

(No Model.)

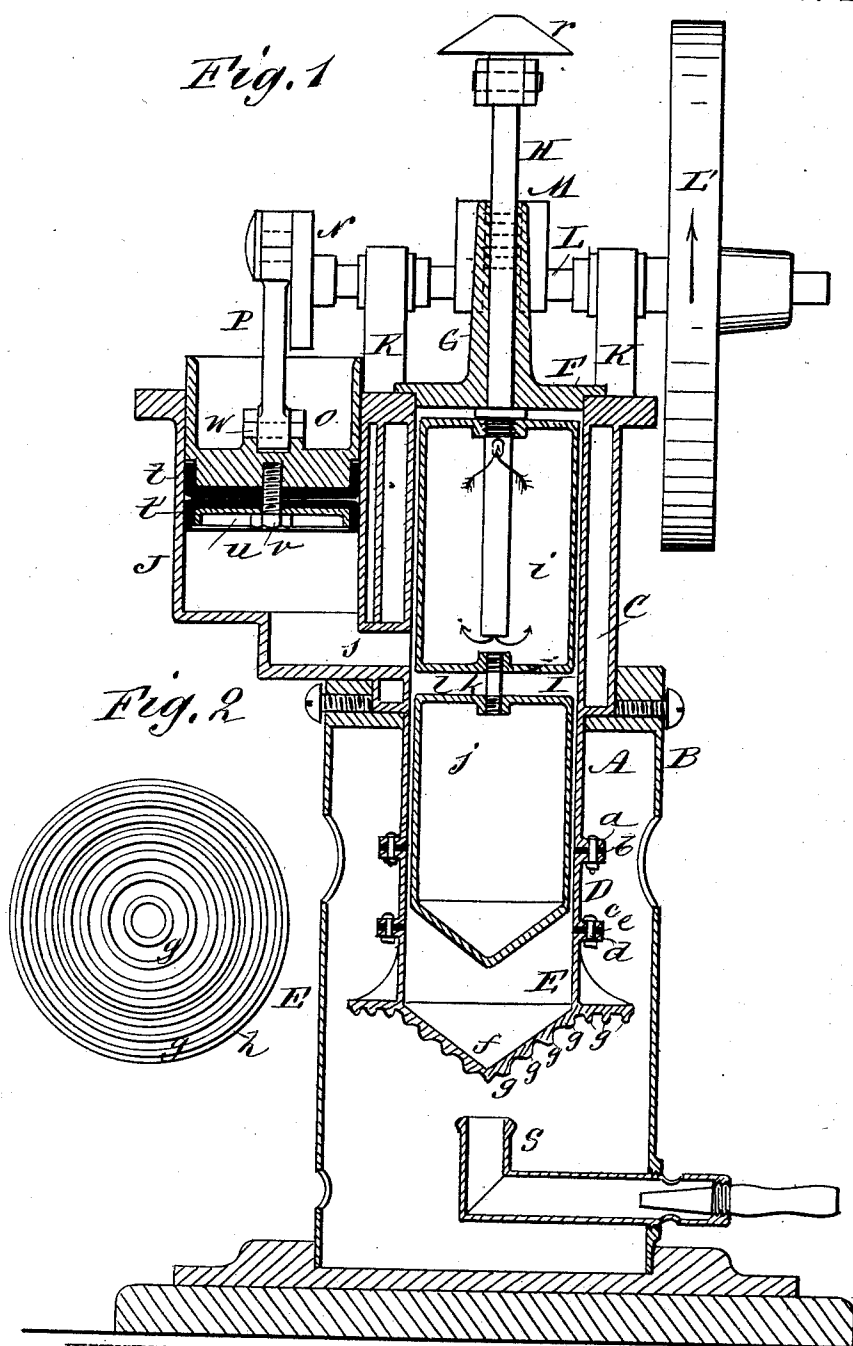
3 Sheets—Sheet 1.

G. M. & I. N. HOPKINS.

CALORIC ENGINE.

No. 374,123.

Patented Nov. 29, 1887.



