2 Sheets--Sheet 1.

O. TROSSIN.

Air and Gas Engines.

No. 141,189. Patented July 22, 1873.

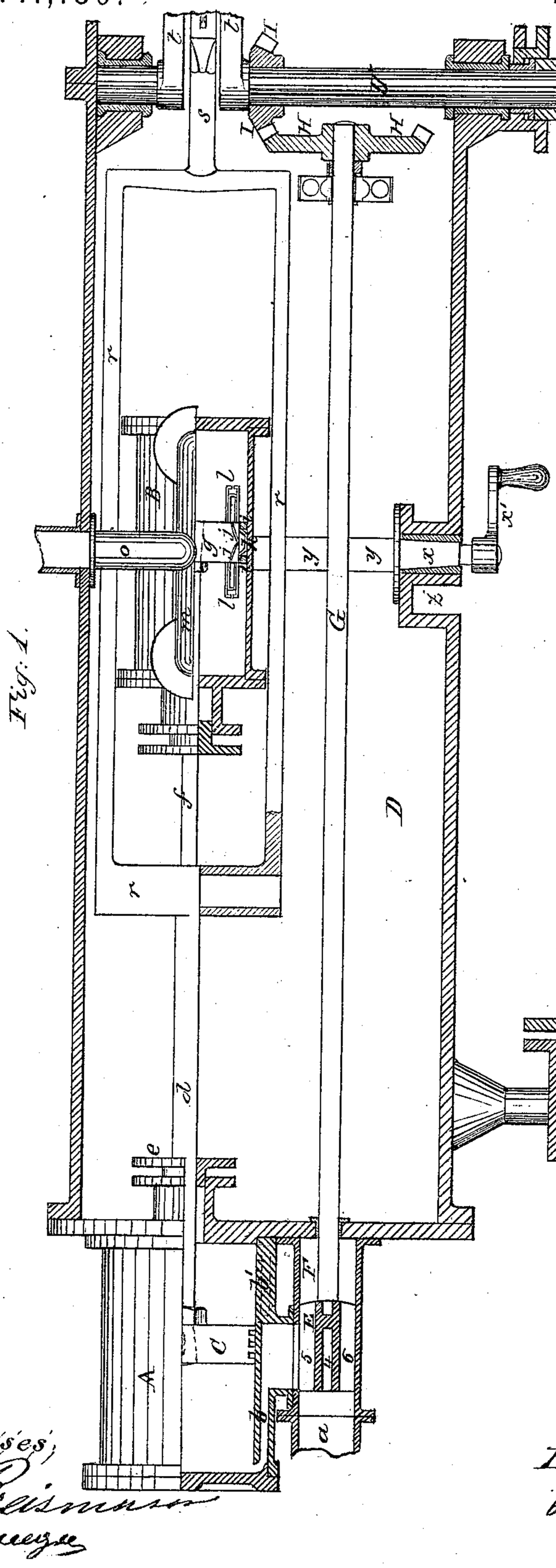
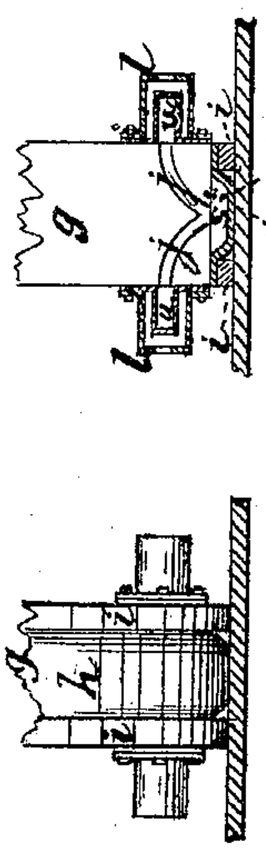


Fig. 1.



