

(No Model.)

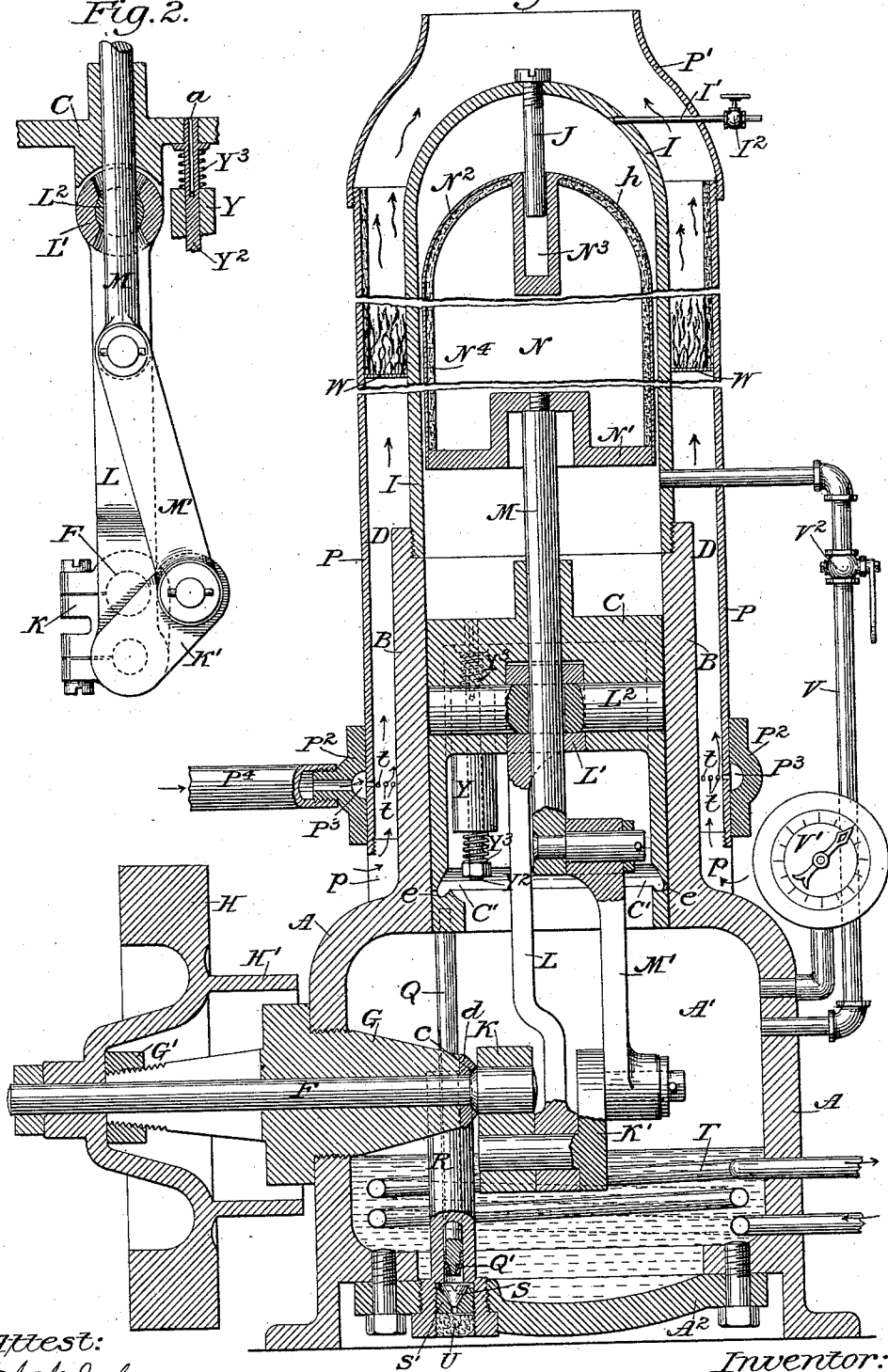
C. W. WEISS.
THERMO DYNAMIC MOTOR.

No. 419,805.

