L. WOODWORTH.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 10, 1909.

991,406.

Patented May 2, 1911

2 SHEETS—SHEET 1.

Fig. 1.

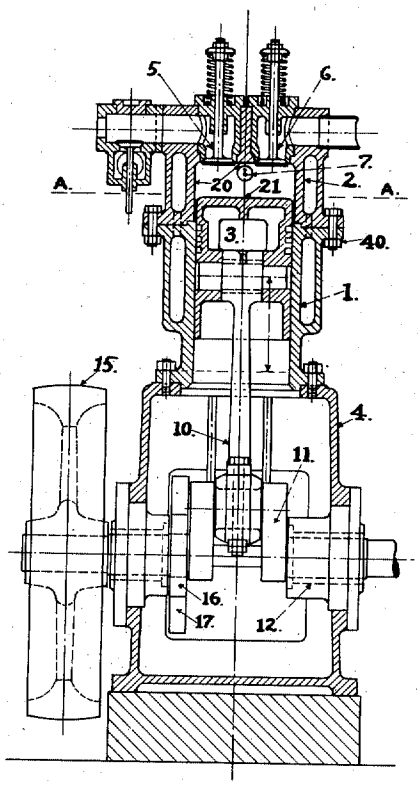


Fig. 2.

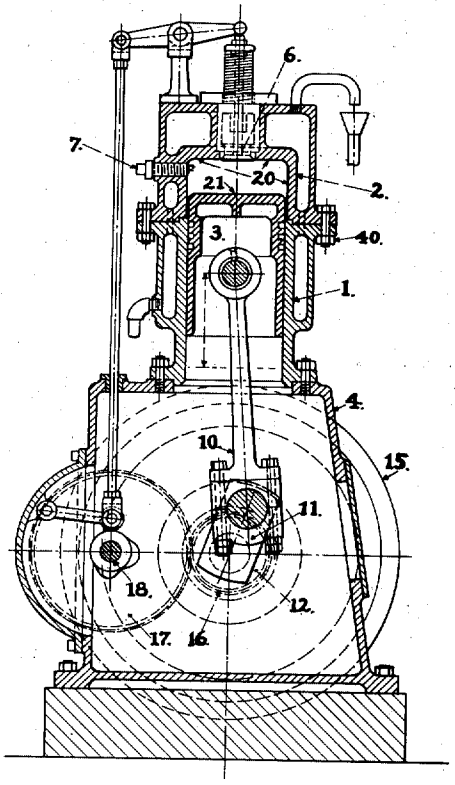
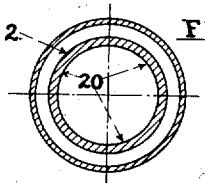


Fig. 3.



Witnesses:

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2 SHEETS—SHEET 2.

Fig. 4.

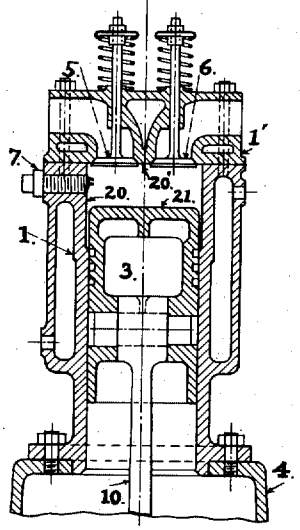


Fig. 5.

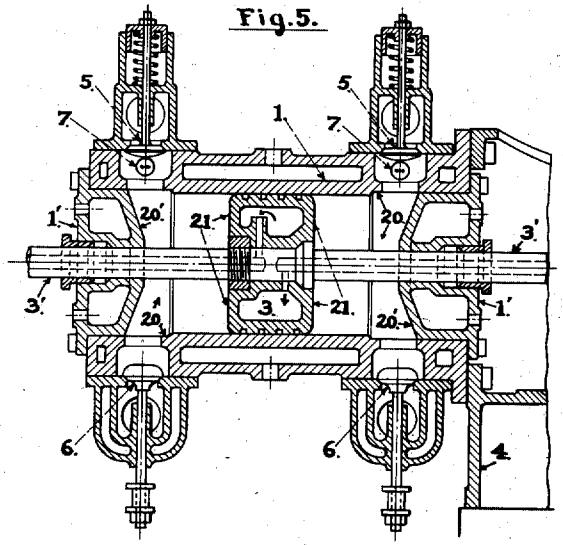


Fig. 6.

