C. L. FORTIER.
CALORIC ENGINE.
APPLICATION FILED JULY 6, 1908.

914,562. Patented Mar. 9, 1909.

2 SHEETS—SHEET 1.

Fig. 4.

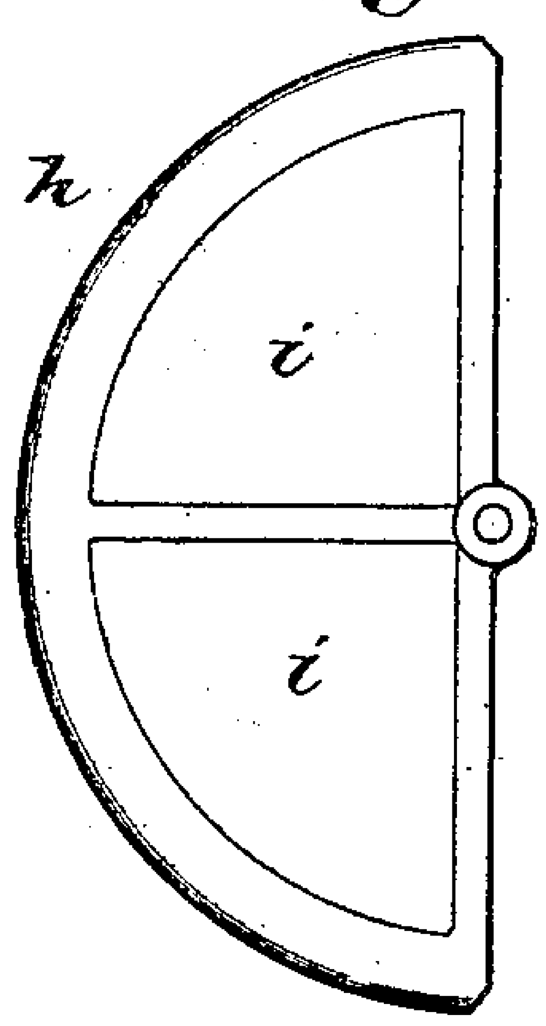
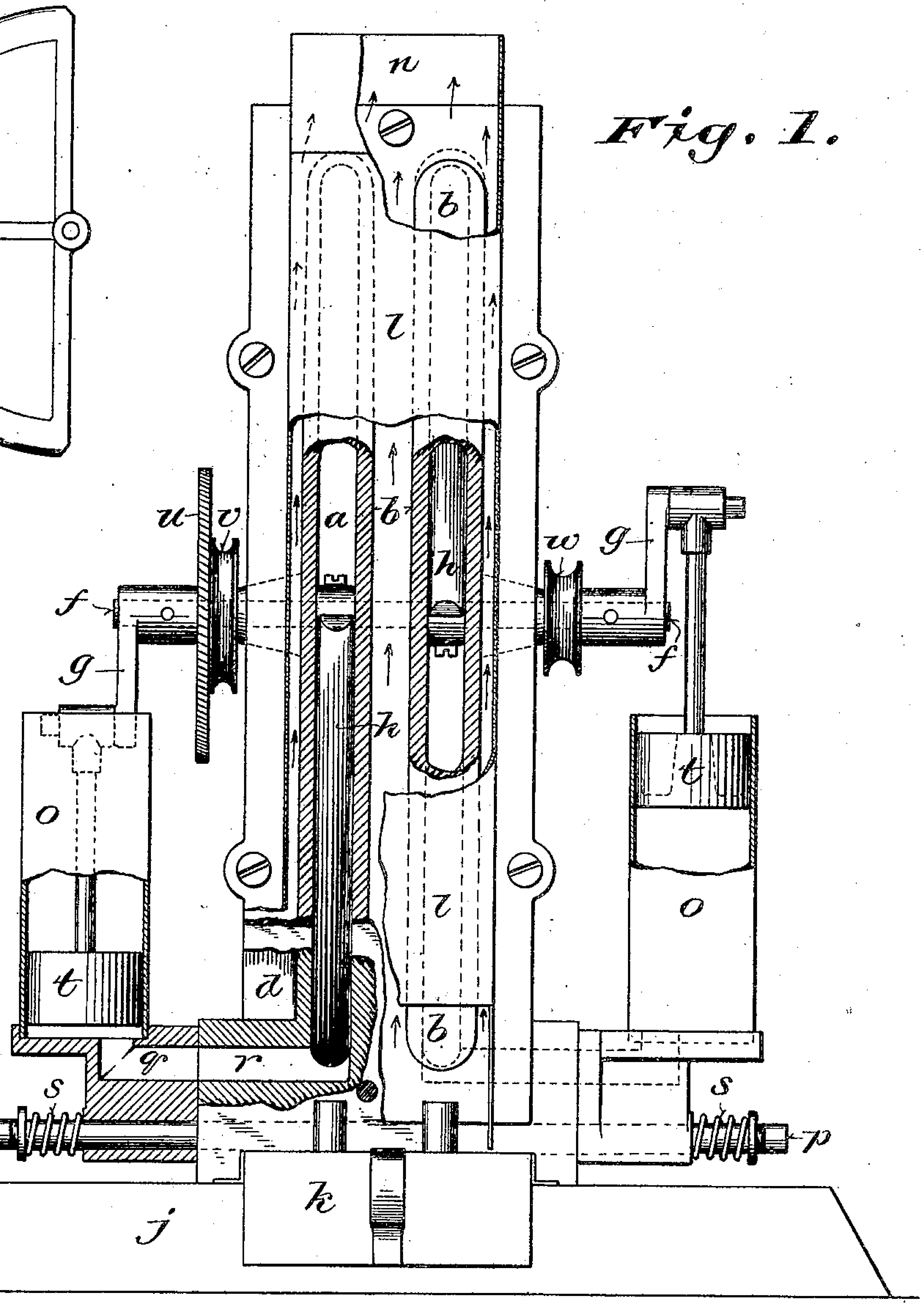


Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

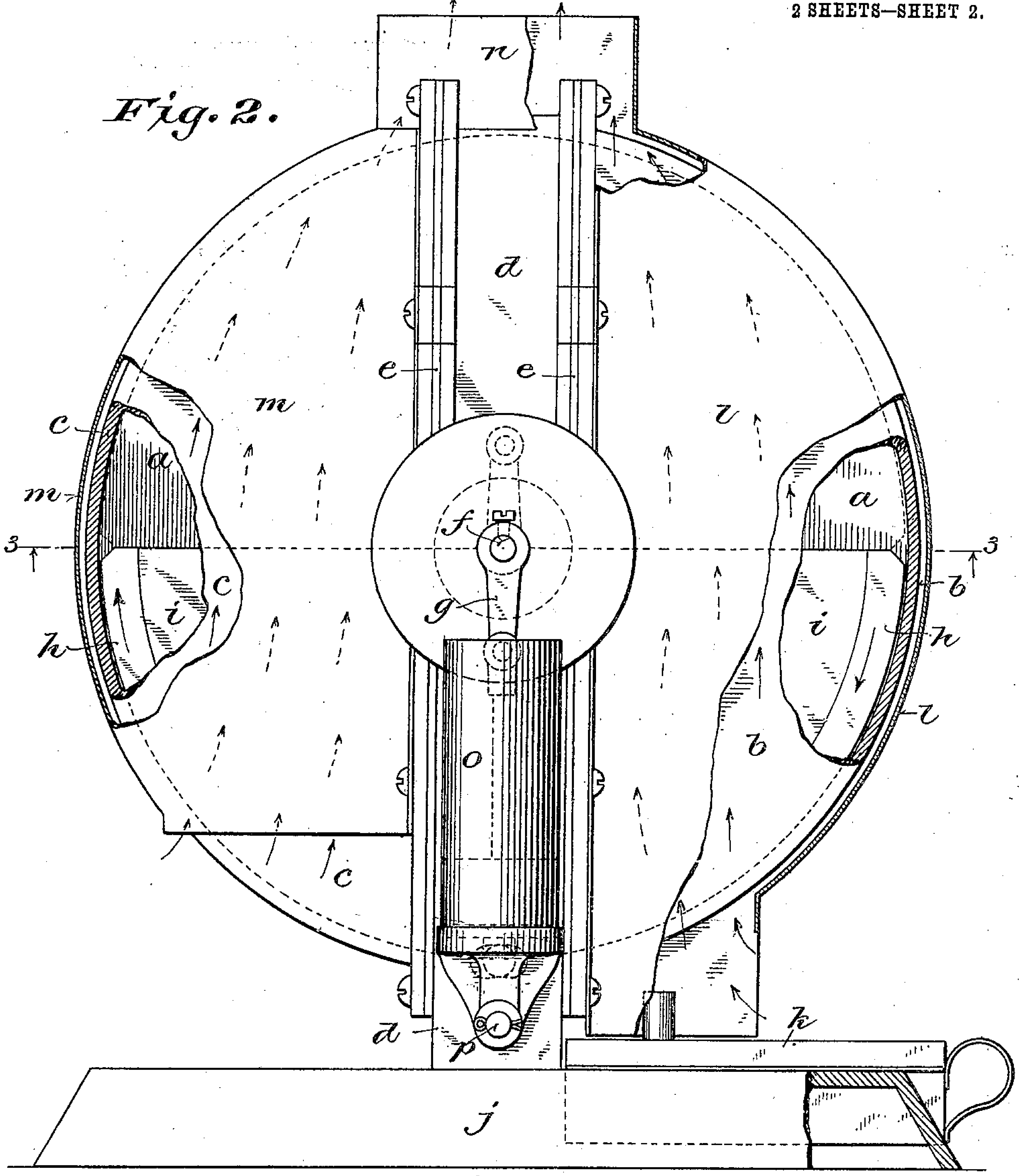
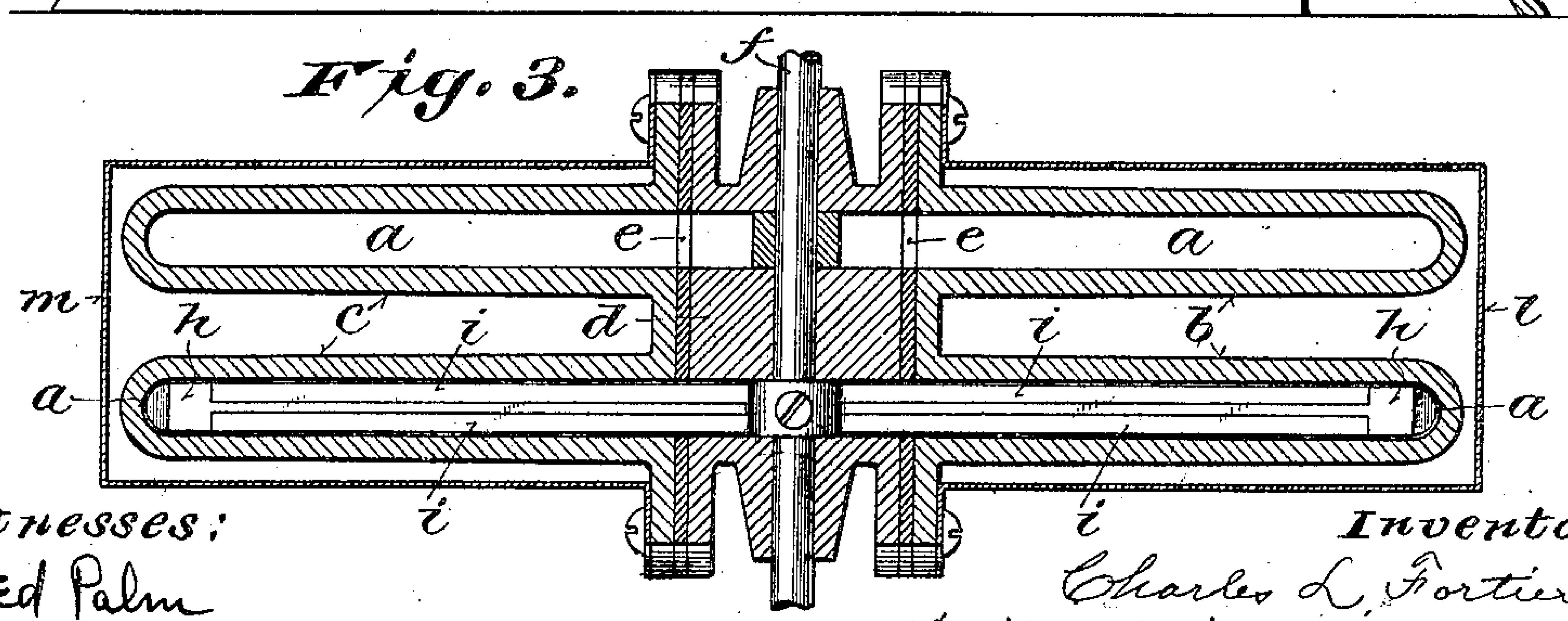


