No. 722,787. PATENTED MAR. 17, 1903.

G. WESTINGHOUSE & E. RUUD.

GAS ENGINE.

APPLICATION FILED MAR. 31, 1898.

NO MODEL. 3 SHEETS—SHEET 1.

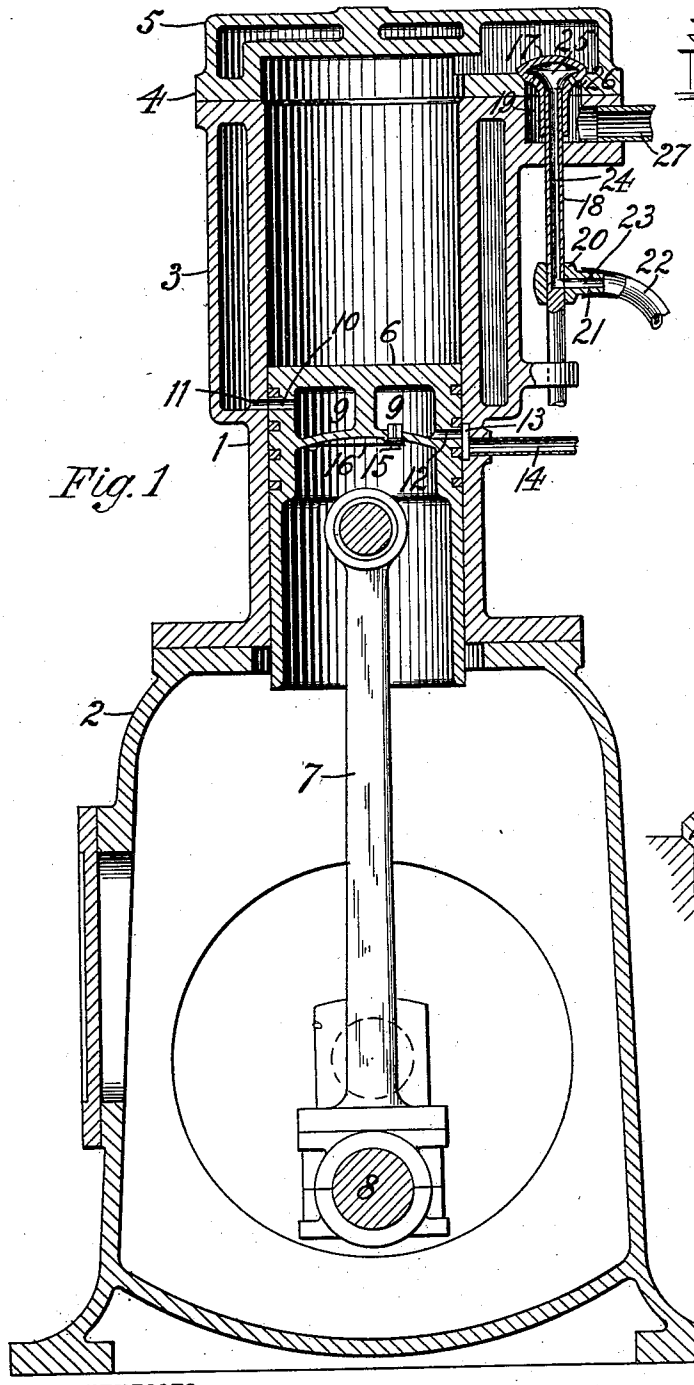


Fig. 1

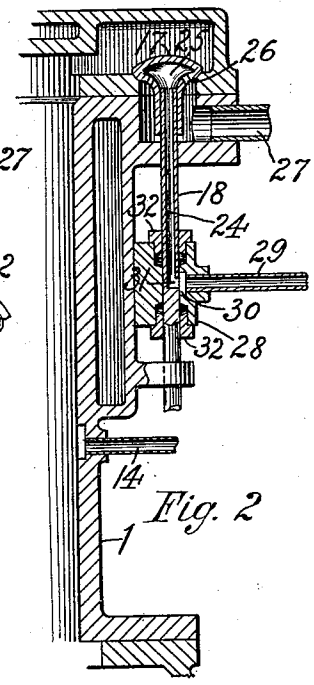
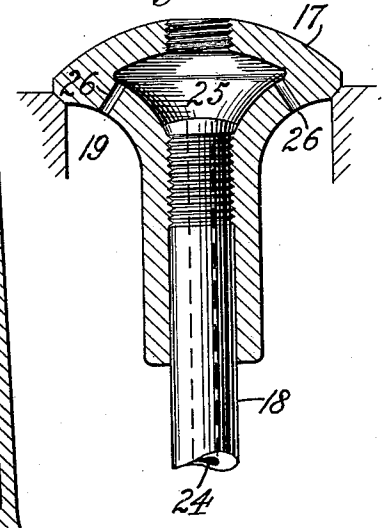


Fig. 2

Fig. 3



WITNESSES:

W. C. Dodicke

Ethel Gallagher

