No. 668,626. Patented Feb. 26, 1901.

C. G. CRONWALL.

HOT AIR POWER OR PUMPING ENGINE.

(Application filed Mar. 12, 1898.)

(No Model.)

Fig. 1.

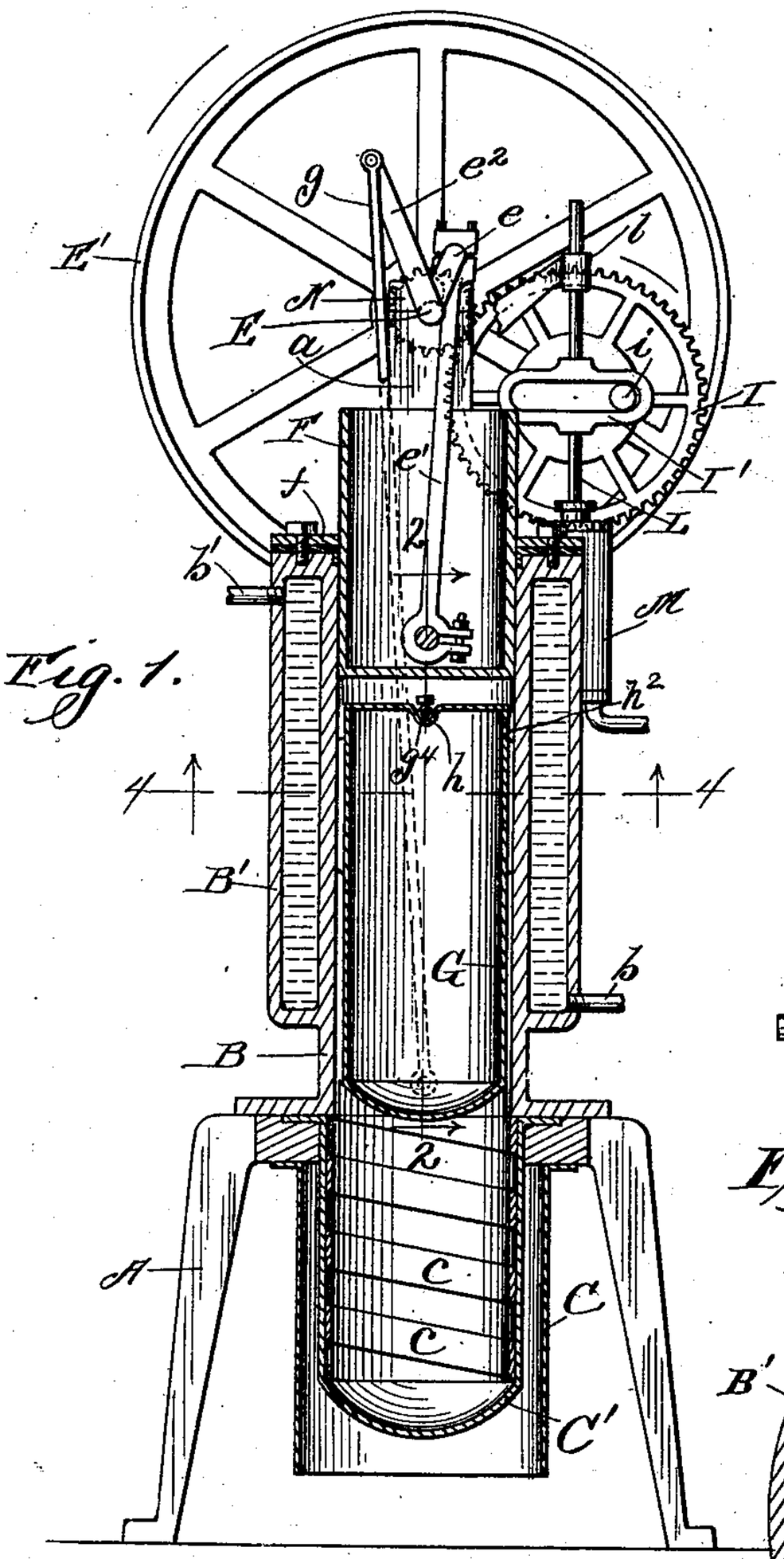


Fig. 2.

