(No Model.)

W. ST. G. ELLIOTT, Jr.

GAS HEATER FOR INTERNAL COMBUSTION ENGINES.

No. 523,628. Patented July 24, 1894.

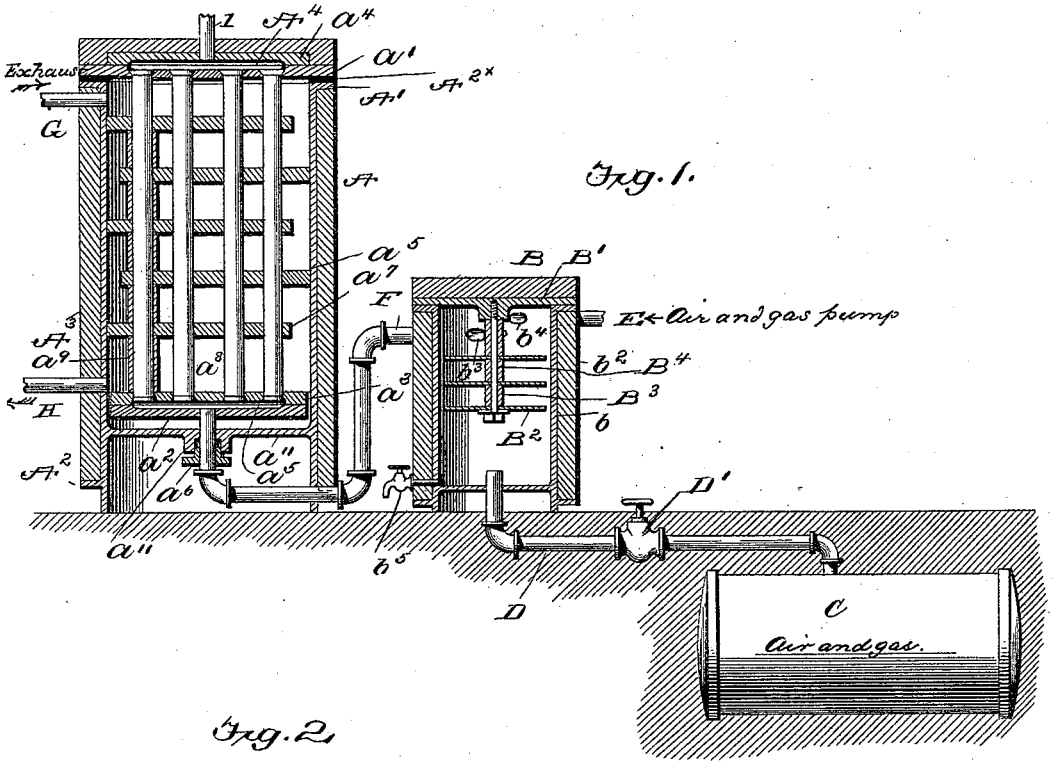

Fig. 1.

Fig. 2.