Witnesses;
H. Reismann
L. Krueger

Inventor;
Otto Trossin

2 Sheets--Sheet 2.

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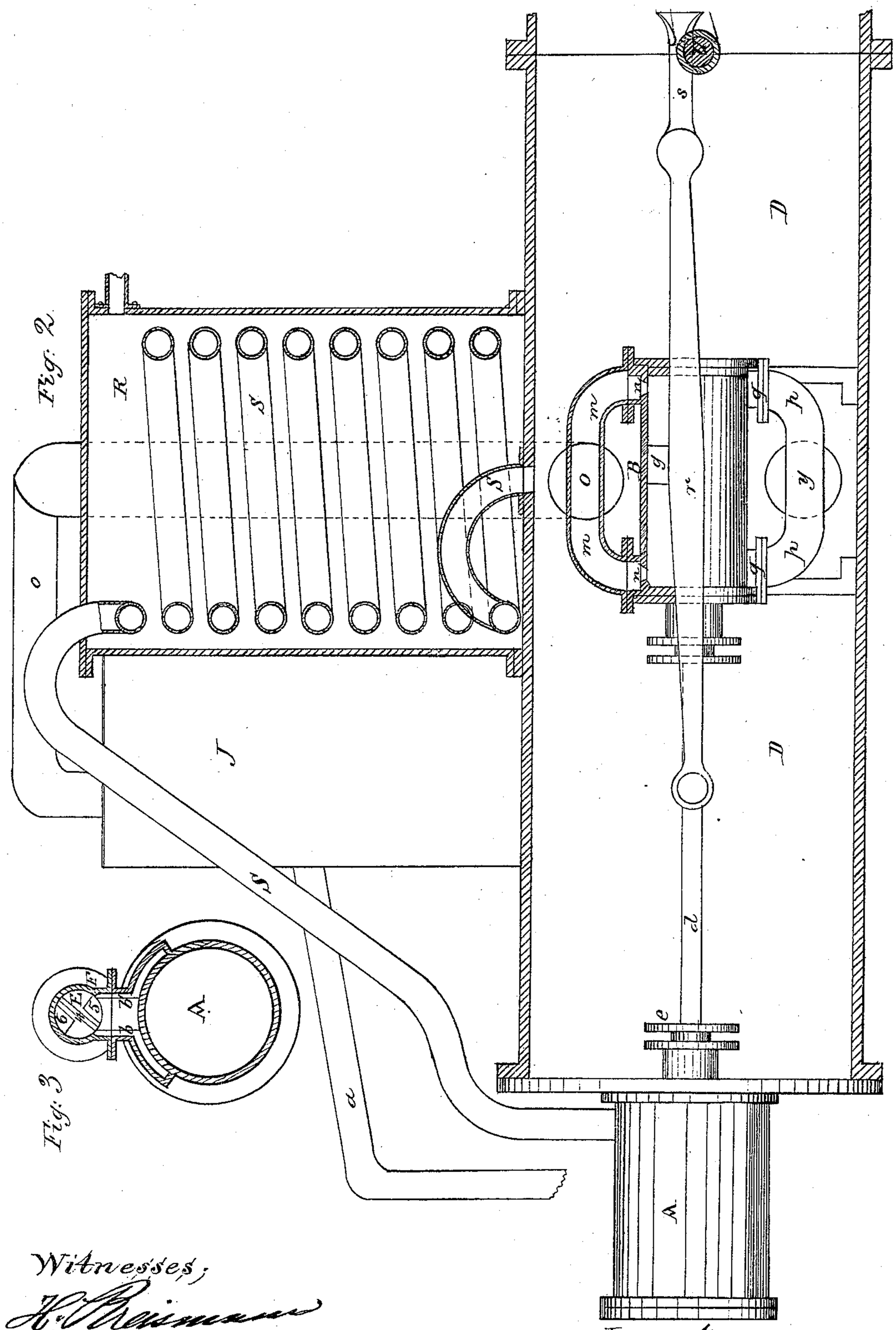

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H. Reimann
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Inventor,
Otto Trossin.

UNITED STATES PATENT OFFICE.

OTTO TROSSIN, OF BERLIN, GERMANY.

IMPROVEMENT IN AIR AND GAS ENGINES.

Specification forming part of Letters Patent No. **141,189**, dated July 22, 1873; application filed August 26, 1872.