Fig. 3.



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UNITED STATES PATENT OFFICE.

CHARLES L. FORTIER, OF MILWAUKEE, WISCONSIN.

CALORIC ENGINE.

No. 914,562. Specification of Letters Patent. Patented March 9, 1909.

Application filed July 6, 1908. Serial No. 442,019.

To all whom it may concern:

Be it known that I, Charles L. Fortier, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Caloric Engines, of which the following is a specification, reference being had to the accompanying drawing, forming a part thereof.

This invention relates to that class of caloric engines which are operated by the alternate heating and cooling and the consequent expansion and contraction of a substantially constant volume of air or other volatile fluid. Its main objects are to avoid loss of power resulting from reversal of the movement of reciprocating displacers commonly employed, and generally to improve the construction and operation of engines of this class.

In the accompanying drawing like characters designate the same parts in the several figures.

Figure 1 is a front elevation of an engine embodying the present invention, certain parts being broken away and shown in vertical cross section; Fig. 2 is a side elevation as viewed from the left with relation to Fig. 1; Fig. 3 is a horizontal section on the line 3 3, Fig. 2; and Fig. 4 is a side elevation on a reduced scale showing a displacer of a modified construction.

Referring to the main figures of the drawing, *a a* designate heating and cooling chambers, which are preferably of circular form and are inclosed by walls of metal or heat conducting material. These walls are preferably made in separate sections, *b*, *c* and *d*, *b* constituting the heating section, *c* the cooling section and *d* an intermediate section to which the sections *b* and *c* are secured by vertical flanges and bolts or screws with interposed sheets *e* of non-heat-conducting material, such as Jenkins' packing, to prevent conduction of heat from section *b* to section *c*. A shaft *f* passing axially through the chambers *a* and having bearings in the intermediate section *d*, is provided with cranks *g* projecting in opposite directions therefrom or at an angle of 180 degrees from each other.

On the shaft *f* within the chambers *a*, are fixed rotary displacers *h*, of segmental or sectorial form. In the present case they are shown as semicircular in form, freely fitting in said chambers and approximately half filling each chamber. They may, however be made less or greater than a half circle, and are set at an angle to each other corresponding with that between the cranks *g*. Within certain limits however, the angular position of the displacers relative to the cranks *g* may be varied. As shown, each displacer is set on the same side of the crank shaft with the adjacent crank, and in the same relative angular position. These displacers may be made of sufficient weight to serve as a balance or flywheel, or may be made of light non-heat-conducting material and the crank shaft provided with one or more external flywheels. They are preferably constructed as shown, partly of metal, affording the requisite weight to serve as a flywheel, and partly of some light non-heat-conducting material, to avoid the transfer of heat from one part of the chambers *a* to the other.

In Figs. 2 and 3 the displacers are shown as each constructed of a hub and rim connected by a web of metal, the recesses in the sides being filled with a light non-conductor of heat *i*. The displacers may however, be constructed in various ways and of various materials. For example, as shown in Fig. 4, the rim and hub may be made of metal connected by spokes of the same material, and the spaces between the spokes filled with some light non-heat-conducting material.

The walls or casing forming the displacer chambers are mounted on a suitable base *j*, with which the intermediate section *d* may be formed, or to which it may be attached independently of the sections *b* and *c*, as shown.