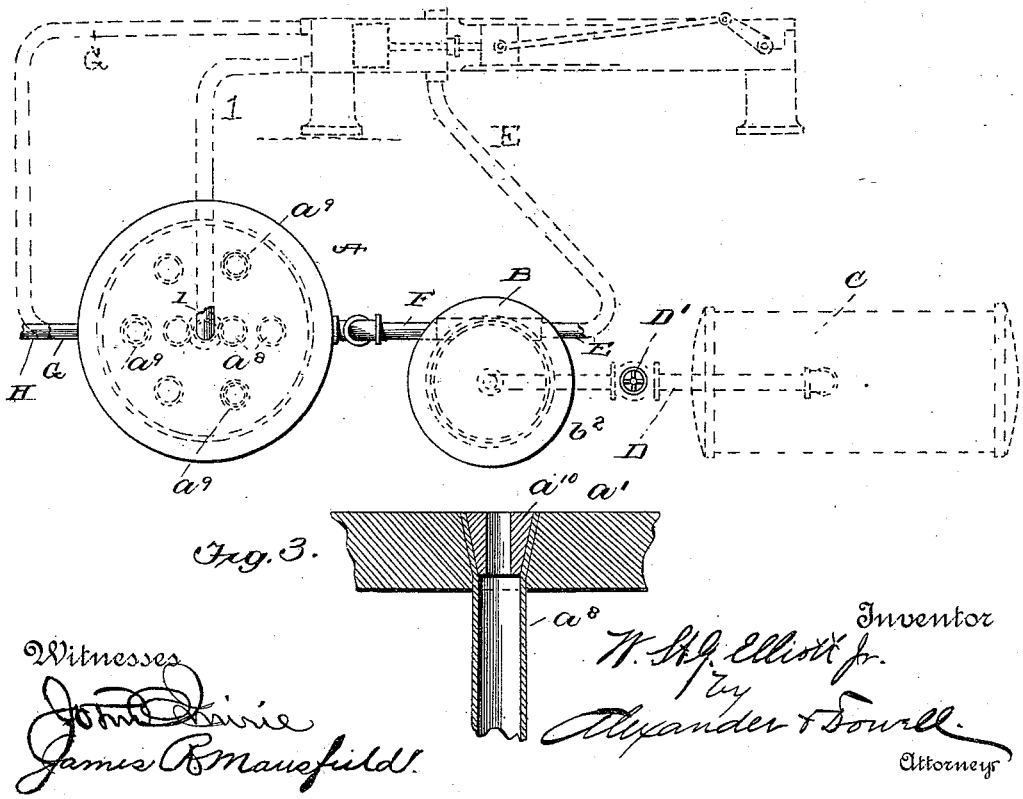

Fig. 3.

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GAS-HEATER FOR INTERNAL-COMBUSTION ENGINES.

SPECIFICATION forming part of Letters Patent No. 523,628, dated July 24, 1894.

Application filed November 12, 1892. Serial No. 451,774. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ST. GEORGE ELLIOTT, Jr., of Walden, in the county of Orange and State of New York, have invented certain new and useful Improvements in Gas-Heaters for Internal-Combustion Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

My present invention is designed for use in connection with those forms of internal combustion engines in which the charging gas is compressed into a receiver and thence admitted into the cylinder or exploding chamber, of the engine and burned.

My invention has especial reference to the gas storing and heating apparatus, and its objects are to first:—to improve the construction of the gas heater or regenerator, and second:—to prevent the hot compressed gases from mingling with the cold gases in the receiver during the working of the engine as to lose their heat, and therefore the invention briefly consists in the novel construction of the regenerator, and in the means of securing the tubes therein; in a novel separator for preventing free mixture of the gases from the pump with those in the receiver, and in novel combination and arrangement of parts hereinafter described and claimed.

In the drawings;—Figure 1 is a central vertical longitudinal section through the regenerator, separator, and side view of a receiver. Fig. 2 is a plan view of Fig. 1, indicating the engine and pump by dotted lines. Fig. 3 is a detail showing the manner of fastening the regenerator tubes.

Referring to the drawings by letters, A represents the regenerator, B the separator communicating with the regenerator by a pipe F; and C the receiver communicating with the separator by a pipe D. The regenerator is constructed of an outer shell a^5 closed near its lower end by a head a'', and having an exterior flange A' A^2, at top and bottom, between which is an exterior lagging A^3 of non-heat-conducting material. Within this shell are a series of vertical tubes a^8 made preferably very thin, so as to transmit heat rapidly, these tubes are connected at their upper ends to a head a' which closes the upper end of shell a^5 and is bolted or otherwise secured to flange A', a suitable gasket $A^{2\times}$ being placed therebetween. The lower ends of these tubes are secured in and to a second head a^3 of less diameter than the interior of the tube, so that it can move longitudinally thereof. In practice I desire to make these tubes so thin that the ordinary manner of securing them to the heads by upsetting or flanging their ends would be unserviceable, therefore I make the openings in the heads conical and drive conical hollow plugs a^{10} into the ends of tubes, as shown in Fig. 3. This expands the ends of tubes and secures them without weakening them, and I herein disclaim the use of conical-threaded plugs as they would be unserviceable and in connection with the thin tubes I employ.

Over and to head a' I secure a plate a^4. The adjoining faces of the plate and head are recessed as shown to form a chamber A^4 with which the upper ends of all the tubes communicate. A plate a^2 is secured to the under surface of head a^3 and the adjoining faces thereof recessed, forming a chamber A^5 with which the lower ends of the tubes communicate. Pipe F connects with this chamber A^5 by one end, which passes through a stuffing box a^6 on head all so as to permit the pipe end to rise and fall with head a^3 owing to contraction or expansion of the tubes.

The chamber A^4 communicates by pipe l with the exploding chamber or cylinder of the engine.