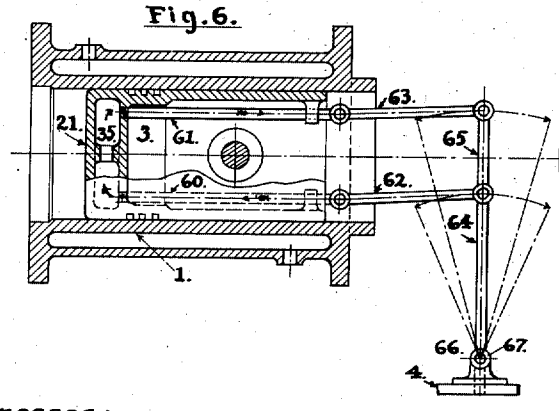
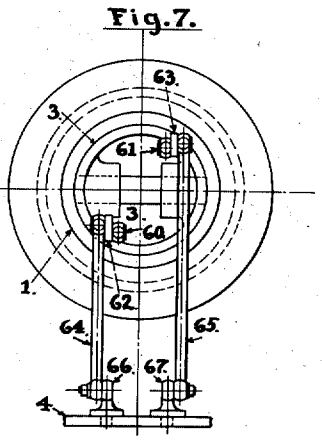


Fig. 7.



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INTERNAL-COMBUSTION ENGINE.

991,406. Specification of Letters Patent. Patented May 2, 1911.

Application filed November 10, 1909. Serial No. 527,198.

To all whom it may concern:

Be it known that I, LYMAN WOODWORTH, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented or discovered certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal-combustion heat motor engines more commonly called gas, petroleum or alcohol engines, in which, any suitable fuel, such as hydrocarbon or carbonaceous material hydrated or not, in gaseous, liquid, or finely divided state, is ignited by any suitable means such as compression, electricity, or a hot body, and burned with air, preferably compressed, the heated air and products-of-combustion constituting or serving as the working-fluid of the engine.

The object of my invention is to increase the efficiency and improve the fuel economy of internal-combustion engines.

My invention consists in certain improvements in the combustion-chambers, cylinders, cylinder-heads, and pistons of internal-combustion engines and in certain combinations of parts with coatings or linings of suitable metal as nickel secured in place by electro-deposition to the interior surfaces thereof, confining the hot working-fluid of the engine, as will be more fully hereinafter described in connection with the accompanying drawings.

Figure 1 shows a side elevation, partly in section, of an internal-combustion engine embodying or containing my improvements. Fig. 2 shows an end elevation, partly in section, of the engine shown in Fig. 1. Fig. 3 shows a cross-section A—A of the combustion-chamber of Fig. 1. Fig. 4 shows a longitudinal-section of the cylinder, cylinder-head, and piston of an internal-combustion motor with my improvements. Fig. 5 shows a longitudinal-section of the cylinder, cylinder-heads, and piston of a double-acting gas engine with my improvements. Fig. 6 shows a side elevation, partly in section, of a water cooled gas engine piston with my improvements. Fig. 7 is an end elevation of the parts shown in Fig. 6.

Referring to Figs. 1, 2, and 3, the water-jacketed cylinder 1 mounted upon the engine frame 4 is provided with the water-jacketed combustion-chamber 2, and the piston 3. The combustion-chamber 2, contains the admission valve 5, the exhaust valve 6, and the igniter 7, and is suitably secured to the cylinder by fastenings 40. The piston 3 is connected by rod 10, to the crank-shaft 11, mounted in suitable bearings 12, in the frame 4. Upon the crank-shaft 11 is mounted the flywheel 15. The cam-shaft 18 is operated by the gear-wheels 16 and 17 so as to make one revolution to every two revolutions of the crank-shaft 11, and provided with suitable cams and connections for operating the admission valve 5, the igniter 7, and the exhaust valve 6, as is well understood in engines of the class described. The combustion chamber 2 and piston 3 which serve to confine the hot working-fluid of the engine, are combined with the interior coatings or linings 20, and 21 respectively of suitable metal as nickel, secured in place by electro-deposition. The combustion-chamber 2 is preferably made in length equal to the stroke of the piston more or less, and in inside diameter sufficiently greater than the outside diameter of the piston 3 to be out of frictional contact therewith. In some forms of my invention, the engine piston 3 is made so that it does not extend beyond the guide walls of the cylinder proper; but I prefer to make the piston 3 reach into the combustion-chamber 2 a length equal to one-third of the piston-stroke more or less, as shown in Figs. 1 and 2.

