbureter for supplying gas or oil vapor to the cylinders, and an electric spark-coil or other suitable means for igniting or exploding the gas for driving the engine.

The invention further consists of a water-jacket comprising a hollow chamber disposed around the explosion cylinder, through which water may circulate under pressure from a pump or like means.

The invention further consists of an exhaust pipe or part of peculiar form and construction which is mounted on the rear sides of the cylinders. The said exhaust part comprising a one-part casting having a large central cavity or passage connected with the exhaust ports of each of the cylinders, and having its front end closed and its rear end open for the discharge of the burned gas and other matter received from the explosion chamber.

The invention further consists of two separate water-jackets or compartments comprising hollow longitudinal chambers one of which is disposed along the top side of the exhaust-passage, the other disposed oppositely along the under side of said passage, the said water compartments being separated from the exhaust-passage by an integral corrugated wall or a wall provided with radiating ribs, to increase the surface to be cooled by the circulating water. One of said jackets serving as a receiving pipe to carry the water from the pump to the cylinder jacket; the other jacket serving as a conductor to carry the water away from the cylinder-jacket and waste the same.

The invention further consists of a third compartment disposed in a manner to partially surround the exhaust-passage and extending from one water-jacket to the other. This latter compartment preferably extending the full length of the exhaust-passage and having its opposite ends open for the free admission of air at either end. This air compartment is also separated from the exhaust-passage by a corrugated or serrated wall which is provided for cooling the wall of the exhaust-passage, and also for the special purpose of heating the air to be supplied to the carbureter. And the invention further consists of simple means for drawing the tempered air away from the air-compartment and forcing the same through the carbureter.

The invention further consists of the novel features and combinations of parts set forth in the detail description which follows, and then particularly pointed out in the claims, reference being had to the accompanying drawing forming a part of this specification.

Referring to the drawing, Figure 1 is a rear side elevation of a two-cylinder engine, showing the location and manner of applying the exhaust parts and carbureter; also showing, by parts broken away, the arrangement of the radiating ribs of the air-jacket. Fig. 2 is a vertical cross-section substantially on the line 2—2 of Fig. 1, showing the construction and arrangement of the principal parts of the

engine; also showing the exhaust-passage and the arrangement of the separate water-jackets and air-jacket; also showing the carbureter and related parts, and means for supplying the carbureter with air warmed in the air-jacket. Fig. 3 is an enlarged detail sectional view, showing a modified construction of the exhaust, the two water-jackets and the air-jacket.

Similar numbers of reference are assigned to corresponding parts throughout the several views.

In the drawing, 2 represents a cylinder and an integral portion thereof comprising the upper half of the crank-case.

3 represents the lower half of the crank-case formed with a flange 4.

5 represents a crank-shaft which passes through the crank-cases, to one end of which is fitted a balance or fly wheel 6.

7 represents an air-tight hollow compartment comprising the crank-case.

8 represents the explosion chamber or cylinder in which a hollow piston 9 reciprocally operates, the latter connected to the crank-shaft by rod 10.

The working parts of my engine may partake of any of the well known constructions and may be connected up in any suitable manner.

11 represents a hollow chamber cast or formed around the explosion cylinder 8, which comprises a water-jacket adapted to be filled with cold water to prevent the explosion-cylinder from becoming over-heated during the operation of the engine. The water-jacket 11 may be constructed in any suitable manner to properly provide for the cooling of the cylinder.

12 represents a hollow cap mounted upon the upper end of the cylinder 8, in a manner to provide a hollow space between the cap and cylinder-head comprising a part of the main water-jacket. A series of suitable bolts are employed to hold the cap in place.

13 represents a carbureter, disposed at the rear sides of the cylinders in any convenient location, but preferably between the exhaust parts and the crank-case. The carbureter may be of any suitable form and construction to carry out the working of my engine, but preferably consists of a simple part capable of supplying gas to one or two cylinders.