WITNESSES:

C. Neveu
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(No Model.)

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Fig. 3

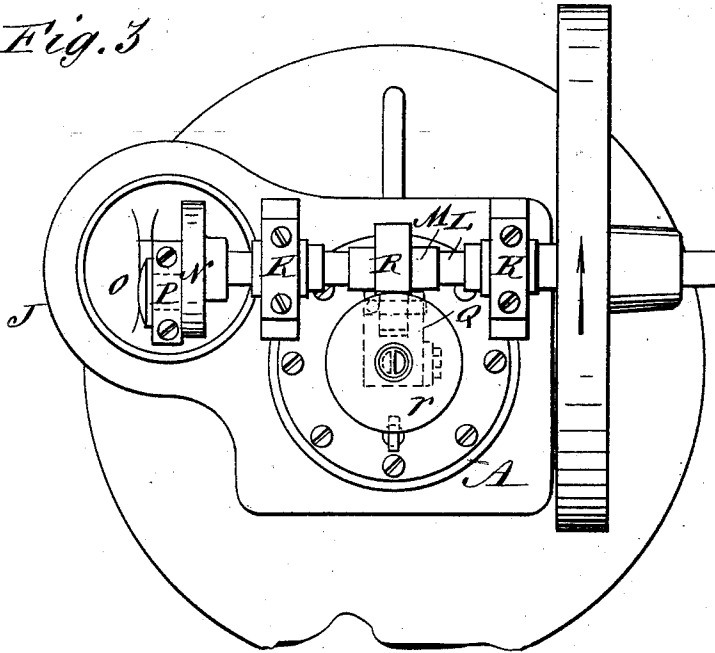


Fig. 4

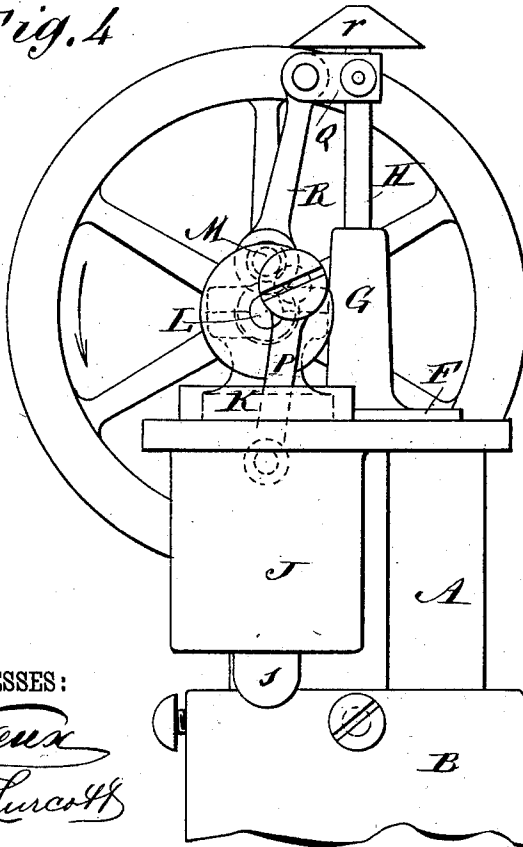
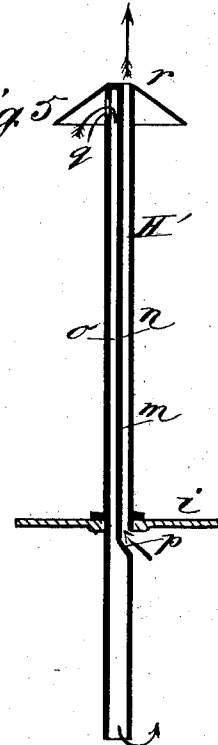