Referring to Fig. 4, the combustion space end of the water-jacketed cylinder 1 is counterbored to clear the piston for a length equal to its diameter more or less, and capped by the water-jacketed cylinder-head 1′ containing the admission valve 5 and exhaust valve 6. The counterbored portion of the cylinder 1, and the interior faces of the cylinder-head 1′ and piston 3 that confine the hot gases are combined with the interior electro-deposited linings or coatings in manner similar to the analogous parts in Figs. 1 and 2.

In Fig. 5 is shown a double-acting gas engine cylinder with my improvements, the heat exposed parts being suitably cooled by means of the circulation of cooling fluid or water in the usual manner. The counterbored ends of the cylinder 1, the interior faces of the cylinder-heads 1′, and the faces of the piston 3 are combined with the interior coatings or linings 20, 20′, and 21 respectively of suitable metal as nickel secured in place by electro-deposition, which several

surfaces serve to confine the hot working-fluid of the engine.

Referring to Figs. 6 and 7, the gas engine piston 3 is formed and fitted with means for circulation of cooling fluid or water, and provided with my improvements in manner similar to piston 3 of Fig. 1. The chamber or passage 35 formed in the heat exposed face of the piston 3, preferably by coring-out the casting, is connected by articulated piping 60, 62, 64 and 66 for leading cooling-fluid thereto; and connections 61, 63, 65 and 67 for conducting fluid therefrom. The terminal supply and exhaust connections 66 and 67 respectively, are preferably mounted upon the engine frame 4. Obviously, telescoping piping might be used instead of the articulated piping for the purposes above described.

In my invention, the said electro-deposition of the said interior coatings, facings, or linings may be affected or performed in any suitable manner; preferably by first making the said interior surfaces smooth, bright and clean, then using an electrolyte of nickel-ammonium sulfate or its equivalent, an anode of nickel or its equivalent, and a suitable current of electricity; the electro-deposited nickel or its equivalent, being then buffed or polished, as is well understood and requires no detailed description.

In my invention, I regard such metals as cobalt or palladium equivalent to nickel; though I deem nickel preferable to its analogues, I do not limit myself to nickel. The function of the said electro-deposited interior coatings is to favor adiabatic-expansion of the hot working gas in the motor.

By the constructions and combinations in internal-combustion engines of coatings or linings of suitable metal as nickel secured in place by electro-deposition to the interior surfaces thereof confining the hot working-fluid of the engine as herein described, the object of my invention is attained.

Having described my invention, I claim:

1. The combination with an internal combustion engine, of linings of suitable metal as nickel, electro-deposited upon the interior surfaces of the walls inclosing the space wherein the working-fluid of the engine is ignited, the said linings having suitable means for cooling, substantially as described.

2. In an internal-combustion engine, the combination with the combustion-chamber of coatings or linings of suitable metal as nickel secured in place by electro-deposition to the interior surfaces thereof, and suitable means for cooling said combustion-chamber by circulation of cooling fluid, substantially as shown and described.

3. In an internal-combustion engine, the combination with the cylinder of coatings or linings of suitable metal as nickel secured in place by electro-deposition to the interior surfaces thereof not in frictional contact with the piston, and suitable means for cooling said cylinder by circulation of cooling-fluid, substantially as shown and described.

4. In an internal-combustion engine, the combination with the cylinder-head of coatings or linings of suitable metal as nickel secured in place by electro-deposition to the interior surfaces thereof, and suitable means for cooling said cylinder-head by circulation of cooling-fluid, substantially as shown and described.

5. In an internal-combustion engine, the combination with the piston of coatings or facings of suitable metal as nickel secured in place by electro-deposition to the surfaces thereof confining the hot working-fluid of the engine, substantially as shown and described.

6. In an internal-combustion engine, the combination with the piston of coatings or facings of suitable metal as nickel secured in place by electro-deposition to the surfaces thereof confining the hot working-fluid of the engine, and suitable means for cooling said piston by circulation of cooling fluid, substantially as shown and described.

In testimony whereof I have signed this specification in presence of two subscribing witnesses.

LYMAN WOODWORTH.

Witnesses:
A. L. Woodworth,
E. W. Horsman.