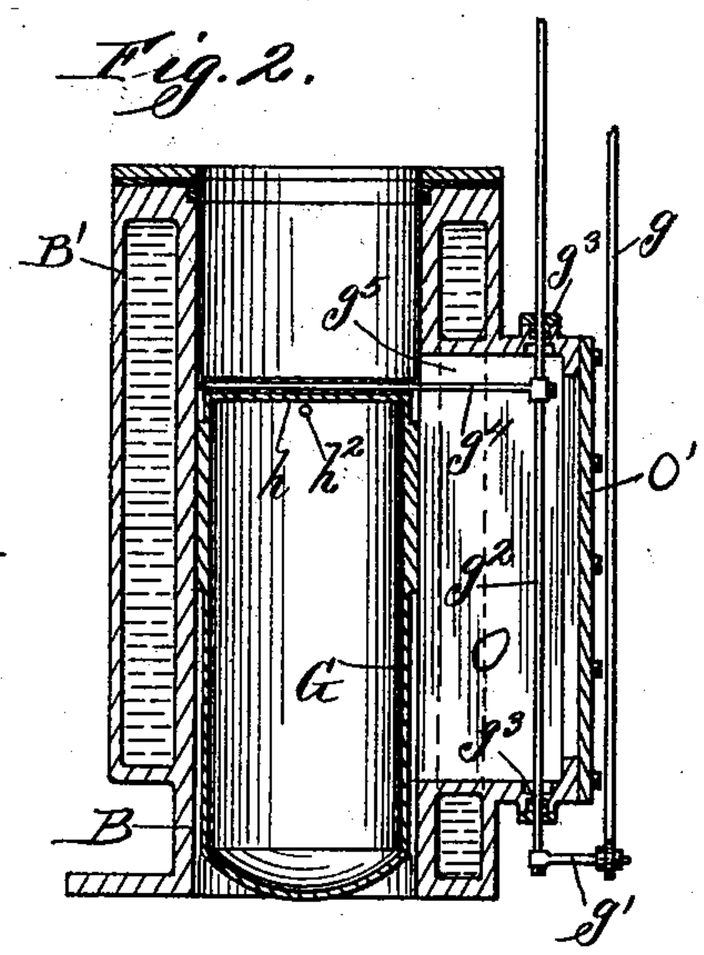


Fig. 3.

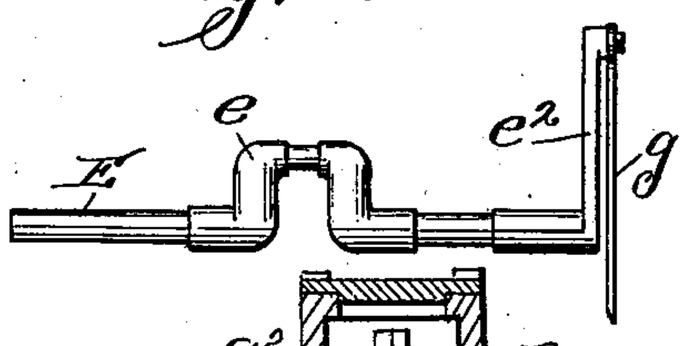
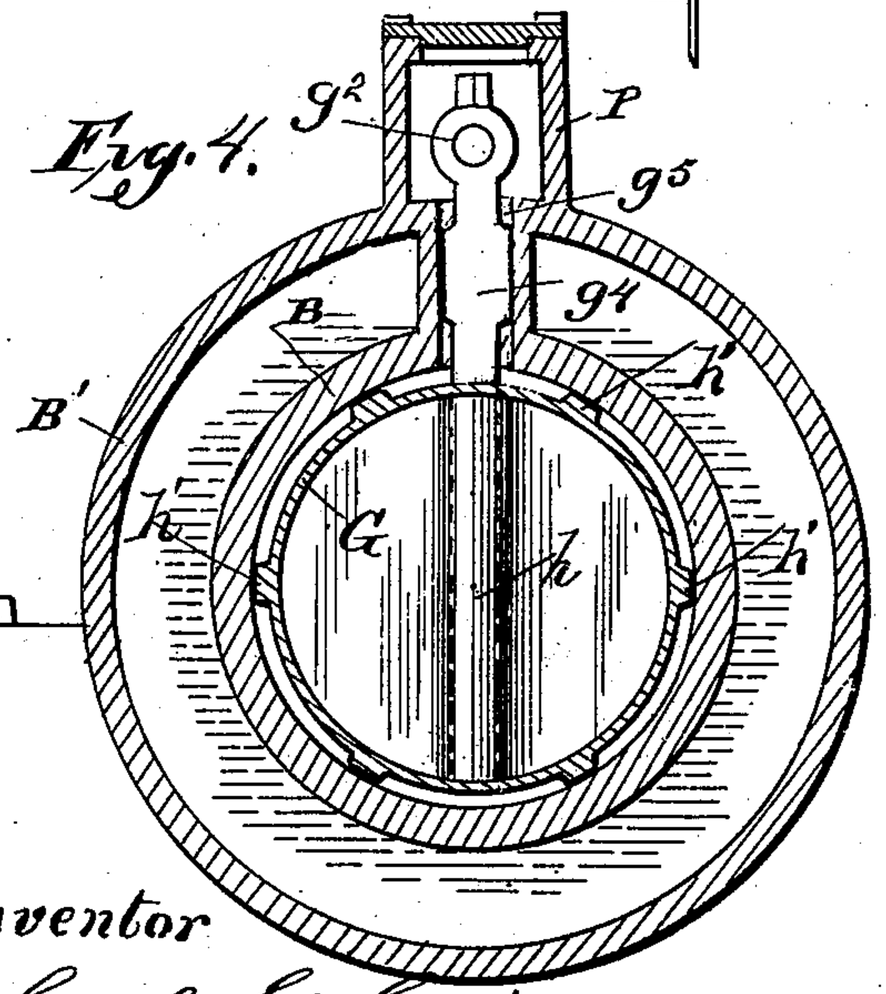