Patented Jan. 21, 1890.

Fig. 2.

Fig. 1.



Attest:

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UNITED STATES PATENT OFFICE.

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THERMO-DYNAMIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 419,805, dated January 21, 1890.

Application filed May 6, 1889. Serial No. 309,726. (No model.)

To all whom it may concern:

Be it known that I, CARL W. WEISS, of Brooklyn, in the county of Kings and State of New York, have invented certain new and
5 useful Improvements in Thermo-Dynamic Motors; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accom-
panying drawings, and to the letters of refer-
10 ence marked thereon, making a part of this specification.

This invention relates to that class of heat-motors in which the motive power is obtained by the alternate heating and cooling
15 of the working-fluid in confinement under a higher pressure than that of the atmosphere. Its object is to retain and utilize by means of a simple apparatus the heat which is usually carried away and lost in this class of
20 motors by the prevalent systems of condensation, and, in connection with an improved construction of the machine, thereby greatly increase its efficiency.

It consists in a novel organization of the
25 motor, as hereinafter described and claimed, whereby the heater or furnace is located above the cooler or condensing space and the air and vapors necessary to support combustion in the heating apparatus are made to
30 flow over the encircling walls of the condensing-chamber and thereby absorb and carry back to the furnace or combustion-chamber the heat set free in the condensing process.

In the accompanying drawings, Figure 1 is
35 a central vertical section of my improved thermo-dynamic motor; Fig. 2, a detailed vertical section in line *xx* of Fig. 1, illustrating the relative arrangement of the working and displacing cranks and the form of the
40 working-piston.

The motor is mounted upon a hollow stand
A, in the upper portion of which is located the cylinder B for the working-piston C, and the lower portion of which is enlarged some-
45 what to form a chamber or chest A' for the double crank upon the end of the main shaft F of the motor. This main shaft F is supported in an extended bearing formed in a
50 long sleeve G, which is fitted laterally into the wall of the crank-chest A', so as form a

tight joint therewith, and which projects through said wall into the crank-chest. The inner end of the sleeve fits against a shoulder *c* on the crank-shaft, and a packing-piece, in the form of a hardened-steel washer *d*, is
55 interposed, having its annular face next to the crank either beveled or, by preference, rounded to correspond with the segment of a sphere having the shaft as its axis and made to fit into a counterpart recess in the prox-
60 imate face of the shoulder *c* on the shaft, as shown in Fig. 1. The outer end of the bearing-sleeve G is preferably tapered and longitudinally split and threaded to receive an
internally-tapered nut G', which when
65 screwed upon the tapered end of the sleeve will operate to cause it to contract upon the shaft and thereby take up any looseness in the bearing occurring from wear. A fly-
70 wheel H, fitted upon the outer end of the shaft F outside of the nut G' to bear against it, is formed with an annular flange H' upon its inner face to project concentrically over the bearing and serve as a band-pulley.

The stand A and working-cylinder B are
75 preferably cast of iron or steel in one piece, so as to be jointless, and the open bottom of the stand is closed by a suitable base-plate A², flanged and bolted thereon with a tight joint. This casting A B is galvanized or japanned,
80 or otherwise treated so as to completely close the pores of the metal to render the same impervious to air or gases, and thereby permit the engine to be worked under a very high internal pressure without leakage.

85 A long working-cylinder I, of thin copper, steel, or other metal which is a good conductor of heat and is capable of resisting high pressure, is fitted to the upper end of the piston-cylinder B with a tight joint, the
90 two cylinders being of the same interior diameter, so that the inner periphery of the one shall form an unbroken extension of the other. The length of this working-cylinder I is preferably made about ten times greater
95 than its diameter to insure sufficient cooling-surface.

A vent-tube I', closed by a cock I², may be inserted in the upper end of the cylinder I, for a purpose to be hereinafter set forth.