To all whom it may concern:

Be it known that I, OTTO TROSSIN, of Berlin, in the Kingdom of Prussia and Empire of Germany, have invented certain new and useful Improvements in Hot-Air or Gas Engines, of which the following is a specification:

The object of my invention is to produce an engine whose motor is either hot air or gas; and my invention herein consists of a reservoir-cylinder for the exhaust air made to inclose the air-supply pump, the driving-shaft thereof, and to support at the end and outside of said cylinder the piston-cylinder and valve-chest, the object and advantages whereof is to place the air supply pump out of the way, and to envelop it with the same hot air which furnishes the motor, thereby utilizing the hot-air reservoir to surround and keep the pump hot by the same air which supplies said pump, and to effect the combination of the working parts in a compact, effective, and economical manner in relation to each other, the heater, and condenser; also, in the combination, with a hot-air or gas engine having an automatic air-supply pump, and an exhaust-air inclosing reservoir, of a condensing-cylinder, provided with a coil of pipe, through which the exhaust air passes from the working-piston cylinder to the reservoir, in order to be again compressed for use; also, the combination with an air or gas reservoir cylinder, wherein the air-supply pump and driving-shaft are inclosed, and which carries at its end the working-piston cylinder and the rotary cut-off valve, of the connected and driving devices which operate the said valve when inclosed within the air-reservoir, whereby great compactness is obtained and the cut-off valve gearing all inclosed within the air-supply reservoir.

In the accompanying drawings, Figure 1, Sheet 1, represents a horizontal central section of my improved hot-air engine. Fig. 2, Sheet 2, represents a vertical central section of the same, the heater being shown; and Fig. 3, Sheet 2, represents a horizontal section through the working-cylinder and the valve-chamber.

At one end of a cylindrical iron reservoir, D, the working-cylinder A of the hot-air or gas engine is secured. In this cylinder a piston, C, suitably packed, moves forward and back, its piston-rod *d* passing through the end of the cylinder A and the reservoir D, extending into the latter, the opening in the end of the reservoir being closed air-tight by means of a metallic stuffing-box, *e*. An air-pump, B, is secured on a suitable frame on the inside of the reservoir, centrally in line with the cylinder A. The piston-rod *f* of the piston *g* of this air-pump is a continuation of the piston-rod *d;* and to these joint piston-rods *d f* is hinged one end of a square frame, *r*, surrounding the air-pump, and being connected at the other end with the crank-shaft U by means of a short rod, *s*, which operates the crank *t*. The piston *g* of the air-pump is packed in the following manner: Its periphery is made so much smaller than the inner side of the pump-cylinder B as to allow an India-rubber ring, *h*, to be held on its periphery by means of two metal rings or tires, *i i*, one on each side, in such manner that the rubber ring may form a bag between the two tires *i*, the periphery of the piston, and the inner side of the cylinder, thus leaving a free space, s^2, on the central surface of the periphery of the piston *g*, from which space channels *j j*, one on each side, lead to the sides of the piston. The outer openings of these channels *j* are closed by India-rubber tubes *u*, which are surrounded by metal tubes *l l*, having openings at their outer ends, and which tubes *l* are secured to the sides of the piston *g*. The India-rubber tubes *u*, the channels *j*, and the free space around the periphery of the piston are filled with any suitable liquid, so that, when the pressure of hot air or gas is exerted on the rubber tubes within the tubes *l*, they are compressed, and the liquid is forced through the channels *j* into the free space s^2 around the piston, and forces the rubber ring *h* firmly against the inner periphery of the cylinder B, thus furnishing an air-tight automatic packing. At both ends the cylinder B connects, by means of valves *n*, with a pipe, *m*, situated above the cylinder, and this pipe *m* connects with another tube, *o*, leading through the side of the reservoir D upwardly into the heater J, through the top of the latter, the tube being provided at its end in the heater with a valve opening into the same. In a similar manner the cylinder B connects at each end, by means of valves *q*, with a pipe, *p*, sus-