Fig. 4.



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UNITED STATES PATENT OFFICE.

CARL G. CRONWALL, OF CHICAGO, ILLINOIS.

HOT-AIR POWER OR PUMPING ENGINE.

SPECIFICATION forming part of Letters Patent No. 668,626, dated February 26, 1901.

Application filed March 12, 1898. Serial No. 673,578. (No model.)

To all whom it may concern:

Be it known that I, CARL G. CRONWALL, a subject of the King of Sweden and Norway, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in a Hot-Air Power or Pumping Engine, of which the following is a specification.

This invention relates to improvements in that class of air-engines in which a displacer-piston is reciprocated and the air alternately heated and cooled; and it consists in certain peculiarities of the construction, novel arrangement, and operation of the various parts thereof, as will be hereinafter more fully set forth and specifically claimed.

The objects of my invention are to simplify yet so construct the engine that greater power will be afforded than has heretofore been attained by engines of a similar type and also to enable parts of the engine to be made of lighter or thinner material, and thereby facilitate the heating and cooling of the air within the air-cylinder.

Other objects and advantages will appear in the description hereinafter contained.

In order to enable others skilled in the art to which my invention pertains to make and use the same, I will now proceed to describe it, referring to the accompanying drawings, in which—

Figure 1 is a central vertical sectional view of my engine, showing the parts thereof in the position they will occupy when ready for use. Fig. 2 is a similar view taken on line 2 2 of Fig. 1 looking in the direction indicated by the arrows and showing the water-jacket and displacer-piston with the rods for operating the latter. Fig. 3 is a perspective view of the crank-shaft detached; and Fig. 4 is a cross-sectional view, taken on line 4 4 of Fig. 1, of the air-cylinder and displacer-piston, viewing them from the bottom.

Similar letters refer to like parts throughout the different views of the drawings.

A represents the supporting-frame, upon which the air-cylinder B is mounted and to which the fire-box C and fire-pot or heater C′ are secured. Surrounding the air-cylinder B is a water-jacket B′, which is provided in its lower and upper portions with pipes *b* and *b′* for the supply and discharge of water. The fire-pot or heater C′ is preferably made of thin sheet-copper, and to reinforce or strengthen the same I may locate on its interior a steel or other metallic band *c*, which is preferably spiral in shape, as shown in Fig. 1 of the drawings. The fire-box C surrounds the fire-pot or heater C′ and extends some distance therebelow to receive and retain the heat from the fire, which may be produced by means of gas, oil, or other suitable fuel located beneath the fire-pot. On the upper part of the air-cylinder and water-jacket and on each side thereof is located an upright standard *a*, in which the crank-shaft E is journaled. This shaft is provided at about its middle with a crank *e*, to which is secured one end of the pitman *e′*, whose other end is secured to the lower portion of the power-piston F, which is located and operates in the upper portion of the air-cylinder and is provided with suitable packing *f* to prevent the escape of air.