The working-piston C is preferably formed with a long bearing-surface and is recessed at its lower end to form an extension of the space in the crank-chest A'. An annular pocket C' is formed about its inner periphery near its lower end, and from said pocket a series of apertures *e e* are pierced through to its outer periphery, so that a lubricating-fluid introduced into the pocket may flow out therefrom upon the bearing-surface of the piston. It is coupled to the inner arm K of the double crank on the end of the main shaft F by means of a pitman L, pivoted at its lower end to the crank and whose upper end is attached to one end of a divided collar L', fitted within a central recess in the head to turn upon a transverse pin L², extending diametrically through the piston and fixed therein. By this means the connecting-rod or pitman L is made to extend parallel with the axis of the piston at one side thereof, and thereby permit a rod M to be carried centrally in the line of said axis through the head of the piston C and through apertures in the intersecting pin L² and divided collar L'. The apertures in the collar L' are enlarged to flare outwardly at each end, as shown in Fig. 2, so as to permit the collar to oscillate freely on the pin L² without interference with the rod M. The upper end of said rod M is connected to a displacing-piston N, fitted to reciprocate within the cylinder I. This displacing-piston is constructed of a circular base-plate N', to which is attached a cylindrical shell N², of thin sheet metal, of a diameter to permit its free movement in the working-chamber and so extended as to fill the entire length thereof beyond the space required for a full stroke. The piston is preferably lined interiorly with a layer N⁴ of asbestos. Its outer end is preferably made of a convex or hemispherical form to correspond with the counterpart outer end of the cylinder I, against which it is carried in its movement. It is guided and held concentrically within the cylinder by means of a pin J, fixed axially at the outer end of the cylinder to project inwardly into a recess or socket N³ formed to receive it in the corresponding end of the piston.

A minute aperture *h* may be pierced in the wall of the piston N to permit an equalization of the pressure inside and outside thereof, so that it may be made of very thin metal without danger of collapsing, care being taken that said aperture shall be so minute as not to interfere with the working of the machine by permitting a free passage of the working-fluid through it.

The piston-rod M in passing through the piston C is provided with an extended bearing therein. It is pivoted at its outer end to a connecting-rod M', by which it is coupled to the end of the second crank-arm K' on the shaft F. This second arm is fixed to the end of the first at an angle therewith of about ninety degrees, more or less, as shown in Fig. 2, so that when the working-piston C is at its

lowest point the displacing-piston N shall be moving outwardly, as shown in Fig. 1.

The connected cylinders B and I are inclosed by a concentric jacket P of larger diameter, which is fitted upon a series of radial lugs *p' p'*, formed at the juncture of the cylinder B with the stand A, the open spaces or intervals between the lugs serving as passages for the free inflow of air into the concentric space or annular air-conduit D between the cylinders and jacket, as indicated by the arrows in Fig. 1. The outer or upper end of the jacket is preferably contracted by means of an annular cap P', as shown in Fig. 1, to serve as an exhaust-flue for said concentric space, and said flue may be connected with a suitable chimney. The lower end of the jacket is encircled by a band P², having a continuous groove or recess upon its inner side, forming an annular chamber P³, which is made to communicate freely with the concentric space inclosed by the jacket by means of a series of minute orifices *t t t* pierced through the jacket around its entire circumference.

A pipe P⁴ is fitted to the band P² to communicate with the annular chamber P³ for the supply thereto of fuel-gas.

A perforated diaphragm W, preferably of wire-gauze, is inserted between the jacket P and cylinder I at a point about opposite the middle of the length of the displacing-piston N when said piston is at the end of its outward stroke. The inner face of the jacket above said diaphragm is lined with asbestos, the lined space serving as a combustion chamber or furnace for the outer heated end of the cylinder I.

The crank-chest A' is charged with air by means of an air-pump, preferably consisting of a plunger-rod Q, attached to the lower end of the working-piston C, to play loosely in a cylinder R, screwed into the base-plate A² of the crank-chest A'. The lower end of the rod is fitted in the customary manner with a cup-shaped packing-ring Q', whose upper free margin will expand as the rod rises and contract as it descends, and a conical check-valve S is seated in a perforated plug S', which screws into the lower end of the cylinder R. This plug is driven in far enough to leave an outer recess in the end of the pump-cylinder to be filled with sponge or wool or other equivalent packing U, which will serve to filter the air drawn through it by the action of the pump.