INVENTORS,

George Westinghouse, &

Edwin Ruud,

by T. J. Hogan, Att'y.

No. 722,787. PATENTED MAR. 17, 1903.

G. WESTINGHOUSE & E. RUUD.

GAS ENGINE.

APPLICATION FILED MAR. 31, 1898.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 5

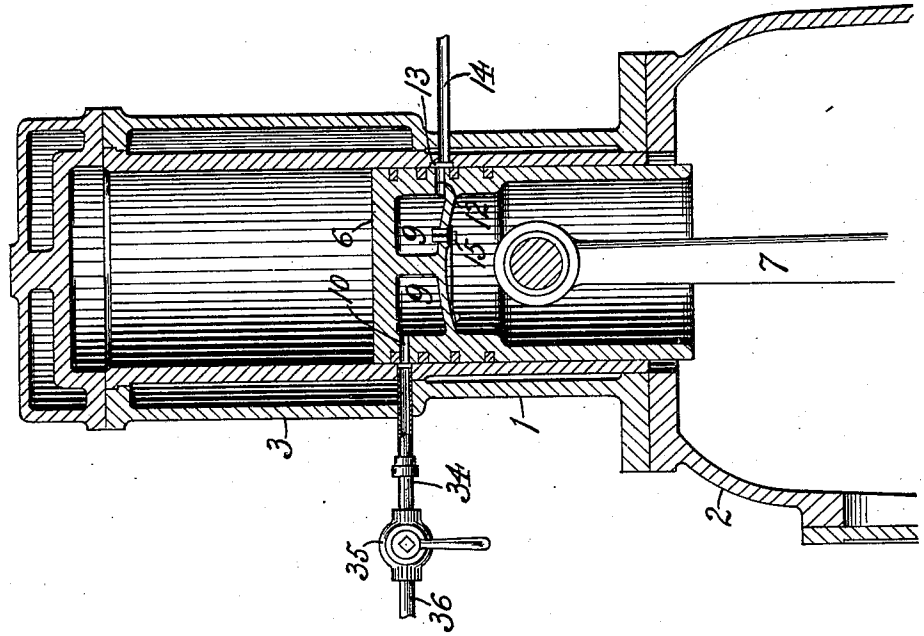
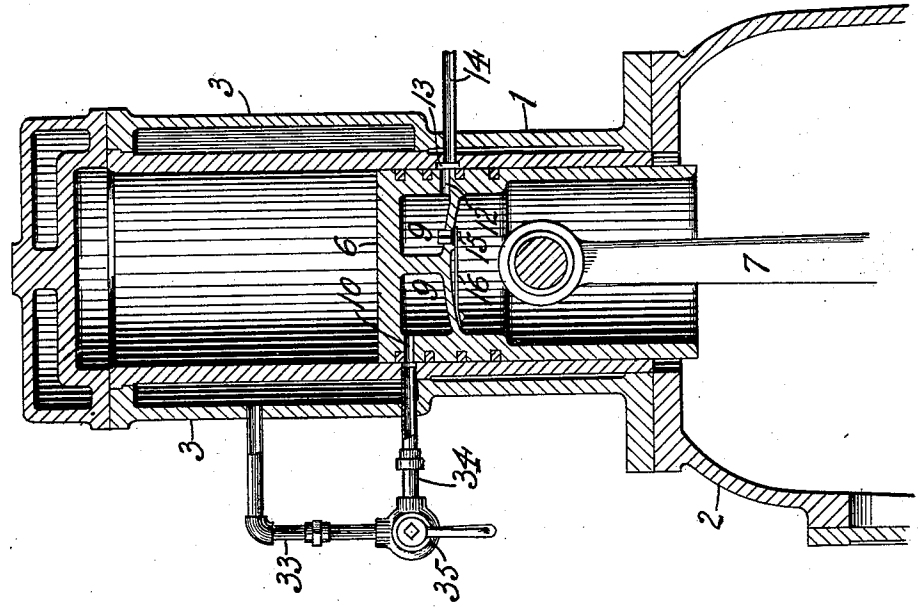


