(No Model.)

M. P. W. BOULTON & E. PERRETT.

CALORIC ENGINE.

No. 311,102. Patented Jan. 20, 1885.

Fig. 1.

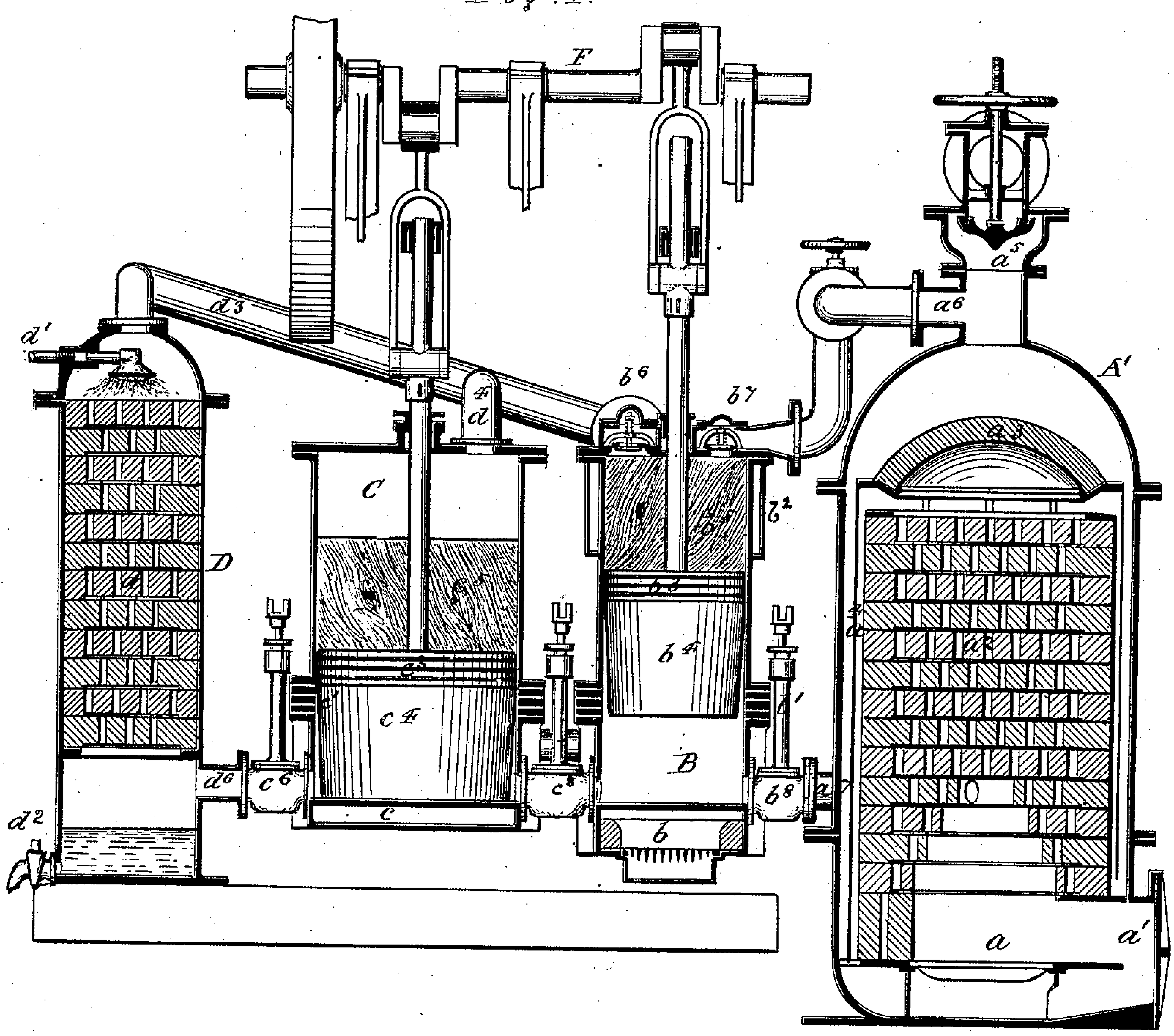
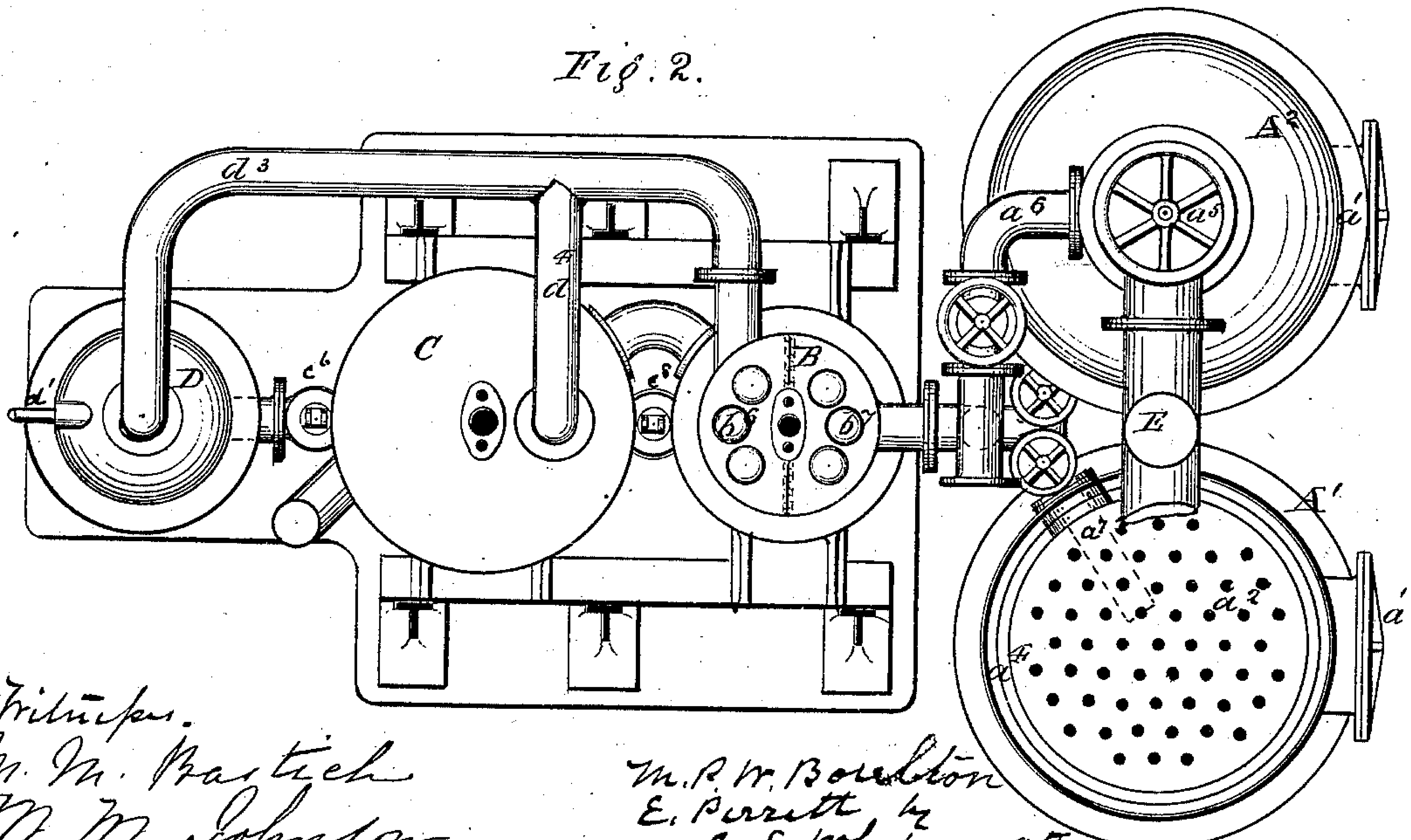


