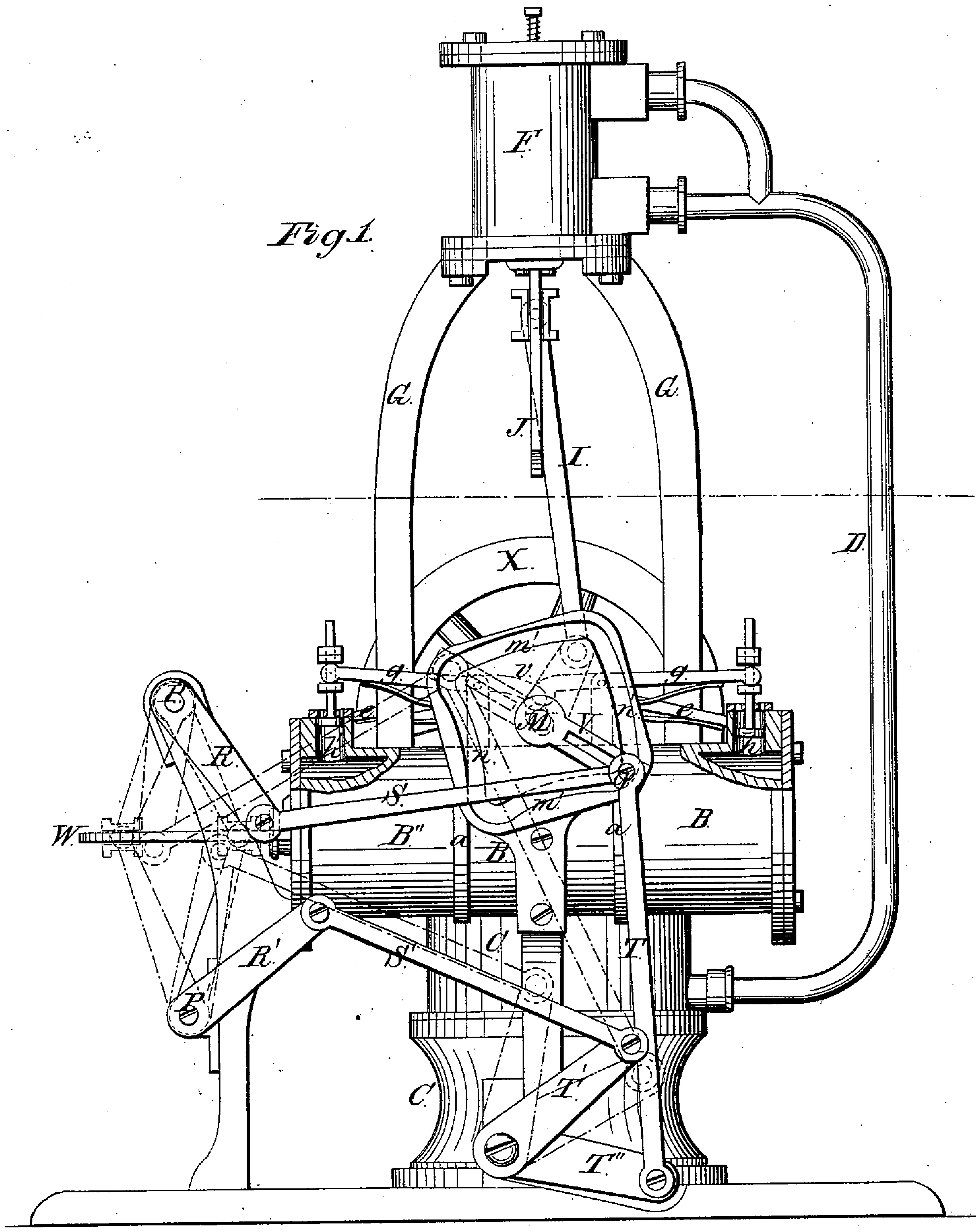
Sheet 1 - 2 Sheets.

H. D. Wallen, Jr.,

Air Engine,

№ 83,114. Patented Oct. 13. 1868.

Fig. 1.



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Sheet 2-2 Sheets.