pended below the cylinder, and which pipe *p* connects with a tube, *y*, extending toward the side of the reservoir D, in opposite direction to the tube *o*, terminating in a conical rotary valve, *x*, in the side of the reservoir, by means of which valve the tube *y* may be connected either with the interior of the reservoir D or with the open air through a channel, Z. On the outside of the reservoir the valve *x* is provided with a handle, *x'*, by means of which the valve may be operated. On the shaft U, just outside of one of the arms of the crank *t*, is keyed a beveled cog-wheel, I, which gears with a larger beveled cog-wheel, H, at one end of a shaft, G, which shaft, running parallel with the piston-rods *d f*, passes through the end of the reservoir D, and extends into the valve-chamber F, where it carries at its end the rotary valve E. This valve is provided with a central diagonal channel, 4, which alternately connects at one end with a pipe, *a*, leading to the heater J, and at the other end with one or the other of two channels, *b b'*, which alternately guide the hot air in front or behind the piston C in the cylinder A. The valve E is also provided with two grooves, 5 and 6, formed in opposite parts of the periphery of the valves, one of which connects alternately with the channels *b b'* in the cylinder A, while the other connects with the exhaust-pipe S, which extends upwardly into the top of a condenser, R, in which the pipe S forms a serpentine coil, the lower end of which opens into the reservoir D. A water-pump, L, operated from an eccentric, M, on the crank-shaft U through a pump-rod, N, serves to fill the condenser R with water, a pipe suitably arranged near the top of the condenser allowing the water to flow off as fast as it is pumped in, in order that a constant stream of water may flow through the condenser. On the outside of the reservoir D the crank-shaft U carries a fly-wheel, T.

The operation of my improved hot-air engine is as follows: Fire being made under the heater J, the air in the same is expanded until the desired degree of pressure—say two or three atmospheres—is attained. The pipe *a*, which connects the valve-chamber with the heater, is provided with a stop-cock, which is now opened. The expanded air rushes in through the channels 4 and *b*, in front of the piston C, which is driven forward, and operates the crank-shaft U, which latter, through the gear-wheels I H, operates the shaft G, and changes the valve. The expanded air now rushes through channel *b'*, behind the piston C, forcing it back, and the exhaust air passes off through one of the grooves 5 or 6 into the exhaust-pipe S, and is, during its passage through the condenser R, cooled and condensed, and enters the reservoir D. During this operation, and until the reservoir D is completely filled with exhaust air, the valve *x* is turned so as to connect the suction-pipe *y* of the air-pump B with the outer air through the channel *z;* for, as the piston C moves forward and back, it operates also the piston *g* of the air-pump, by means of the piston-rods *d f*, and the piston *g* forces the air which it sucks in through the pipes *y* and *p* out again, through the pipes *m* and *o*, into the heater, thus supplying the heater continually and automatically with fresh air. As soon as the reservoir D is completely filled with exhaust air, the valve *x* is turned so as to close its connection with the fresh air, and connect the suction-pipe *y* with the interior of the reservoir D, from which moment the air in this reservoir, and consequently the same air, is used over and over again. Supplies of fresh air can be admitted at any time, if necessary, without interrupting the operation of the engine for even a moment. To stop the engine, the supply of hot compressed air is merely shut off by means of the stop-cock in pipe *a*.

Having described my invention, I claim—

1. In an air or gas engine, the reservoir-cylinder D for the exhaust air, made to receive and inclose the air-supply pump B and the driving-shaft U, and to support the piston-cylinder and valve-chest in relation to the parts inclosed, substantially as described, and to obtain the advantages stated.

2. The combination, with an air or gas reservoir cylinder, D, wherein the air-supply pump B and driving-shaft U are inclosed, and which carries at its end the working-piston cylinder A and the rotary cut-off valve E, of the valve-rod G, gearing H I, and driving-shaft U, when inclosed within the reservoir D, substantially as described, and to obtain the benefits stated.

3. In combination with the cylinder A, the air-supply pump B, and the reservoir D of a hot-air engine, a condenser, R, arranged and operating essentially as and for the purpose set forth.

4. The hot-air or gas engine, consisting of the cylinder D, to supply the air or gas, the pump B, piston-cylinder C, rotary valve E, working-shaft U, valve-rod G, gearing H I, heater J, and condenser R S, when these parts are constructed and arranged, for joint operation, substantially as described.

OTTO TROSSIN.

Witnesses:
OTTO SCHADE,
ROBERT GOTTHEIL.