14 represents the carbureter or "manifold", which comprises a hollow part disposed above the carbureter and connected to the crank-case 7, by means of a port 15 formed through the casing 2, and through which the gas enters the crank-case 7 beneath the piston, when the latter is moved to its upper position in cylinder 8.

16 represents a pipe connecting the carbureter with the intake 14.

Vaporized air or gas is drawn from the carbureter into the crank chamber 7, by the suction or vacuum produced by each upward stroke of the piston. At the beginning of each downward stroke of the piston the latter closes the port 15.

17 represents a by-pass formed in casing 2 opposite port 15, its lower end opening into crank cavity 7, its upper end terminating in a port 18.

The gas confined in chamber 7 is compressed by the downward movement of the piston, and when the piston descends to its lowest position it opens port 18, through which the gas is then forced into the lower end of the explosion chamber 8. The initial upward movement of the piston closes the port 18, and the final upward movement again opens the port 15. The piston as it continues its upward stroke compresses the gas at the upper end of chamber 8, and at the instant the piston reaches its highest point of travel, an electric spark is introduced through an opening 19 and ignites the confined gas, an explosion immediately occurs, which forces the piston downwardly again, and so on, during the operation of the engine. After each explosion of the gas in cylinder 8 and the resulting downward stroke of the piston, the gas becomes burned and expanded, and must be expelled from chamber 8, to make room for a charge of fresh gas. In order to get rid of the dead gas, an exhaust port 20 is formed through the rear wall of each cylinder at the lower end of chamber 8, opposite the gas inlet port 18. Port 20 opens into an enlarged cavity of chamber 21 arranged concentric with said port, and the latter is connected with an exhaust passage 22 formed centrally in a member or part 23. Part 23 is preferably made of cast iron in one part, and is disposed horizontally and secured to the rear sides of the cylinders by means of bolts 24, which pass through lugs cast on the upper and lower sides of said part, and are then threaded into the cylinder walls. The front end of the part 23 is closed, but the rear end is preferably open and fitted with an exhaust pipe 25.

The exhaust pipes or parts of all gas engines, being directly connected to the explosion chambers become highly heated by reason of the constant and rapid discharge of the hot exhaust. In the past considerable trouble has been experienced, because of the over-heating of the exhaust parts, which, as a rule, have not been provided with any cooling means. I have found that engines of the class perform their work more effectively and the exhaust parts have a longer wearing life, when the temperature of the exhaust parts is kept as low as possible by some artificial cooling agent. To this end I provide two water compartments or jackets 26 and 27, respectively representing upper and lower water-jackets, each of which consists of a

hollow space or chamber formed in the part 23 outside of the exhaust passage 22, the said compartments, 26 and 27, being separated from said exhaust-passage by corrugated or serrated walls 28. These walls are formed so that the corrugations preferably occur on both sides of the wall. The said walls may however be constructed with a plain inner surface and corrugated or serrated on the outer side next to the water, and produce the same cooling effect.

29 represents a pipe connected to the under side of the rear end of exhaust-jacket 27 through which water received from a pump or other source of supply is forced into said jacket. The water then circulates through the length of jacket 27 and enters the main cylinder-jacket 11 by passing through ports 30. After the water circulates around and cools the main cylinder it rises to and fills the hollow space beneath the cylinder cap 12 from whence it flows downwardly through the narrow duct or passage 31 formed in the water space 11 and then passes through a port 32 into upper exhaust jacket 26. The water is then carried away and wasted through a pipe 33 which connects to the rear end of the jacket 26.