Fig. 5



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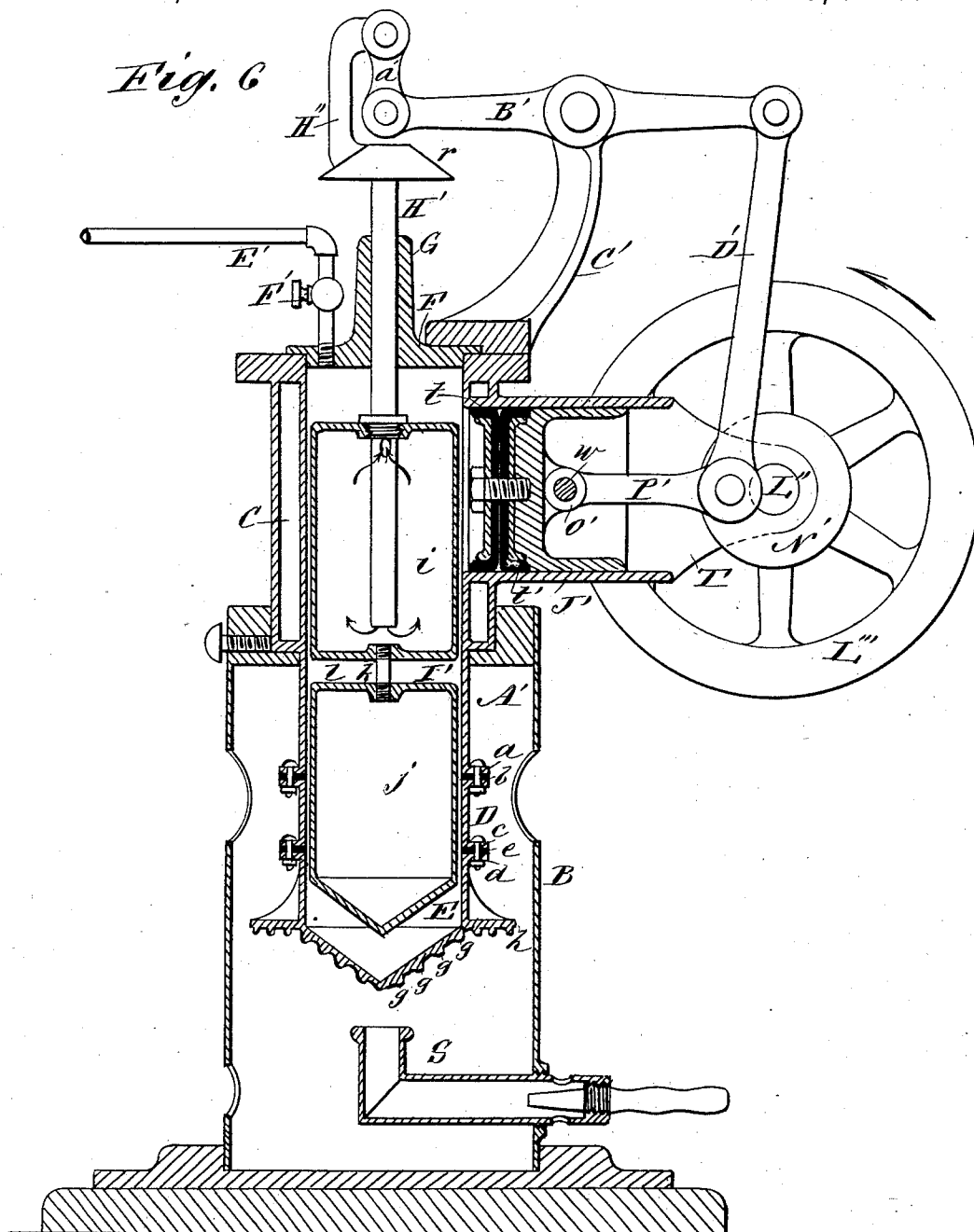
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Fig. 6



WITNESSES:

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UNITED STATES PATENT OFFICE.

GEORGE M. HOPKINS AND I. NEWTON HOPKINS, OF BROOKLYN, NEW YORK.

CALORIC-ENGINE.

SPECIFICATION forming part of Letters Patent No. 374,123, dated November 29, 1887.

Application filed July 29, 1887. Serial No. 245,636. (No model.)

To all whom it may concern:

Be it known that we, GEORGE M. HOPKINS and I. NEWTON HOPKINS, both of Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Caloric-Engine, of which the following is a specification, reference being had to the annexed drawings, forming a part thereof, in which—

Figure 1 is a vertical transverse section of our improved caloric-engine. Fig. 2 is an inverted plan view of the bottom of the heating-chamber. Fig. 3 is a plan view of the engine. Fig. 4 is a partial side elevation. Fig. 5 is a longitudinal section of the tubular rod of the transfer-piston, and Fig. 6 is a vertical transverse section of a modified form of our improved engine.

Similar letters of reference indicate corresponding parts in all the views.

The object of our invention is to construct a caloric-engine in which the heating and cooling zones will be sharply defined, and in which the displacement of the air in the downward direction will be effected quicker than in the upward direction.

The object of our invention is, further, to provide means for establishing a circulation of air in part of the transfer-piston to assist in cooling the piston, and, further, to provide a packing especially adapted to the power-piston of a caloric-engine.

Our invention has for its object, also, the construction of a removable heating-chamber and an insulating device for preventing the conduction of the heat from the heating-chamber to the cooling-chamber.

Our invention consists in the combination, with the power-cylinder and piston, of an expansion-cylinder connected with the power-cylinder and provided with a transfer-piston divided into two approximately equal sections and connected together by a connecting rod or stem of small diameter, to prevent the equalization of the temperatures of the upper and lower portions of the piston.