Fig. 4



WITNESSES:

W. E. Doolittle

Ethel Gallagher

INVENTORS,

George Westinghouse, &

Edwin Ruud,

by T. J. Hogan, Att'y.

No. 722,787. PATENTED MAR. 17, 1903.

G. WESTINGHOUSE & E. RUUD.

GAS ENGINE.

APPLICATION FILED MAR. 31, 1898.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 6

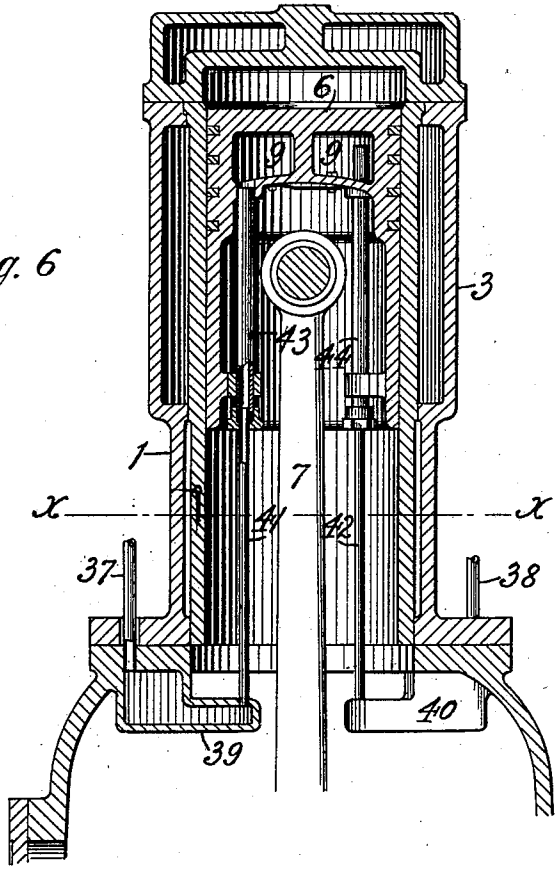
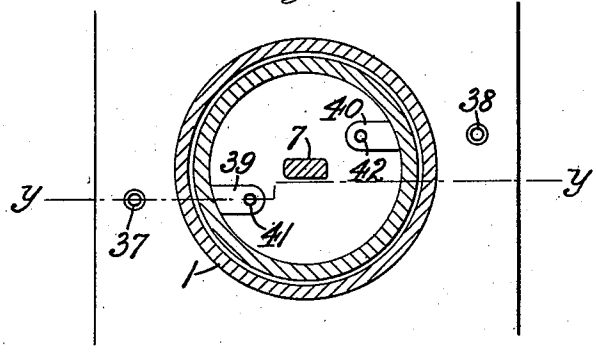


Fig. 7



WITNESSES:
W. E. Doolittle
Ethel Gallagher

INVENTORS,
George Westinghouse, &
Edwin Ruud,
by T. J. Hogan, Att'y

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE AND EDWIN RUUD, OF PITTSBURG, PENNSYLVANIA, ASSIGNORS TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 722,787, dated March 17, 1903.

Application filed March 31, 1898. Serial No. 675,891. (No model.)

To all whom it may concern:

Be it known that we, GEORGE WESTINGHOUSE and EDWIN RUUD, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Gas-Engines, of which improvement the following is a specification.