I contemplate filling the crank-chest A' nearly to the level of the shaft F with water and oil, the oil and the vapor from the water both serving as lubricants and the vapor itself operating to increase the efficiency of the air confined in the machine and prevent the burning of the walls of the cylinder under a dry heat. A coil T may be placed in the bottom of said crank-chest to cool the water in the chest when the condensing-surface in the upper part of the machine is not sufficiently

extended to work efficiently, said coil being supplied with a stream of cold water flowing through it.

A pressure-gage V' is fitted to communicate freely with the crank-chest A' to indicate the working-pressure in the machine. The crank-chest may be connected to the working-chamber in the cylinder I by a pipe V , controlled by a stop-cock V^2 .

The piston C is fitted with a governor consisting of a weight Y , mounted to play freely upon a fixed valve-rod Y^2 , extending through the piston to project from its under side. Coiled springs Y^3 are placed upon the rod at each end of the weight and the valve is confined between said springs by means of a nut screwing upon the outer end of the rod. One or more apertures or air-passages a (see Fig. 2) are pierced longitudinally in the valve-rod to extend inwardly from its upper end and open out radially through its periphery at a point below the upper end of the weight when it is normally at rest between the springs, so that the weight will operate as a valve to cover and close said apertures. This weight will have a tendency to move on the rod as the movement of the piston is retarded during each stroke thereof, and the momentum of the weight acquired by reason of a too rapid movement of the piston will suffice to cause it to move far enough to uncover and open the air-passages, and thereby allow the pressure in the working-cylinder to find vent through them into the crank-chest.

In the operation of this improved motor the statical pressure within the machine is made to greatly exceed that of the atmosphere. This pressure is equalized within the machine by leakage around the periphery of the working-piston C and the rod M of the displacing-piston, so that the pressure in the working-cylinder is the same as that in the crank-chest when the machine is at rest. It will be observed that to maintain this high pressure the machine is so constructed as that the crank-shaft is the only moving part which extends outward from within, and that the joint of said shaft with the sleeve through which it extends outwardly is kept air-tight by means of the curved or tapered steel washer or packing-piece seated in the shoulder of the shaft, as described, which adapts itself to any looseness of the shaft in the bearing, while the fixed joints are all made perfectly tight, and the very pores of the metal are filled, so as not to be pervious to the contained gases.

The required pressure is obtained within the machine, first, by means of the air-pump, whose maximum efficiency in increasing the pressure is determined by the space left between the check-valve and the lower end of the plunger when the latter is at the end of its stroke toward the valve, and, second, by the vaporization of the water introduced in the bottom of the crank-chest. When the maximum pressure is attained, the air com-

pressed in the pump above its check-valve will simply expand and contract in unison with the movement of the plunger without permitting a further inflow through the valve.

By letting the air escape from the head of the cylinder I through the vent-tube I' as fast as the water in the crank-chest vaporizes under the heat of the machine to take its place the machine may be operated by steam and air, and finally by steam alone.

In working the machine a combustible gas is admitted through the pipe P^4 into the annular chamber P^3 , and from it through the orifices $t t t$ into the lower part of the annular conduit D , surrounding the cylinders B and I . As the gas ascends in said conduit, it admixes with the air freely admitted through the ports between the lugs $p p$, and forms, upon the principle of the Bunsen burner, a highly-combustible compound which is ignited above the foraminous or perforated diaphragm W .

The upward flow of the currents of air and gas around the cylinders B and I serves to cool the inner end or condensing-space in the working-chamber and to keep it comparatively cool, while the intense flame above the diaphragm operates to heat the outer end of the cylinder I to a very high temperature. This outer end of the working-chamber constitutes, in connection with the furnace or burner encircling it, the "heater," and the remaining portion encircled by the air-conduit D the "cooler," of the machine.