It also further consists in the combination, with the upper portion of the transfer-piston, of a tubular piston-rod extending downward into the piston and provided at its upper end with an air-collecting funnel, the said tubular

rod and funnel being arranged to cause a constant circulation of air within the upper half of the transfer-piston.

Our invention also consists in the combination, with the power-piston, of a packing of felt or analogous material for completing the joint between the piston and the cylinder.

It also further consists in the combination, with the power-cylinder and piston and expansion-cylinder and transfer-piston, of a crank-shaft arranged above the center of the power-cylinder and on one side of the axial line of the expansion-cylinder, and a connecting-rod connecting the piston-rod of the transfer-piston with the crank upon the shaft located at one side of the axis of the expansion-cylinder.

It also further consists in a removable end piece or heating-chamber connected with the expansion-cylinder by means of an intermediate cylinder-section and heat-insulating packing, all as hereinafter more fully described.

The expansion-cylinder A is mounted upon the fire-box B, and is provided around its upper half with a water-jacket, C.

To the flange *a*, formed on the lower end of the expansion-cylinder A, is attached a flanged ring, D, with an intervening packing, *b*, of asbestos or other heat-insulating material, and to the lower flange, *c*, of the ring D is adapted the flange *d* of the heating-chamber E, with an intervening heat-insulating packing, *e*. The flanges at the lower parts of the expansion-cylinder A are connected by bolts.

The bottom *f* of the chamber E is conical in form and provided with concentric external ribs, *g*, for increasing the heating-surface. It is also furnished with a flange, *h*, at the juncture of the conical portion with the cylindrical portion, the said flange being also provided with circular ribs *g*.

To the top of the expansion-cylinder A is secured a head, F, provided with a sleeve, G, through which extends the tubular rod H.

In the expansion-cylinder A is placed the transfer-piston I, formed of the parts *i* *j*, the part *j* being made conical at its lower end to conform to the conical bottom *f* of the heating-chamber E. The upper part, *i*, of the trans-

fer-piston is cylindrical in form and is connected with the lower part by a short rod, *k*, leaving a space, *l*, between the two parts of the transfer-piston. The diameter of the transfer-piston I is made less than the internal diameter of the expansion-cylinder A, to allow the air to pass freely from one end of the cylinder to the other. The tubular piston-rod H extends downward into the upper part, *i*, of the transfer-piston to a point near the bottom thereof, where it is left open.

The tubular rod H is divided longitudinally by a partition, *m*, which extends from the upper end of the rod to a point a short distance below the top of the part *i* of the transfer-piston, forming two passages, *n o*. The passage *n* communicates with the interior of the part *i* of the transfer-piston through an opening, *p*, in the side of the tubular rod H, and the passage *n* is stopped below the said opening *p*, while it is left open at the upper end of the rod. The passage *o* is closed at the top and communicates through an aperture, *q*, in the side of the tubular rod with the space below the hollow funnel *r*, secured to the top of the rod. It will thus be seen that when the funnel *r* is moved downward air is gathered by it and forced into the aperture *q*, down the passage *o*, into the part *i* of the transfer-piston, displacing the air contained by the said transfer-piston, forcing it out through the opening *p* and passage *n*.

To the side of the expansion-cylinder A is attached the power-cylinder J, arranged parallel with the expansion-cylinder, and communicating therewith through the passage *s*.

To the top of the expansion-cylinder A are secured pillow-blocks K, in which is journaled the crank-shaft L, carrying the fly-wheel L'. The crank-shaft L is provided with a crank, M, in the middle of its length, and with a crank, N, upon the end projecting over the power-cylinder J. The cranks M N are set at an angle of about forty-five degrees with each other.

To the crank M is connected a connecting-rod, R, at a point above and at one side of the crank-shaft L. This connection, by virtue of the angle of the connecting-rod, insures a quick downward and slow upward movement of the transfer-piston, thereby giving the air more time to become heated in the hot end of the expansion-cylinder.

To the power-cylinder J is fitted a piston, O, provided with the cup-packing *t t'*, the said cup-packing being held in place by the washer *u* and the screw *v*, passing through the washer into the body of the piston. The packing *t t'* is formed of felt or analogous fibrous material—such as heavy woolen or cotton cloth. A packing of this nature absorbs a large amount of oil and insures constant lubrication of the piston, and is sufficiently tight for the purposes of a caloric-engine.