The object of our invention is to provide an improvement in internal-combustion engines; and to this end it consists in means for cooling certain movable parts of the engine and in certain combinations and features of construction hereinafter set forth.

In the accompanying drawings, which illustrate applications of our invention, Figure 1 is a central vertical section through the cylinder and crank-case of an internal-combustion engine, showing an embodiment of our invention; Fig. 2, a section on the same plane as Fig. 1, but showing only a part of the engine-cylinder with a modification of the means whereby a cooling fluid may be supplied to the exhaust-valve of the engine; Fig. 3, an enlarged sectional view of the exhaust-valve shown in Figs. 1 and 2; Fig. 4, a sectional view showing a modification of our improvement by which the cooling fluid is supplied from the water-jacket of the cylinder to the interior of the piston; Fig. 5, a section similar to that of Fig. 4, showing means for supplying the cooling fluid from a source outside of the cylinder-jacket; Fig. 6, a sectional view on the line $y\ y$ of Fig. 7, showing a further modification in which the fluid may be supplied to and discharged from the piston through a sliding or telescopic connection; and Fig. 7, a section on the line $x\ x$ of Fig. 6.

In internal-combustion engines the exhaust-valve and the end of the main piston on which the working pressure is exerted are exposed to the action of the hot gases during the whole of the working and exhaust strokes of the engine, and the consequence is that if unprovided with means for cooling they will always be at a very high temperature and in some cases sufficiently high to prematurely ignite the gas. By our invention efficient and comparatively simple and inexpensive means are provided for circulating a cooling fluid through these parts, and thereby preventing any objectionable degree of heating.

In Fig. 1 of the drawings the cylinder 1 of the engine is mounted on a crank-case 2 and is surrounded on a part of its length by a jacket 3, within which a cooling medium is circulated for the purpose of preventing injurious overheating of the cylinder. The cylinder-head 4 is provided with a jacket 5, and the space through which the cooling medium is passed around the cylinder is preferably in communication with the space inclosed by the jacket or cylinder-head. The main piston 6 is connected by a connecting-rod 7 with the crank 8 on the main shaft, and in the upper portion of the piston is formed a chamber 9, which is provided with a port or passage 10, so located that it is adapted to register with a passage 11 in the wall of the cylinder when the piston is at or near the lower end of its stroke. The passage 11 communicates with the interior of the jacket 3, and when the piston is at or near the lower end of its stroke the chamber 9 is in communication with the interior of the jacket 3. A passage 12 through the wall of the piston is adapted to connect the chamber 9 with a port or cavity 13 when the piston is at or near the lower extremity of its stroke, and a pipe or passage 14 leads from the cavity 13.

When a cooling fluid is supplied to the jacket around the cylinder and the piston 6 moves into position to connect the ports or passages 10 and 11, a portion of the cooling fluid will pass through those passages into the chamber 9 in the piston 6, and at the same time and during the time that the passage 12 is in communication with the cavity 13 fluid will flow from the chamber 9 through the passage 12 and cavity 13 and be discharged through the pipe or passage 14. When the piston moves from the position which it occupies in Fig. 1 and during its upward-and-downward

stroke, the flow through the passage 11 from the jacket and the flow through passage 12 from the chamber 9 will be cut off and chamber 9 will be kept charged with fluid during the upward-and-downward stroke of the piston. When the piston approaches the end of its downward stroke, the passage 12 will register with the cavity 13 before the passage 10 registers with the passage 11, and there will be little or no resistance to the passage of the cooling fluid into the chamber 9 through the passages 11 and 10.

If water or other liquid be employed as the cooling fluid, it may flow to and through the pipe 14 by the action of gravity only, or it may, if preferred, be forced through and out of the piston under pressure, no matter what the fluid may be.

In order to avoid explosion by pressure generated from the fluid within the piston, we may provide a safety or relief valve 15 for controlling a passage leading from the chamber 9 into the open-ended trunk of the piston and through which the pressure may be relieved and fluid discharged into the crank-case. The valve 15 is normally held to its seat by spring 16.

In order that the pipe 14 and cavity 13 may be quickly and surely cleared of water before the return of the piston, it is preferred that the lower end of the piston should pass above the cavity 13, or at least partly uncover it, when the piston moves to the upper end of its stroke, so as to permit water to drain therefrom into the crank-case.