In a recess in the base below the heating section *b* of the displacer casing, a lamp *k* or other suitable fuel burner is removably fitted for heating the air or other medium contained in the chambers *a*, for operating the engine.

The heating and cooling sections *b* and *c* are inclosed or housed by casings or jackets *l* and *m*, which may be made of sheet metal and secured by flanges to the flanges of the sections *b* and *c* for confining and circulating heating and cooling agents such as air and water, next to the walls of the chambers *a*. In the present case these casings or jackets are designed for the use of air both as the heating and cooling medium, each having an intake opening for the admission of air at the bottom, and an exit opening for the escape of air at the top. The casing or jacket *l* is preferably extended at the bottom as shown, to partially house and protect the flame of the lamp or fuel burner, and both casings preferably open at the top into a common escape flue or duct *n*.

o o are the working cylinders of the engine, mounted in the present case to oscillate at their lower ends on trunnions *p*. They each communicate with the adjacent chamber *a* through a port or passage *q* in the lower cylinder head and a laterally extended port or passage *r*, with which it registers in the lower part of section *d* of the displacer casing. The vertical faces of the cylinder heads through which the ports *q* open are snugly held against the adjoining faces of section *d* through which the ports *r* open, by springs *s*. In the cylinders *o* are fitted trunk pistons *t*, the rods of which are directly connected with the wrist pins of the cranks *g*. The crank shaft may be provided as shown, with a mill disk or wheel *u*, for starting the engine, and with one or more pulleys such as *v* and *w*, for driving one or more machines which the engine may be intended to operate.

The engine constructed as herein shown and described, operates as follows: The air entering the opening in the lower part of the jacket *l* and heated by the lamp or burner *k*, passing upward as indicated by the arrows on Fig. 2, imparts heat to section *b* of the walls of chambers *a*, by which it is rapidly communicated to the air within said chambers, thereby causing it to quickly expand. As the air in each chamber *a* expands, it passes through the registering ports *q* and *r* into the lower end of the associated cylinder *o*, forcing the piston *t* therein upward, the associated displacer passing during this operation from a position on the under side to a position on the upper side of the crank shaft, and transferring the confined air in the associated chamber from the cooling side of said chamber to the heating side thereof. As each displacer removes the confined air in the chamber *a* from the heating to the cooling side thereof, the air is rapidly cooled and contracted by contact with section *c*, and thus exhausted or partially exhausted through the registering ports *q* and *r* from the connected cylinder, tends to draw the piston *t* therein downward. These operations taking place alternately in rapid succession on both sides of the engine, impart a steady rotary movement to the crank shaft and displacers fixed thereon, one of the pistons moving upward while the other moves downward. Cool air or other cooling medium entering the opening in the lower part of the jacket *m* and passing upwardly therein as indicated by arrows on Fig. 2, rapidly absorbs and carries off heat from the walls of section *c* of the displacer casing, which in turn abstract the heat from the air confined in contact therewith in the chambers *a*, causing it to rapidly condense or contract while the displacers are passing through the opposite or heating portions of said chambers. With the arrangement shown the strong current of heated air produced by the lamp or burner *k* and issuing from the casing or jacket *l* into the common escape flue or duct *n*, entrains with it air from the casing or jacket *m* and induces a strong upward current of cool air through the same.

The engine may be provided with a number of heating and cooling chambers, and a corresponding number of displacers for each working cylinder, so as to increase the area of the heating and cooling surfaces to which the air confined in said chambers is subjected, and thus produce greater and more rapid changes in temperature when desirable.

By the term "air" as herein used to designate the medium by which the engine is actuated, it is intended to include any suitable gas, vapor or mixture thereof. By the term "semicircular" as herein applied to the displacers, it is intended to include a segmental or sectorial figure greater or less than a half circle.

The number and relative arrangement of the working cylinder and pistons may be varied, and various changes in the details of construction and arrangement of parts besides those specifically mentioned may be made, without departing from the principle and scope of the invention.

I claim:

1. In a caloric engine the combination with the working cylinder and piston, of a heating and cooling chamber communicating with said cylinder, and a continuously rotative displacer partially filling said chamber, substantially as described.