34 represents a large hollow compartment perferably extending the full length of the exhaust member 23 and comprises the space between the integral outer and inner walls of the part 23, extending from the rear edge of the exhaust-jacket 26 partially around exhaust-passage 22 to the rear edge of exhaust jacket 27, thus forming a semi-circular cavity separated from the exhaust-passage 22 by a continuation of the corrugated wall 28. The space 34 comprises an air-jacket having its opposite ends open to admit the atmosphere freely from either direction. This air-jacket is intended in the first instance, to serve as a means for cooling the adjacent portion of the exhaust passage, and the corrugations of the dividing wall are employed for the purpose of providing a greater radiating surface for dissipating the heat and at the same time exposing this greater surface to the cooling action of the air. This air-jacket is provided for another purpose, namely, for heating or tempering the air required for properly carbureting gasolene or oil; it being essential in an engine of this class that the air be heated to a certain extent before it is drawn into the carbureter and converted into gas. In this manner the air-jacket performs two important functions: the cooling of a portion of the exhaust passage by the fresh air when first admitted to the jacket, and the heating or tempering of the air for carbureting by the hot corrugated surface of the wall 28. To draw the tempered air from jacket 34 I provide a conducting pipe 35, which connects with a port 36 formed in the outer shell of the air-jacket. Pipe 35 then extends downwardly and inwardly and then upwardly through the center of the carbureter and connects with the intake 14 by means of a port 37. The tempered air is drawn from jacket 34 by the intermittent suctions or inhalations produced by each upward stroke of piston 9, which draws the gas or vapor from the carbureter and intake through the port 15 as heretofore described. Under this method of connecting the carbureter and jacket 34, there is almost a constant inflow of air through the open ends of the jacket, while the engine is working, which prevents the over-heating of wall 28 of the exhaust-passage adjacent to said jacket, and owing to the frequency of the strokes of the piston, the air required for the operation of the carbureter will not become too hot. The quantity of air required for operating the carbureter and the proper tempering thereof may readily be regulated by the size of the pipe 35 or the port 36. The vaporizing of the oil 38 in the carbureter is effected by means of a small tube 39 which is disposed in the pipe 35 as shown in Fig. 2. This small tube is disposed in a manner to provide a small opening or vent leading from the interior of the pipe 35 into the interior of the carbureter at the point above the level of the oil. By arranging the tube 39 in this manner, its outer end being in the path of the air which is being sucked from jacket 34, the oil vapor in the carbureter, is siphoned out of the latter and incorporated with the warm air taken from jacket 34, thereby producing the gas for operating the engine.

In Fig. 3 I have shown a modified form of the exhaust part 23, which comprises an exhaust-passage 22 having a square bore and having its walls formed plain or flat, the upper and lower water-jackets 26 and 27 being rectangular in cross-section. The outer surface of the dividing wall 28 between the jackets and the exhaust passage is provided with radiating ribs 40 in place of the corrugations shown in Figs. 1 and 2. In Fig. 3 is also shown an air-jacket or compartment 34, which is preferably formed rectangular in cross-section and detachably connected to the main body of part 23 by bolts 23′. The outer surface of the dividing wall between the air-chamber and the exhaust-passage is also provided with the radiating ribs 40. The serrated or ribbed surface 40 is provided for the same purpose as described for the corrugations in Figs. 1 and 2. The ribs 40 and also the corrugations, of the water-jacket 27 are intended specifically for heating the cold water as it first comes from the pump so as to prevent too great a chilling effect upon the cylinder, while at the same time the cold water is intended to reduce the temperature of the exhaust-passage. The corrugations and ribs of the upper exhaust-jacket are intended principally for dissipating the heat

received from the exhaust. The water received by the upper jacket of the exhaust which is drawn from the top of the cylinder jacket 11 through the passage 31 will have a comparatively high temperature and will not have a very great cooling effect upon the upper portion of the exhaust-passage for that reason, but notwithstanding its higher temperature the fact of its being liquid and forced through the jacket by the action of the pump, will prevent the burning out of the upper wall of the exhaust. It is preferred in constructing the three jackets of the exhaust-passage, to give to the air-jacket a larger space than to the water-jackets, so that the air may circulate more freely and rapidly by reason of the rapid inhalations of the air for carbureting. In the modified construction shown in Fig. 3, the means employed for introducing and drawing-off the water from the upper and lower jackets are the same as shown in Figs. 1 and 2, and the means for conducting the air from jacket 34 to the carbureter are also the same excepting that the pipe 35 is preferably connected to the under side of the air-jacket.