On one end of the crank-shaft E is mounted a balance-wheel E′, and on the other end of said shaft is fixed at an angle to the crank *e* a crank e^2, of greater length than the first-named crank and having pivotally secured to its free end a pitman-rod *g*, which is similarly connected at its lower end to an arm *g′*, fixed to the lower end of a vertically-movable rod g^2, which passes through suitable stuffing-boxes g^3 in a lateral offset O in the casing of the water-jacket or air-cylinder. Secured at one of its ends to the rod g^2 and extending horizontally through a vertical slot g^5 in the air-cylinder and out into said offset O is a rod g^4, which is secured to the upper portion of the displacer-piston G, located and operating in the air-cylinder. Said offset O has a face-plate O′ bolted or otherwise secured to its outer side and which can be removed when it is desired to adjust the point of connection between the horizontal and vertical rods g^4 and g^3 or to repair or replace any of the working parts. Hence it is not necessary to disarrange the mechanism or remove anything but the face-plate for this purpose.

In the drawings I have shown the upper end of the displacer-piston, which is closed, as being formed with a transverse depression *h* and with the rod g^4, secured in said depression, and I prefer to so form the piston

and so secure the rod for the reason that such an arrangement will allow the upper end of the displacer-piston and the lower end of the power-piston to come nearer together.

The displacer-piston, as shown in Figs. 1 and 4 of the drawings, is somewhat smaller than the interior of the air-cylinder and is provided on its exterior and near its upper portion with vertical ribs h', which will rest against the interior of the air-cylinder and keep the displacer-piston in proper position therein, besides affording space between the exterior wall of the displacer-piston and the inner wall of the air-cylinder for the passage of air, as well as diminishing the friction of the contacting surfaces. The displacer-piston G is made of thin material and is provided in its upper portion with a port or opening h^2 for the passage of air.

In Fig. 1 of the drawings I have shown my engine with a construction for the purpose of operating a pump which I may sometimes employ and which consists of a gear-wheel I, journaled on a suitable support and having a crank-pin or roller i, located within a yoke I', secured to a piston-rod L, which operates a piston within the pump-cylinder M and has near its upper end a bearing l, secured on a suitable arm or brace (not shown) for its support. The gear-wheel I meshes with a pinion N, secured to the crank-shaft E, and when it is rotated it is evident that the gear-wheel I will be revolved, which operation will cause the piston-rod L to be reciprocated through the medium of the crank-pin or roller i and the yoke I', with which it engages.

Instead of using the construction just above described for operating the pump it is evident that a belt may be applied to a wheel or pulley located on the crank-shaft and power transmitted therethrough for operating various kinds of machinery.

The operation of my engine is as follows: The air within the air-cylinder is expanded by the application of heat to the fire-pot and is contracted by the cooling effect of the water within the water-jacket, which operation causes the power-piston and displacer-piston to be reciprocated within the air-cylinder very much in the usual manner of hot-air engines, thus shifting the air and causing it to be alternately heated or cooled or expanded and contracted. The displacer-piston being provided with an opening or port h^2 in its upper portion, it is evident that as the said piston ascends by reason of the expansion of the air in the lower portion of the air-cylinder some of the cold air between the two pistons will be free to pass into the always-hot displacer-piston, there to become heated, thus causing said piston to act as an air-reservoir and allowing it to be made of thinner material than would otherwise be required on account of the uniform or nearly uniform pressure of air within and without the said piston. It is further apparent that as the crank e^2 is on the crank-shaft E at an angle to the crank e and is longer than the last-named crank greater power will be attained by reason of the longer stroke and greater body of air employed and that when in about the position shown in Fig. 1 of the drawings the lower end of the power-piston F and the upper end of the displacer-piston G will be in close proximity to each other, thus causing nearly all of the air to be forced to the lower portion of the air-cylinder to be heated and expanded.

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

1. In an air-engine, the combination of an air-cylinder, with a hollow displacer-piston located therein and having its top and bottom closed and an opening or port in its upper portion for the free passage of air, and a power-piston located in the upper portion of the air-cylinder, substantially as described.

2. In an air-engine, the combination with the air-cylinder, and a reciprocating power-piston therein; of a displacer-piston also therein, its end next the power-piston being flat except for a transverse depression, a rod secured therein and projecting laterally through a vertical slot in said cylinder, a reciprocating rod mounted in guides and attached to said lateral rod, and means for moving the reciprocating rod, as and for the purpose set forth.

3. In an air-engine, the combination with the air-cylinder having a vertical slot near its lower end, a lateral offset in the casing covering said slot and having a removable face-plate, and a power-piston reciprocating within the cylinder above said slot; of a displacer-piston within the cylinder beneath the power-piston, a rod extending from the displacer-piston horizontally out through said slot, a vertical rod guided in stuffing-boxes in the top and bottom of the offset, connections between the horizontal and vertical rods, and means for driving the latter from a point entirely exterior to the cylinder and offset, as and for the purpose set forth.

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