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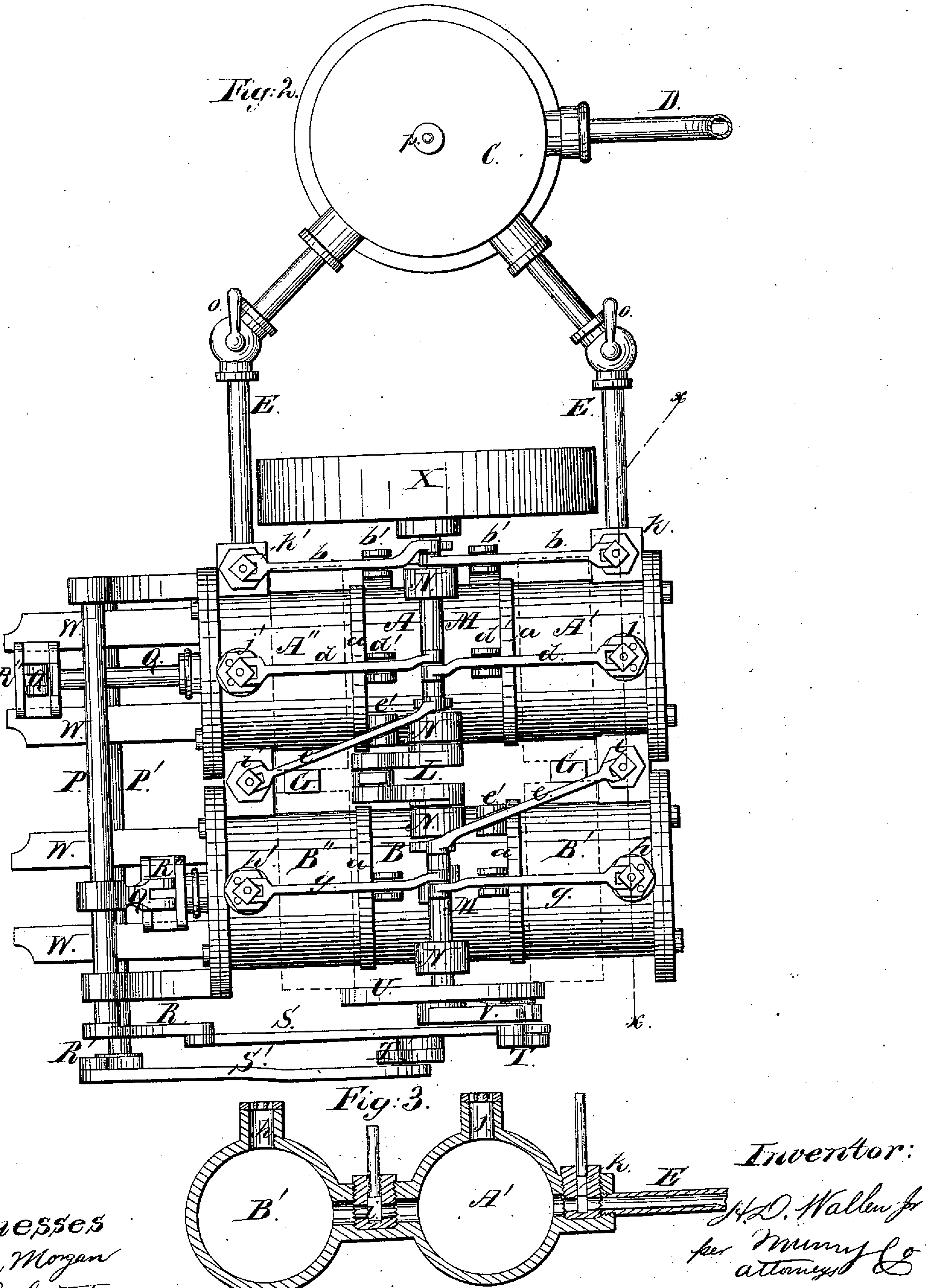
Fig: 2.

Fig: 3.



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United States Patent Office.

H. D. WALLEN, JR., OF FORT COLUMBUS, NEW YORK.

Letters Patent No. 83,114, *dated October* 13, 1868.

IMPROVEMENT IN CALORIC-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, H. D. WALLEN, Jr., of Fort Columbus, in the county of New York, and State of New York, have invented a new and useful Improvementi n Caloric-Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation of my invention.

Figure 2 is a plan view of the same.

Figure 3 is a detail cross-section through the line *x x*, fig. 2.

Similar letters of reference indicate corresponding parts.

The object of this invention is to provide hot-air engines which will work with better results than those heretofore made.