By providing an exhaust part 23 arranged and applied as shown, a great saving may be effected in the casting and finishing of the main cylinders, and renders it practical to produce an engine of extremely simple and light design. By reason of the novel and simple methods of supplying and carrying away the water used for cooling the main cylinder and exhaust parts, I not only employ fewer pipes and fittings for the purpose, but am able to supply the jackets of the main cylinders with water which has been tempered to an extent which cannot injure or distort these parts, and still supply water at a temperature sufficiently low to effect a proper cooling of the different parts.

The provision of the air-jacket adds a new element to the cooling of the exhaust, which may be obtained by simply drawing air from the free atmosphere, without requiring any pump or fittings other than the simple air-jacket 34. By the employment of the air-jacket, as shown, the size of the water-jackets for the exhaust is reduced, which renders them more effective, for the reason, in the first instance, that the water is not liable to become too hot before it reaches the main jacket; and in the second place, the hot-water from the main jacket is employed to protect but a small portion of the exhaust-passage on its way to the waste pipe.

It is a natural characteristic of all gas engines, for the gas or vapor to expand, as soon as the explosion takes place in the cylinder. This expansion does not cease at the end of the receding stroke of the piston, but continues for a time after the gas or vapor is discharged into the exhaust part or pipe. The result of this tendency to prolonged or continued expansion, especially in the case of gas engines, is to effect a choking of the exhaust passage to such an extent that a back pressure is exerted upon the explosion chamber, which materially lowers the efficiency of the engine in both speed and power. A large number of marine engines in use at present, are equipped with submerged exhausts, which are employed chiefly because they serve the desired purpose of a muffler or deadener of the annoying sounds of the exhaust, and these appliances are usually provided with an expansion chamber, which is disposed between the engine and the discharge nozzle. The expansion chamber having a lower temperature than the exhaust pipe leading to it, creates a slight condensation of the gas and vapor and thereby lessens the tendency of the exhaust parts to become choked and the discharge to be retarded. It is an object of my invention to accomplish this desirable result without the necessity of providing any extra parts, such as the expansion tank or chamber referred to. As hereinbefore explained, the cold water employed for cooling my engine and exhaust parts, is first admitted into the lower jacket 27 of the exhaust, and from this part it flows into and circulates around and over the explosion chamber. Applying the water at its lowest temperature to the lower compartment 27, brings the water into contact with a comparatively large area of the surface of exhaust-passage 22, where it exerts a cooling effect upon the walls of said passage sufficient to cause a condensation of the hot gas and vapor within the said passage, and the result is that there is no tendency whatever for the exhaust chamber to become choked. The water in turn is also slightly tempered by passing through the lower exhaust-jacket so that when it enters the main jacket of the cylinder it is not too cold. The air drawn into the air-jacket 34 will exert a similar influence upon, and materially increase the condensation in the exhaust.

Any number of cylinders may be joined to form an engine, and the exhaust-passage may be cast in different lengths to suit the size of the engine. The only change required to be made in the said parts, for the different sized engines being in the number of the ports for the exhaust and for the passage of the water out of one jacket and into the other jacket of the exhaust.

Under the construction and arrangement of the parts as shown and described herein, I am able to greatly reduce the number of water pipes and other fittings, and to accomplish the cooling of the various parts of my engine, as well as, to supply warm air for the carbureter in a simpler, more effective and less expensive manner than has heretofore been done.

Obviously some changes or modifications

may be made in the parts of the engine without departing from the spirit of my invention, and I therefore do not wish to restrict myself to the precise construction and arrangement of the same, as herein shown and described.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is—

1. An explosive engine, comprising a cylinder having a water-jacket and an exhaust port, an exhaust-member mounted on the side of the cylinder and connected thereto by means of said port, separate water-spaces to cool said exhaust-member, one of said water-spaces disposed on top, the other disposed on the underside of said exhaust-member, a port to connect said lower water-space with the lower end of the jacket of said cylinder, a port to connect said upper water-space with the top of said cylinder jacket, an inlet to connect said lower water-space with a source of cold water supply, an over-flow pipe connected to said upper water-space for drawing the hot-water away from said cylinder, an air-jacket disposed concentric to said exhaust-member between said upper and said lower water-space, a carbureter operatively connected to said cylinder, and a pipe connecting said air-jacket with said carbureter, adapted to conduct hot-air from the air-jacket to said carbureter, substantially as described.