The interior of the shell, exterior to tubes a^8 is filled with the heated exhaust or exploded gases from the engine, which enters at one end of shell through pipe G, and leaves at the other end through pipe H. In order to bring the exploded gases into close contact with the tubes, I employ a series of partition plates a^7 which are placed one above the other in the shell and through suitable openings in which the tubes pass. The plates are cut away at one edge, to leave a passage for the gases, and are so arranged that the gases must move alternately across the tubes, in a zig-zag direction, in passing from pipe G to pipe H. The plates are spaced apart by means of sleeves a^9, on some of the tubes about three sleeves being employed under each plate.

The sleeves fit the tubes closely, and the tubes fit closely in the openings of the plate so that the heat can be extracted from the waste gases and delivered to the gas in the tubes both by radiation and conduction.

The "separator" consists of a shell b, similar to, but smaller than shell a^5, closed at top by a plate B', and covered exteriorly by a lagging b^2 of non-heat-conducting material. The pipe F communicates with the interior of the separator by a tangential opening b^3 near its upper end, and above opening b^3 is another tangential opening b^4 which communicates with a pipe E leading to a gas pump. B^2, B^2, are a series of disks suspended by a bolt B^4 within the separator one above the other, but all below openings b^3, said disks being separated by sleeves B^3 on the bolt. The pipe D enters the lower end of separator, below the disks. The receiver is of any desired construction, of sufficient size and strength to hold a quantity of gas under pressure. A valve D' is put in pipe D to prevent leakage from the receiver when the engine is not running.

The separator has a draw-off cock b^5 for drawing out any condensed oils or moisture.

In operation the receiver is filled with gas under pressure and when the engine is started the gases from the pump, heated by compression are forced into the separator B and owing to the location of openings b^3, b^4, the incoming gases are kept in the upper part of the separator, the cooler gases in the lower part thereof crowding back into the receiver, then at the proper time the warm gases are sucked from the separator, into the exploding chamber through pipe F and connections and if any extra amount of gas is required it is taken from the receiver, and if an over supply of gas is pumped into the separator it is stored in the receiver. The separator also is useful to cause the precipitation of any oil or moisture with which the gases might be saturated. The compressed gases are forced through tubes a^8, being heated during their passage therethrough by the exterior burned gases, in the regenerator, and the tubes can be made very thin without damage as the greatest pressure is on their interior and as the tubes and lower head are freely suspended in the shell there is no danger of injury from expansion and contraction of parts, due to change of temperature. When pipes E and F are in line they are set at different levels in order that no eddies will be caused in the separator as would be if they were on a level, as the pumping in and drawing out of gases does not usually occur at the same time.

The separator is useful by itself, to save the heat of the gases from the pump, and so the regenerator is useful without the separator, hence I desire to claim them when used separately or together.

I may employ a single cylinder and piston in my engine, utilizing one end of the cylinder at one side of the piston as the air pump, and the other end of cylinder, at opposite side of the piston as the exploding chamber. In Fig. 2 I have indicated by dotted lines a single acting engine connected with the above described apparatus, thus of course the form of engine may be varied,

Having thus described my invention, what I wish to secure by Letters Patent thereon, is—

1. For a gas engine a regenerator consisting of a series of tubes connected to chambered heads and suspended by one of said heads within a close vessel one of said heads being free to move in the vessel, so that the tubes can freely expand or contract, the respective chambered heads communicating with a gas inlet and outlet pipes, substantially as described.

2. The combination of the shell having a bottom, a series of tubes connected to chambered heads and suspended in said shell, the lower head being free to move in the shell and the upper head closing the upper end of the shell, gas inlet and outlet pipes respectively communicating with the chambers in said heads, and inlet and outlet pipes for conducting heated gases through the shell, exterior to the tubes, substantially as specified.

3. For a gas engine a regenerator consisting of a series of tubes connected to chambered heads and suspended by one of said heads within a close vessel, so that the tubes can freely expand or contract one of said heads being free to move in the vessel, the respective chambered heads communicating with gas inlet and outlet pipes, a series of partitions in said vessel, forming a zig-zag passage around the tubes, and inlet and outlet pipes connecting with the opposite ends of said passage, substantially as set forth.

4. The combination of the shell having a bottom, a series of tubes connected to chambered heads and suspended in said shell, the lower head being free to move in the shell and the upper head closing the upper end of the shell, gas inlet and outlet pipes respectively communicating with the chambers in said heads, and inlet and outlet pipes for conducting heated gases through the shell, exterior to the tubes, and a series of plates arranged in the shell between the heads, substantially as described.