Fig. 2.



Witnesses.
M. M. Bartlett
M. M. Johnson

M. P. W. Boulton
E. Perrett by
C. S. Whitman atty

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

MATTHEW P. W. BOULTON, OF TEW PARK, COUNTY OF OXFORD, AND EDWARD PERRETT, OF WESTMINSTER, COUNTY OF MIDDLESEX, ENGLAND.

CALORIC ENGINE.

SPECIFICATION forming part of Letters Patent No. 311,102, dated January 20, 1885.

Application filed June 12, 1884. (No model.) Patented in England April 14, 1882, No. 1,788; in France July 24, 1882, No. 150,277; in Germany July 25, 1882, No. 21,046; in Belgium July 29, 1882, No. 58,617; in Austria December 15, 1882, No. 2,313, and in Italy December 31, 1882, XXIX, 205.

To all whom it may concern:

Be it known that we, MATTHEW PIERS WATT BOULTON and EDWARD PERRETT, citizens of England, residing, respectively, at Tew Park, county of Oxford, England, and at Westminster, county of Middlesex, England, have invented a new and useful Caloric Engine, (for which we have obtained patents in Great Britain, dated April 14, 1882, No. 1,788; France, dated July 24, 1882, No. 150,277; Belgium, dated July 29, 1882, No. 58,617; Germany, dated July 25, 1882, No. 21,046; Austria, dated December 15, 1882, No. 2,313; and Italy, dated December 31, 1882, Vol. XXIX, 205,) of which the following is a specification.

We will describe one form and arrangement of engine according to our invention, referring to the accompanying drawings.

Figure 1 is a longitudinal section, and Fig. 2 is a plan.

The engine consists of four principal parts, as follows: A heater provided in duplicate, A′ and A^2, a pumping-cylinder, B, an expanding or working cylinder, C, and a cooler, D. The heater A′ is an upright cylindrical vessel, having in its lower part a fire-place, *a*, the access to which can be tightly closed by a cover, *a′*. Above the fire-place there are superposed a number of circular slabs, a^2, of fire-brick or equivalent refractory material perforated by numerous holes and having spaces between them for free passage of air. Instead of using perforated slabs, ordinary fire-bricks may be built up with interstices between them. Above the refractory material there is a brick dome, a^3, from the periphery of which a metal-plate partition, a^4, extends down nearly to the bottom of the vessel, dividing into two annular channels the space surrounding the refractory structure. From the top of the vessel there is a passage to a chimney, E, provided with a valve, a^5, by which it can be tightly closed. Two pipes, a^6 and a^7, each provided with a shut-off valve, communicate with the interior of the vessel—the one at the top and the other in the lower part. The other heater, A^2, is in every respect similar to A′, and the two are worked alternately, in the following manner: The valves of a^6 and a^7 of A′ being closed, and the door *a′* and chimney-valve a^5 being open, a fire is kept for several hours burning in the fire-place *a*. The flames and hot products of combustion pass up through the holes or interstices of the fire-bricks a^2, are deflected by the dome a^3 down the annular channel within the partition a^4, then ascend outside a^4, and pass away by the chimney E. When the fire-bricks a^2 are thus heated, the door *a′* and chimney-valve a^5 are tightly closed. The valves of a^6 and a^7 are opened. The air in the upper part of the pumping-cylinder is forced in by a^6. It passes down the annular channel outside of a^4, ascends inside a^4, is deflected by the dome a^3, passes through the interstices of the hot fire-bricks a^2, becomes heated and issues hot by the pipe a^7. While A′ is being heated by fire within it, A^2, which had been previously heated, is employed for heating the air, and when A′ is sufficiently heated and A^2 cooled their operation is inverted—that is to say, A^2 is now heated by fire within it and A′ is employed to heat the air, and thus continuously the action of the two heaters is alternated.

Instead of two heaters, any desired number of heaters may be employed in similar manner. The annular channels on each side of a^4, by maintaining a jacket of comparatively cool air between the outer casing and the hot bricks within, reduces loss of heat by conduction and radiation.

The cylinder B is made in two parts—a cool upper part and a hot lower part—which is in the first place heated, and may afterward be kept hot by a small fire, *b*, for which flames of gas may be substituted when convenient. The flange of the lower part of the cylinder is bolted to that of the upper part at *b′* with several layers of imperfectly-conducting material—such as asbestus sheet interposed between the flanges—so as to lessen as much as possible conduction of heat from the one part to the other. The upper part, which is preferably kept cool by a water or air jacket, b^2, is fitted with a packed piston, b^3, having projecting down from it a shield, b^4, deep enough to occupy all the hot part of the cylinder when the piston is down.

To the upper side of the piston b^3 is attached a block, b^5, of wood or other equivalent bad conductor of heat.

In the cylinder-cover are fitted suction-valves b^6 and discharge-valves b^7, the latter opening into a channel communicating with the pipes a^6 of the heaters. The lower part of the cylinder has a valve, b^8, worked by a cam or eccentric governing a communication with the pipes a^7 of the heaters. As the piston b^3 reciprocates, air is drawn into the upper part of B, and forced thence into the one or the other of the two heaters A′ or A^2, while by the alternate opening and closing of the supply-valve b^8, and of a discharge-valve, c^8, which will be hereinafter referred to, hot air from the heater enters the lower part of the cylinder B, and after forcing up its piston passes to the cylinder C to expand therein.