2. In a caloric engine the combination with the working cylinder and piston, of a heating and cooling chamber communicating with said cylinder and having heat conducting walls, a continuously rotative displacer partially filling said chamber and connected with said piston, and means for heating the walls of said chamber on one side of the axis of the displacer, substantially as described.

3. In a caloric engine the combination with the working cylinder and piston, of a heating and cooling chamber communicating with said cylinder and having heat-conducting walls, a continuously rotative displacer partially filling said chamber and connected with said piston, means for heating the walls of said chamber on one side, and means for cooling the walls of said chamber on the other side of its axis, substantially as described.

4. In a caloric engine the combination with the working cylinder and piston, of a circular heating and cooling chamber communicating with said cylinder and having heat-conducting walls, a semi-circular rotary displacer mounted in said chamber and con-

nected with said piston, and means for heating the walls of said chamber on one side of its axis, substantially as described.

5. In a caloric engine the combination with the working cylinder and piston, of a circular heating and cooling chamber communicating with said cylinder and having heat-conducting walls, a semi-circular rotary displacer mounted in said chamber and connected with said piston, means for heating the walls of said chamber on one side, and means for cooling the walls of said chamber on the other side of its axis, substantially as described.

6. In a caloric engine the combination with the working cylinder and piston, of a heating and cooling chamber communicating with said cylinder and having heat-conducting walls, those on the heating side being insulated from those on the cooling side, a casing inclosing a space around the heating walls, means for circulating a heating medium through said space, and a continuously rotative displacer partially filling said chamber and having an actuating connection with said piston, substantially as described.

7. In a caloric engine the combination with the working cylinder and piston, of a heating and cooling chamber communicating with said cylinder and having heat-conducting walls, a casing inclosing heating and cooling spaces next to different portions of said walls, means for circulating a heating medium in the heating space, means for circulating a cooling medium in the cooling space, and a continuously rotative displacer partially filling said chamber and having an actuating connection with said piston, substantially as described.

8. In a caloric engine the combination with the working cylinder and piston, of a circular heating and cooling chamber communicating with said cylinder and having heat-conducting walls, and a semi-circular rotary displacer mounted in said chamber and composed of a metal frame and a light non-conductor of heat filling, the displacer and piston being connected so as to operate synchronously, substantially as described.

9. In a caloric engine the combination of heating and cooling chambers having heat-conducting walls, working cylinders each communicating with an associated heating and cooling chamber, reciprocating pistons fitted in said cylinders, a shaft passing through said chambers and provided with cranks at an angle to one another, rotary displacers mounted on said shaft within said chambers at an angle to one another corresponding to that of said cranks, and means for heating a portion of the walls of said chambers, substantially as described.

10. In a caloric engine the combination of heating and cooling chambers having heat-conducting walls, working cylinders each communicating with an associated heating and cooling chamber, reciprocating pistons fitted in said cylinders, a shaft passing through said chambers and provided with cranks at an angle to one another, rotary displacers mounted on said shaft within said chambers at an angle to one another corresponding to that of said cranks, means for heating a portion of the walls of said chambers, and means for cooling another portion of said walls, substantially as described.

11. In a caloric engine the combination of a working cylinder and piston, a heating and cooling chamber communicating with said cylinder and having heat conducting walls, a displacer actuated by said piston in said chamber, a casing inclosing outside of and next to said walls air spaces which have a common exit, and a burner arranged to produce a current of heated air through one of said spaces and to induce a current of cool air through the other, substantially as described.

12. In a caloric engine the combination of a heating and cooling chamber having heat conducting walls, a working cylinder communicating with said chamber and provided with a piston, a rotary displacer partially filling said chamber and connected with said piston, jackets inclosing air spaces outside of and next to said walls on opposite sides of a vertical plane passing through the axis of the displacer, and a burner arranged to produce an upward current of heated air in one of said spaces, and having a common exit duct with the other through which it is adapted to induce an upward current of cool air, substantially as described.

In witness whereof I hereto affix my signature in presence of two witnesses.

CHARLES L. FORTIER.

Witnesses:
CHAS. L. GOSS,
ALICE E. GOSS.