2. An explosive engine, comprising a cylinder surrounded by a water-jacket, an exhaust port in said cylinder, an exhaust-member having an exhaust-passage connecting with said port, a water-space disposed along the underside of said exhaust-passage connecting with the lower end of the jacket of said cylinder, a water-space disposed along the upper side of said exhaust-passage connecting with the upper end of the jacket of said cylinder, an air-jacket disposed along the outer side of said exhaust-passage between said water-spaces, the opposite ends of said air-jacket being open to admit air drawn from the atmosphere, a carbureter disposed at the rear side of said cylinder, an intake mounted on the rear side of said cylinder, and a pipe forming a passage for hot-air from said air-jacket through said carbureter into said intake, substantially as described.

3. An explosive engine, comprising a cylinder having an exhaust port, an exhaust-member having an exhaust-passage disposed centrally therein and connecting with the exhaust port of said cylinder, the said exhaust-passage formed by a corrugated wall inclosed in a concentric casing, a water-jacket disposed on the upper side of said exhaust-passage, a water-jacket disposed underneath said exhaust-passage, and an air-jacket disposed concentric to said exhaust-passage between said water-jackets, adapted to coöperate with said water-jackets for cooling said exhaust-passage, substantially as described.

4. In a gas engine, the combination with a cylinder having a water-jacket formed around and above the same, and having an exhaust port, of an exhaust-passage formed by a corrugated wall and connecting with the port in said cylinder, the said exhaust-passage surrounded by an integral outer casing disposed parallel to said corrugated wall, a water-space disposed on the upper side of said passage between said casing and said corrugated wall, a water-space disposed on the underside of said passage between said casing and said corrugated wall, an inlet-pipe to connect the lower water-space with a source of cold-water supply, a port to connect the lower water-space with the water-jacket of the cylinder, a port to connect the upper water-space with the water-jacket of the cylinder, a pipe to drain the water from the upper water-space, an air-jacket disposed between said casing and said corrugated wall the upper and lower edges thereof abutting the outer edges of said upper and said lower water-spaces, the opposite ends of said air-jacket being open for the admission of air to cool said exhaust-passage, the air in said air-jacket adapted to be heated by contact with said corrugated wall, a carbureter attached to the rear side of said cylinder, and a pipe to conduct the heated air from said air-jacket to said carbureter, substantially as described.

5. In an exhaust engine, the combination with a plurality of explosion cylinders having separate water-spaces, each cylinder provided with an exhaust port, of an exhaust-member comprising a one-part casting having a central passage formed by a corrugated wall inclosed in an integral outer shell and connecting with the exhaust port of each cylinder, a water-jacket disposed on the upper side of said central passage and connected to the water-space of each cylinder, a water-jacket disposed underneath said central passage and connected to the water-space of each cylinder, and an air-jacket comprising a hollow compartment having its opposite ends disposed concentric to said central passage between said upper and said lower water-jacket, adapted to coöperate with said water-jackets for cooling said central passage, substantially as described.

6. In an explosive engine, the combination with a cylinder surrounded by a water-compartment and provided with an exhaust port, of a member having a central exhaust-passage formed within a corrugated wall and connected with the exhaust port of said cylinder, the said member having a plain outer casing arranged concentric to and spaced from said corrugated wall, a water-jacket

formed in the upper side of said member between said casing and said wall, and connected with said water-compartment, and having an outlet port for wasting water received from said water-compartment, a water-jacket formed in the under side of said member between said casing and said wall connected to said water-compartment, and having an inlet-port for receiving cold water for cooling said exhaust-passage and said cylinder, and an air-jacket formed in said member between said casing and said wall and between said water-jackets, adapted to coöperate with said water-jacket for cooling said exhaust-passage, substantially as described.