5. The combination of a closed cylindrical vessel with an inlet and outlet pipe, communicating tangentially therewith at one end and at different levels, substantially as set forth.

6. The combination of the closed vessel a gas receiver communicating therewith, at one end, and a gas supply pipe and outlet pipes communicating therewith near the other end, substantially as described.

7. The combination with a pump, a receiver and a regenerator of a separator consisting of a closed vessel having inlet and outlet openings b^3, b^4 respectively communicating with

the regenerator and pump, and the disks B^2 suspended therein below the openings and a communication between the separator and receiver below said disks, substantially as specified.

8. The combination with a pump, a receiver and a regenerator, of a separator consisting of a closed vessel having inlet and outlet openings b^3, b^4 respectively communicating with the regenerator and pump, and the pipe leading from the receiver into the lower end of the separator, substantially as set forth.

9. The combination with the shell closed at bottom, the head a' closing the upper end of said shell, the chambered plate a^4, secured to said head, the tubes a^8 attached to and suspended from head a', the head a^3 attached to the lower ends of the tubes and thereby freely suspended within the shell, the chambered plate a^2 attached to head a^3, and the pipes F and l, and G, H, all constructed and arranged to operate substantially as described.

10. The combination of the receiver C, the separator B, and a regenerator, the pipe D connecting the receiver and separator, the pipe F connecting the separator and regenerator, the pipes E leading into the separator, and pipe l communicating with pipe F through the generator, and the pipes G and H for directing burned gases to and from the regenerator, substantially as specified.

11. The combination with the shell closed at bottom, the head a' closing the upper end of said shell, the chambered plate a^4, secured to said head, the tubes a^8 attached to and suspended from head a', the head a^3 attached to the lower ends of the tubes and thereby freely suspended within the shell, the chambered plate a^2 attached to head a^3, and the pipe F and pipe l communicating with pipe F through the generator, and the pipes G and H for directing burned gases to and from the regenerator, and the partition plates a^7, and separating sleeves a^9, all constructed and arranged to operate substantially as and for the purpose set forth.

12. The combination of the closed vessel a gas receiver communicating therewith, at one end, and gas inlet and outlet pipes communicating therewith at different levels near the other end, with deflecting disks suspended in said vessel between the said pipes and communicating with the receiver, substantially as described.

13. A separator for gas engines, adapted to be interposed between the pump and receiver and receiver and combustion cylinder, and so constructed that the hot gases passing from the pump through the separator to the regenerator, will be kept out of contact with the cooler gases in the receiver, substantially as specified.

14. In a gas engine the combination of a pump a chamber, pipes leading from the pump, to the engine cylinder, communicating with said chamber, a receiver, and a pipe leading from said receiver to said chamber, provided with a hand valve, substantially as described.

15. In a gas engine the combination of a separator having pipes leading from the engine pump, communications for conducting gas from the separator to the exploding chamber of the engine, a receiver, and a pipe connecting the receiver and separator and having a hand valve.

16. In a gas engine the combination of a pump, a receiver, wherein the compressed gases are stored, having one pipe serving as both outlet and inlet, and a regenerator interposed between the engine and receiver substantially as specified.

17. The combination with a gas engine, of a gas pump, a receiver, a chamber or closed vessel interposed between the pump and receiver and communicating respectively therewith at opposite ends, and a communication between the said chamber, (at the end adjoining the pump connection) and the engine cylinder, substantially as set forth.

18. In a gas engine the combination of the pump and exploding chamber, the regenerator A communicating with the exploding chamber, and the separator B interposed between the pump and regenerator and communicating with both, all substantially as described.

19. In a gas engine the combination of the pump and exploding chamber, the receiver indirectly communicating with both the pump and the exploding chamber, and a separator interposed between the receiver and pump, and exploding chamber, all constructed and arranged to operate substantially as specified.

20. In a gas engine, the combination of the pump and exploding chamber, the receiver, and the regenerator, and pipe connections all constructed and arranged to co-operate, substantially as described.

21. In a gas engine the combination of the pump and exploding chamber, the receiver, separator and regenerator and pipe connections, all constructed and arranged to operate substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

WILLIAM ST. GEORGE ELLIOTT, JR.

Witnesses:

IRVING H. LOUGHRAN,

JNO. L. FALCONER.