The heating of the outer end of the working-chamber operates to expand the air or gases therein, and thereby force the working-piston C inward. This movement of the working-piston C will cause the displacing-piston N to move outward in the cylinder just before the stroke of the working-piston is completed, and thereby force the hot expanded working-fluid in a thin annular sheet over and against the inner side of the cooler portion of the cylinder, and by reason of its condensation produce such a reduction of pressure at this point as will facilitate the outward stroke of the working-piston. The heat radiated from the walls of the cylinders I and B below the burner is rapidly taken up by the currents of air and gas passing to the burner, so that these walls are kept thereby comparatively cool to serve as an effective condensing-surface, while the heat imparted therefrom to the currents supplying the burner is utilized and economized at the burner by increasing its efficiency, the apparatus in this respect operating as a regenerative device, whereby the heat imparted to the working-fluid at the heater is transferred therefrom and delivered up to the condensing-surface of the cooler and from it to the inflowing combustible gases, which return it to the furnace. The agitation of the water in the crank-chest by the movement of the cranks serves to facilitate its vaporization, and the vapor passing up into the working-chamber greatly in-

creases the efficiency of the working-fluid therein. This vaporization increases as the machine and stand become heated, so that the working-pressure is automatically increased by the working of the machine until a maximum is reached.

The automatic operation of the air-pump serves to supply any loss that may occur by leakage, thus keeping the static pressure at its maximum.

The construction of the motor with but a single working part extending outwardly from the working-chambers enables it to be run practically with a pressure of five hundred pounds or more to the square inch, the maximum pressure being, in fact, limited only by the strength of the engine, while the higher the pressure the higher will be the efficiency of the machine, and by placing the heater above the cooler not only is the shaft with its cranks and fly-wheel kept at the base of the machine with manifest advantage, but the exhaust-heat from the burner is automatically carried off without interfering with the cooling-surface. As the force and velocity of the current drawn through the annular conduit D, encircling the working cylinder, become stronger, the capacity thereof for cooling or taking up the heat from the cylinders below the burner, as well as the intensity of the flame and its capacity for heating the cylinder above the burner, is proportionately increased with great economy of fuel.

A supply of gas may be admitted directly from a suitable supply-pipe P⁴ without the intervention of an annular distributing-chamber P³, as described, although such a distributing-chamber is productive of better results.

Instead of admitting a combustible gas at the lower end of the annular conduit encircling the working-cylinders to admix with the current of air flowing upward therein and form a combustible compound to be burned above the diaphragm W, I contemplate replacing the diaphragm by hydrocarbon-oil burners of any approved form placed within the jacket P, so that they shall be furnished with the necessary supply of air for combustion through said annular conduit, the resultant effect being the same.

By opening more or less the cock V' in the pipe V, connecting the crank-chest A' on one side of the working-piston directly with the cylinder I on the opposite side thereof, the movement of the motor may be checked or arrested at pleasure.

I claim as my invention—

1. In a non-exhausting thermo-dynamic motor, a working and a displacing piston, both moving in a single extended closed chamber made tight to maintain a static pressure therein exceeding that of the atmosphere, in combination with cranks coupled to said pistons and revolving in one end of the same chamber upon a shaft projecting with an air-tight joint through the wall thereof, substantially

in the manner and for the purpose herein set forth.

2. A non-exhausting thermo-dynamic motor comprising a working and a displacing piston, both moving in a single extended closed chamber made tight to maintain a static pressure therein exceeding that of the atmosphere, cranks coupled to said pistons and revolving in one end of the same chamber upon a shaft projecting with an air-tight joint through the wall thereof, and a body of liquid contained in said chamber to be agitated by the revolution of said cranks, whereby the working-fluid in the chamber is charged with vapor from said liquid, substantially in the manner and for the purpose herein set forth.

3. The combination, in a non-exhausting thermo-dynamic motor, with its working and its displacing pistons, both moving in the same closed chamber, made tight to maintain a static pressure therein exceeding that of the atmosphere, and with its cranks coupled to said pistons and revolving in an extension of the same chamber upon a shaft projecting with an air-tight joint through the wall thereof, of a body of liquid contained in said chamber and an air-pump coupled to the working-piston and having its inward port covered by said liquid, whereby in the operation of the machine a supply of air is introduced and forced through said liquid to produce a discharge of vapor therefrom within said closed chamber, substantially in the manner and for the purpose herein set forth.