As shown in Figs. 1, 2, and 3, the exhaust-valve 17 is provided with a downwardly-extending stem 18, which may be operated by any preferred means so as to open and close the exhaust-passage 19 at the proper times, and the valve and stem are made hollow and provided with means for circulating water or other cooling fluid therethrough.

In Fig. 1 of the drawings a collar 20 is clamped or otherwise rigidly secured on the stem 18, and a nipple 21, formed on the collar, is provided with a passage 23, which connects at one end with the passage 24, formed on the stem 18, and which at its other end opens into the flexible pipe or hose 22, which is secured to the nipple 21. The flexible pipe or hose 22 may be connected with any pipe, passage, or vessel from which the cooling fluid is to be supplied, and it should be of such length and flexibility as to permit the necessary reciprocating movement of the stem 18, by which the valve is opened and closed. The cooling fluid passes through the pipe 22, passages 23 and 24, and fills the chamber 25 in the valve 17, from which it flows through the passages 26 into the exhaust-passage 19 and is discharged with the burned gases through the exhaust-pipe 27.

In Fig. 2 of the drawings the valve and its stem are of substantially the same construction as the valve and stem shown in Fig. 1; but the means for connecting the passage 24 in the stem with the water-supply are somewhat different. Instead of supplying the water or other cooling fluid through a flexible pipe or hose the end of which is movable with the stem 18 we provide a bracket 28, which is rigidly secured to a fixed part of the engine or frame and which has a passage through it in which the stem 18 is adapted to reciprocate. The port 31 at the lower end of the passage 24 in the stem 18 opens into this passage in the bracket and communicates with a cavity or chamber 30, to which the cooling fluid is supplied through the pipe 29, and the movement of the stem 18 is such that the port 31 never passes beyond the stuffing-boxes 32, which are provided to prevent leakage around the stem.

In Fig. 4 of the drawings we have shown a modification of the means for cooling the piston in which the fluid is supplied from the cylinder-jacket through outside connecting-pipes 33 and 34 in order that the supply of water or other cooling fluid which is admitted to the interior of the piston may be regulated at will by means of the valve 35.

In Fig. 5 the cooling fluid is supplied through a pipe 36 from any external source, and the quantity of fluid admitted through the pipe 34 is controlled by a valve 35.

In Figs. 6 and 7 of the drawings we have shown a modification in which the fluid is supplied to the interior of the piston and discharged therefrom through telescopic or sliding pipe connections. Pipes 37 and 38 communicate with the interior of the boxes or cored-out projecting parts 39 and 40, which may be secured to or formed integral with the crank-case. Pipes 41 and 42 are connected at one end to the boxes 39 and 40, and their opposite ends open into the pipes 43 and 44, which are secured to the piston 6 and communicate with the chamber 9 in the piston. The ends of the pipes 43 and 44 are provided with stuffing-boxes which fit around and slide on the pipes 41 and 42 as the piston moves up and down and which prevent leakage of the cooling fluid. Either of the pipes 37 or 38 may be employed as the supply-pipe and the other as the discharge-pipe. If the fluid enter through the pipe 37, it will pass through the box 39, pipes 41 and 43, through the chamber 9 in the piston, and will be discharged through the pipes 44, 42, or 40 and pipe 38.

By means of the construction shown in Figs. 6 and 7 a continuous circulation of fluid through the piston may be obtained.

We claim as our invention and desire to secure by Letters Patent—

1. In an internal-combustion engine, a hollow exhaust-valve having one or more ports in its shell through which the cooling fluid

that is supplied to the interior of the valve is discharged into the exhaust-passage.

2. In an internal-combustion engine, an exhaust-passage, a hollow exhaust-valve having one or more ports in its shell and having a hollow stem through which a cooling fluid is supplied to the valve to be discharged through the port or ports into the discharge-passage.

In testimony whereof we have hereunto set our hands.

GEO. WESTINGHOUSE.
EDWIN RUUD.

Witnesses:
H. A. CROOKS,
W. D. UPTEGRAFF.