The cylinder C is also made in two parts—a cool upper part and a hotter lower part—which may be kept heated by a casing, c, forming part of the flue from the fire b. The flanges at c', by which the two parts of the cylinder are joined, have, as at b', interposed layers of imperfectly-conducting material. The piston c^3 has a shield, c^4, and a block, c^5, as described with reference to b^3. The valve c^8 in opening discharge from b opens supply to C, and another valve, c^6, opens discharge from C. The pistons of B and C are connected to opposite cranks on a fly-wheel shaft, F, on which shaft are suitable eccentrics or cams of ordinary construction for working the valves b^8, c^8, and c^6. If the engine takes in its supply from the atmosphere, the exhaust is discharged into the atmosphere, and the cooler with its connecting parts is dispensed with.

Instead of taking in a supply of air from the atmosphere, the engine may be supplied with air compressed by another engine or source of power. In such a case the compressed air may either be delivered to the upper or cool part of the cylinder B, in the same manner as the intake from the atmosphere, as above described, or it may be delivered direct to the heater, in which case the pumping apparatus in the upper or cool part of the cylinder B is dispensed with.

When the engine is intended to work with air at high pressure, such air not being compressed by another engine, then a cooler is employed, as shown at D. This is a vessel containing bricks d, or other porous or easily-wetted material—such as coke built up with interstices—which is kept wetted by a shower of water from a pipe, d', at the top, the surplus water being run off by a cock or valve, d^2, at the bottom of the vessel. At the lower part of the vessel there is a passage, d^6, from the valve c^6, and from its upper part there is a pipe, d^3, leading to the suction-valve b^6. There is a communication, d^4, between the pipe d^3 and the upper part of the cylinder C. The air discharged through the valve c^6, still heated, enters the lower part of D, passes up through the interstices among or between the wetted material d, becoming cooled thereby, and flows by the pipe d^3 to supply the intake of the cylinder B. From this it is sent through the heater and acts in the cylinders B and C in the manner previously described.

A small compressing air-pump (not shown) is provided and worked by the engine in order to supply loss by leakage.

Although we have described the use of two heaters, A′ A^2, worked alternately, which is necessary when the engine has to have continuous action, a single heater will obviously suffice in cases where the action is intermittent. For instance, when the engine is worked only during the day, the single heater may be heated during some hours of the night and give out its heat during the day.

I am aware that it is not new, in working furnaces at atmospheric pressure, to heat a chamber containing refractory materials by fire, and then pass air through the chamber thus heated, (see, for instance, English Patent No. 1,320 of 1857;) but in furnaces thus worked it was not contemplated to use the heater as a closed vessel capable of withstanding pressure as is required for a hot-air engine.

Having thus described the nature of our invention and the best means we know of carrying it out in practice, we claim—

1. A caloric or hot-air engine, consisting of a heater or heaters, A′ A^2, a pumping-cylinder, B, and an expanding cylinder, C, with their pipes, valves, and connections, arranged and operating substantially as described.

2. A caloric or hot-air engine, consisting of a heater or heaters, A′ A^2, a pumping-cylinder, B, an expanding cylinder, C, and a cooler, D, with their pipes, valves, and connections, arranged and operating substantially as described.

3. The herein-described improvement in the art of heating the air or gaseous fluid of caloric engines, which consists in alternately heating, by a furnace, closed heaters containing refractory material, as described, and subsequently alternately heating the working-fluid forced into the heaters and under pressure by the alternate action of the heated refractory material of the heaters, substantially as and for the purposes set forth.

4. For heating the working fluid of a caloric engine, a heater, A′ or A^2, consisting of a vessel which contains refractory material, a^2, disposed with suitable interstices or apertures, and has a fire-place, a, with a tightly-closing door, a', a chimney-valve, a^5, a dome, a^3, a partition, a^4, and supply and discharge pipes a^6 and a^7, provided with shut-off valves, substantially as herein described.

5. For cooling the working-fluid of a caloric engine, a cooler, D, containing wetted material *d*, disposed with suitable interstices, and provided with water supply and discharge pipes $d' d^2$, and with inlet and outlet pipes d^6 and d^3 for the working-fluid, substantially as described.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 12th day of May, A. D. 1884.

M. P. W. BOULTON.
EDWARD PERRETT.

Witnesses:
JOHN IMRAY,
OLIVER IMRAY.