4. The combination, in a thermo-dynamic engine, with its heater and its cooler, of an air-supply conduit formed in or upon the wall of the cooler to connect with the burner or furnace of the heater, whereby the heat radiated from the former is taken up by the current of air flowing to the latter, substantially in the manner and for the purpose herein set forth.

5. The combination, with the crank-shaft, in a thermo-dynamic engine, of a working-cylinder placed above said shaft, a heater at the upper end of the working-cylinder, and a passage for the supply of air to the heater formed in or upon the wall of the working-cylinder, whereby the working-cylinder is protected from the exhaust-heat escaping from the burner or furnace and is cooled by the current of air flowing thereto, substantially in the manner and for the purpose herein set forth.

6. A non-exhausting thermo-dynamic motor having the upper or outer end of its working-cylinder encircled by a heating device and the remainder of said cylinder inclosed in a concentric jacket forming an encircling annular conduit through which the heating device is supplied with the air necessary to support combustion therein, whereby the one end of the cylinder is heated and the remainder cooled by the operation of the heat-

ing device, substantially in the manner and for the purpose herein set forth.

7. The combination, in a non-exhausting thermo-dynamic motor, with its working and displacing pistons and the connected cylinders in which they move, of an outer jacket of enlarged diameter inclosing said cylinders to form an encircling annular conduit open at both ends, a perforated diaphragm fitted in the upper or outer portion of said annular conduit, and a gas-supply pipe communicating with the lower end of the annular conduit, substantially in the manner and for the purpose herein set forth.

8. The combination, in a non-exhausting thermo-dynamic motor, with its working and displacing pistons and the connected cylinders in which they move, of an outer jacket of enlarged diameter inclosing said cylinders to form an encircling annular conduit open at both ends, a perforated diaphragm fitted in the upper or outer portion of said annular conduit, an annular chamber encircling the lower or inner end of the jacket and communicating by a series of orifices with the inclosed conduit, and a gas-supply pipe fitted to communicate with said chamber, substantially in the manner and for the purpose herein set forth.

9. The combination, in a non-exhausting thermo-dynamic motor, with the communicating piston-cylinders and crank-chest inclosing its working parts and made air-tight, of a water-receptacle included within said crank-chest below the working-piston, whereby the air confined within the machine may be automatically charged with vapor during the operation of the motor, substantially in the manner and for the purpose herein set forth.

10. The combination, in a non-exhausting thermo-dynamic motor, with the communicating piston-cylinders and crank-chest inclosing its working parts and made air-tight, of a water-receptacle included within said crank-chest below the working-piston, whereby the air confined within the machine may

be automatically charged with vapor during the operation of the motor, and a cooling device fitted in said receptacle, whereby its temperature may be lowered, substantially in the manner and for the purpose herein set forth.

11. The combination, with a working-piston, in a non-exhausting thermo-dynamic engine, of the longitudinally-perforated rod extending through the piston and secured thereto, the weighted governor-valve playing upon said rod to cover and uncover its ports, and the springs fitted at either end of said valve to control and confine its movement, substantially in the manner and for the purpose herein set forth.

12. The combination, with the closed working-chamber, in a thermo-dynamic motor, a bearing-sleeve projecting with a tight joint through the wall of said chamber, and a shaft projecting outwardly from said chamber through said sleeve and having a shoulder to bear against the inner end thereof, of an annular metallic packing-piece interposed upon the shaft between the shoulder and sleeve and having a beveled or rounded face to fit into a counterpart seat in the shoulder, whereby an air-tight joint is obtained and preserved at this point, substantially in the manner and for the purpose herein set forth.

13. The combination, in a non-exhausting thermo-dynamic motor, with its working-piston and the cylinder in which it moves, of the governing-pipe V, through which communication is established between the spaces at the opposite ends of the piston, and the valve V', controlling said pipe to open or close it, substantially in the manner and for the purpose herein set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CARL W. WEISS.

Witnesses:

A. N. JESBERA,
E. M. WATSON.