The general features of the invention consist in the employment of two parallel cylinders, each cylinder being provided with air-heating chambers at each end. The cylinders communicate with each other through suitable ports, opening from the heating-chamber of one cylinder into the adjacent heating-chamber of the other, and these ports are provided with valves, the timely operation of which is accomplished by suitable valve-gear.

The pistons are made, by means of any suitable "lost-motion" devices, to move and rest alternately; that is to say, one piston is at rest, either at the top or bottom of the stroke, while the other piston is making the stroke towards the resting piston.

This arrangement allows time for the air to be received into and heated in the air-chambers at either end of the cylinders, which is a prominent feature of my invention.

Another advantageous feature obtains in the utilization of the excess of pressure in the first cylinder to assist in actuating the piston of the second or auxiliary cylinder, whereby the expanded air of the first cylinder escapes into the second heating-chamber, and, by its pressure, assists to actuate the second piston to make its stroke while the first piston is resting. This operation takes place at each end of the cylinders, so that the pistons are actuated, in both directions, by expanded air.

By expanding the air at both ends of the cylinders, I am enabled to employ a smaller air-pump, in proportion to the capacity of the cylinders, than the caloric-engines heretofore made, for one volume of air is drawn into the air-heating chambers at each stroke of the pistons, after the manner of a common air-pump. The air thus introduced is augmented by the introduction of compressed air, which escapes from the reservoir, in which it was compressed by the air-pump, and this, being then heated, actuates the piston, as will be shown.

This operation is more specifically explained by reference to drawings, where A is the first cylinder, and B the second or auxiliary cylinder.

The air-chambers of the cylinders are shown at A′ A″ and B′ B″, respectively.

In practice, the air-chambers may be of copper or composition, the better to withstand the action of the flame by which they are kept heated.

The air-pump F is double-acting, and is worked by a crank, L, and rod, I, the crank being on the main driving-shaft, M, of the engine.

The air-pump delivers air, through the pipe E, into the reservoir C, in which it is kept compressed.

E E are the induction-pipes, which admit the compressed air from the reservoir into the air-chambers A′ A″ of the first cylinder, through the eduction-ports *k k′* of the said chambers, which ports are provided with any suitable valves.

b b are the valve-levers of such valves, and are pivoted at *b′ b′*, and operated by cams on the shaft M, to open and close the said ports.

j j′ are the exhaust-valves for the air-chambers.

d d are the levers for these latter valves, and are pivoted at *d′ d′*, and actuated by cams on the shaft M, in the same manner as the induction-valves, though at different times.

i i′ are the induction-valves for the second cylinder, and are operated by levers *e e*, pivoted at *e′ e′*, and cams on the driving-shafts, as the other aforesaid levers. These valves admit the compressed air from the chambers A′ A″ after the completion of the stroke of the first piston.

h h′ are the exhaust-valves of the second cylinder, and operate in a manner similar to the corresponding valves of the first cylinder. The operation of these valves and pistons is as follows:

I will suppose that the engine is running, and proceed with the description from the port *k* of the first cylinder.

The air from the reservoir enters at *k*, augmenting, by one volume, (the measure of the cylinder A,) the air already in the chamber A′. The chamber A′ being constantly heated, the air it now contains is expanded, and the piston is actuated one stroke, leaving its rod at rest.

There is now a pressure of two atmospheres in the first cylinder behind the piston, for the chamber A′ was primarily filled with air at the ordinary tension of one atmosphere. This was augmented by another and equal volume of air from the reservoir, which raised the tension of the air to two atmospheres. This, being heated to a degree sufficient to expand the air to twice its natural volume, gave an initial pressure behind the piston of four atmospheres. When the piston reaches the extent of its stroke, the tension of the air behind it has fallen to two atmospheres.

The first piston, by means of suitable lost-motion mechanism, is now made to rest, and the valve *i* is opened, permitting the air in the first cylinder to escape into the chamber B′ of the second cylinder.

Fig. 1 shows the engine at the moment that the first piston has completed its stroke. The valve *i* is being opened to admit air to the chamber of the second cylinder, which contains also one volume of air, which is now augmented by one-half volume of air from the first cylinder; the second chamber will then contain one and a half volume of air, giving a pressure of one and a half atmosphere. The air now becomes expanded, giving, if the proper heat be applied, an initial tension of three atmospheres, which tension acts to drive out the second piston.