The piston O is connected by a connecting-rod, P, with the pin of the crank N, the lower

end of the said connecting-rod being pivoted in the lower part of the piston upon the pin *w*.

The tubular piston-rod H is provided with a short laterally-projecting arm, Q, in which is pivoted the upper end of the connecting-rod R, which is connected with the crank M.

The motion of the engine is in the direction indicated by the arrow.

Below the heating-chamber E is placed a Bunsen burner, S, or other suitable source of heat. When heat is applied to the heating-chamber E, the air contained thereby becomes heated and expanded and forces the piston O upward in the cylinder J, thereby turning the shaft L, and, through the crank M and connecting-rod R, raising the transfer-piston I, so as to displace the air in the upper part of the expansion-cylinder and cause it to descend into the warmer part of the cylinder, where it is expanded. When the power-piston O reaches the upper part of its stroke, the transfer-piston begins to descend, thereby displacing the air in the bottom of the expansion-cylinder and transferring it to the top of the expansion-cylinder, where it is cooled, producing a vacuum, which allows the atmospheric pressure to push the piston O downward. This operation is repeated for every revolution of the engine.

The upper part of the expansion-cylinder is kept cool by the circulation of water through the water-jacket C, and heat is removed from the upper part, *i*, of the transfer-piston by the circulation of air through the tubular piston-rod H, as before described. Heat is prevented from being communicated from the lower part of the transfer-piston to the upper part thereof by the connecting-rod *k* and the air-space *l*, existing between the upper and lower parts of the piston. The intense heat of the heating-chamber E is prevented from being communicated to the upper part of the expansion-cylinder by the insulating-packing *b e*.

In Fig. 6 we have shown a modification of the engine, in which the power-cylinder J' is arranged at right angles to the expansion-cylinder A', and the crank-shaft L' is journaled in an arm, T, connected with the power-cylinder. A fly-wheel, L'', is mounted upon the shaft L'. The power-piston O' is connected with the crank N' on the crank-shaft L' by the rod P'. The upper end of the tubular piston-rod H' in this case is provided with an arm, H'', which is connected by a link, *a'*, with a walking-beam, B', which is pivoted to an arm, C', and the said walking-beam B' is connected by the rod D' with the crank N'. By means of this arrangement the rectangular motions of the piston O' and the transfer-piston I' are made to time properly, so that the same results are secured as in the other case.

To increase the efficiency of the engine we provide a water-pipe, E', which enters the head of the expansion-cylinder and supplies a small amount of water to the said cylinder,

which is alternately converted into steam and condensed as the air containing the steam is transferred from the upper to the lower end of the expansion-cylinder. The water supplied

5 is controlled by the valve F'.

The parts of the modified form of the engine shown in Fig. 6, other than those already referred to, are like the same parts shown in the other figures, and are therefore designated

10 by the same letters of reference.

By bisecting the transfer-piston in the manner described and insulating the heating-chamber from the body of the expansion-cylinder we are enabled to secure sharply-defined zones

15 of heat and cold, which insure increased efficiency.

In the above specification by the term "expansion-cylinder" we mean the cylinder in which the air is alternately expanded and contracted by being transferred from the hot lower

20 end of the cylinder to the cool upper end thereof.

Having thus fully described our invention, we claim as new and desire to secure by Letters Patent—

25 1. In a caloric-engine, the combination, with the power-cylinder and piston and the expansion-cylinder, of a transfer-piston formed of two hollow cylindrical parts connected to-

gether by a small rod screwed centrally into the adjoining heads of the parts of the transfer-piston, with an air-space intervening between the parts of the piston, and connective mechanism connecting the power and transfer

30 pistons, substantially as specified.

2. The combination, with the upper part, i, of the bisected transfer-piston, of a tubular longitudinally-divided piston-rod and funnel attached thereto, the said tubular piston-rod and funnel being adapted to maintain a circula-

40 tion of air in the upper half of the transfer-piston, substantially as specified.

3. In a caloric-engine, the combination, with the power and expansion cylinder and power and transfer pistons, of a crank-shaft arranged

45 at one side of the axis of the expansion-cylinder and transfer-piston and provided with a crank connected with the rod of the transfer-piston at a point above and at one side of the crank-shaft, whereby a quick downward and

50 slow upward motion is imparted to the transfer-piston, substantially as and for the purpose specified.

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I. NEWTON HOPKINS.

Witnesses:

EDGAR TATE,

EDWD. M. CLARK.