7. In an explosive engine, the combination with a cylinder surrounded by a water-compartment and provided with an exhaust port, of a member having a central exhaust-passage connected with the exhaust port of said cylinder, the said member having a plain outer casing arranged concentric to said exhaust-passage, a water-jacket formed in the upper side of said member between said casing and said exhaust-passage and connected with the water-compartment, and having an outlet-port for wasting hot-water received from said water-compartment, a water-jacket formed in the under side of said member between said casing and said exhaust-passage and connected to the water-compartment of the cylinder and having an inlet-port for receiving cold-water for cooling said exhaust-passage and said cylinder, an air-jacket formed in said member between said casing and said exhaust-passage and between said water-jackets, adapted to coöperate with said water-jackets for cooling said exhaust-passage, a carbureter operatively connected with the cylinder, and a pipe connecting said air-jacket with said carbureter adapted to supply said carbureter with air tempered by the heat of the exhaust, substantially as described.

8. A gas engine, comprising a plurality of cylinders, each having a water-jacket and an independent exhaust port, an exhaust-member comprising a one-part casting secured in horizontal position to the rear sides of said cylinders, said exhaust-member having a common central passage open at one end and connecting with each cylinder by means of said exhaust ports, a water-space comprising a longitudinal compartment, one disposed above and the other disposed beneath said central passage, a pipe connecting to the lower compartment adapted to supply cold-water to said compartment, ports for the passage of the water from said lower compartment into the jackets of said cylinders, ports for the passage of the water from the top of each cylinder into said upper compartment, an air-jacket comprising a chamber having open ends partially surrounding said central passage and extending from one exhaust water-space to the other, an intake mounted on the rear sides of said cylinders beneath said exhaust-member, a port to connect each cylinder with said intake, a pipe connecting at one end with air-jacket the other end connecting with said intake, and a carbureter mounted on said pipe between said air-jacket and said intake, substantially as described.

9. In combination with the cylinder of an explosive-engine having a water-jacket, an exhaust-pipe having an outer casing and two oppositely disposed water-spaces between the outer casing and said exhaust pipe, an air-space disposed between said exhaust-pipe and said casing and between said water-spaces, means for circulating water through one water-space of the exhaust-pipe to the water-jacket of the cylinder, and from the water-jacket of the cylinder to the second water-space of the exhaust-pipe, a carbureter mounted in operative position on the side of the cylinder, and a pipe to conduct air from said air-space to the carbureter, substantially as described.

10. An explosive engine, comprising a cylinder provided with water-spaces and an exhaust port, a corrugated exhaust-pipe inclosed in a casing and connected with the exhaust port of the cylinder, a water-jacket disposed on the upper side of said exhaust-pipe, a water-jacket disposed on the under side of said exhaust-pipe, a pipe for supplying cold-water to the lower jacket of said exhaust-pipe, a pipe to carry away the water from the upper jacket of said exhaust-pipe, and an air-jacket disposed between said exhaust-pipe and casing and separating said upper and lower water-jackets, substantially as described.

11. An explosive-engine, comprising a cylinder provided with water-spaces, an exhaust-pipe inclosed in an integral outer shell two water-jackets disposed between said pipe and said shell for cooling said exhaust-pipe, one of said jackets disposed on the upper side, the other jacket disposed on the under side of said exhaust-pipe, an air-chamber disposed concentric to said exhaust-pipe between said water-jackets, a carbureter to supply gas to the cylinders, an intake interposed between the carbureter and cylinder, and a pipe connecting said air-chamber with the carbureter and intake, adapted to supply the carbureter with air tempered by the heat of said exhaust-pipe, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

CLAUDE A. CLARK

Witnesses:
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MAY M. WALSH.