When the second piston arrives at the end of its stroke, the air which was in the opposite chamber A″ is augmented by air from the reservoir, in the manner first described, and the first piston is driven back while the second is resting.

As the first piston begins to return, the valve *j* opens, and exhausts the air before the piston, thus leaving the chamber A′ full of air, when the said piston has arrived back from where it started, as herein described.

The operation is the same at both ends of the cylinder.

The cams on the shafts M are so formed and set as to lift the several valves at certain movements, which movements are governed by the relative position of the pistons. Thus, valve *k* opens first, and admits a charge of air, (one cylinder's measure,) from the reservoir, and then closes. The piston is driven out, the exhaust-valve *j* being open to discharge the air before it.

When the first piston is out, the valve *i* opens, and remains open for a portion of the stroke of the second piston; the exhaust-valve *h′* being open to discharge the air in front of the second piston. The valves *i* or *i′* are closed when in front of the second piston.

The air-pump is double-acting, and of the same capacity as the cylinders.

The reservoir is also of the same capacity as the cylinders, or nearly so, and as it contains primarily one volume of air, and receives another at each stroke of the pump-piston, it will always contain at least two volumes of air while the engine is running, but in practice a pressure of about four atmospheres is allowed to collect in the reservoir before the cocks *o o* are opened to connect it with the first cylinder. As a measure of air is delivered into the reservoir for one that is discharged therefrom into the cylinder, the proper excess of pressure is maintained in the reservoir to inject a charge or measure of air into the chambers A′ A″, when the valves *k* or *k′* are momentarily opened for that purpose.

p is a safety-valve in the reservoir.

The lost-motion mechanism, for resting each piston alternately, will now be described.

P P′ are rocking-shafts, each having an arm, Q, the rounded end of which works with finished contact within a suitable recess in its respective cross-head R″ of the piston-rods Q, by means of which the rock-shafts are oscillated by the movement of their respective pistons.

The rock-shafts are provided with other arms, R R′, which are connected, by rods S S′, to the vibrating arms or plates T T″, as shown. These latter arms are rigidly affixed to one another, and vibrate together.

U is a fixed plate, having a rectangular slot, *m m′ n n′*. This rectangular slot is composed of four connected arched slots, the radial centres of which are the centres of vibration of the rods T and S.

The rod T connects the arm T″ with the rod S on stud *q*, the projecting end of which traverses in the rectangular slot of the said plate U.

V is a slotted arm, on the end of the shaft M, and the stud *q* works in the said slot as it traverses in the rectangular slot. Motion is thus communicated to the shaft M.

The arms T′ T″ rest alternately for each piston, but the arms R R′ move and rest with their respective pistons and rocking-shafts.

W W W W are the cross-head guides.

The air-pump is supported by the uprights G G.

X is the fly-wheel and pulley, for transmitting the power of the engine.

The red outlines show the positions of the several parts of the lost-motion mechanism, when both pistons are at the extent of the out-stroke. The other positions of the same, are the positions when both pistons are at the end of the return-stroke.

The air-chambers may be heated, in practice, by any of the known devices for such purpose, but I prefer to employ a coil of pipe, encircling each chamber, and provided with series of burners, so arranged along the coils, that the flames from the said burners will impinge directly upon the chambers, and thus keep them heated.

This form of heating-apparatus will be available for burning gas or petroleum, when properly-constructed burners for each case are employed.

When coal or other similar fuel is employed, annular chambers, encircling the air-heating chambers, may be employed to conduct the heat from the fuel, and bring the heat thereof in contact with the air-chambers.

Having thus described my invention,

I claim as new, and desire to secure by Letters Patent—

1. The two parallel cylinders A B, when arranged side by side, and provided at both ends with air-heating chambers A′ A″, B′ B″, and the valve-gear to cause the alternate movement and resting of the pistons, all substantially as shown and described.

2. The rock-shafts P P′, having arms *e* R R′, the connecting-rods S S′ T, and angular lever T′, substantially as herein shown and described, in combination with and arranged with relation to the shaft M, slotted plate U, slotted arm V, and cross-heads R″, as set forth.

The above specification of my invention signed by me, this 8th day of May, 1868.

H. D. WALLEN, Jr.

Witnesses:

C. B. Thompson,

Alex. F. Roberts.