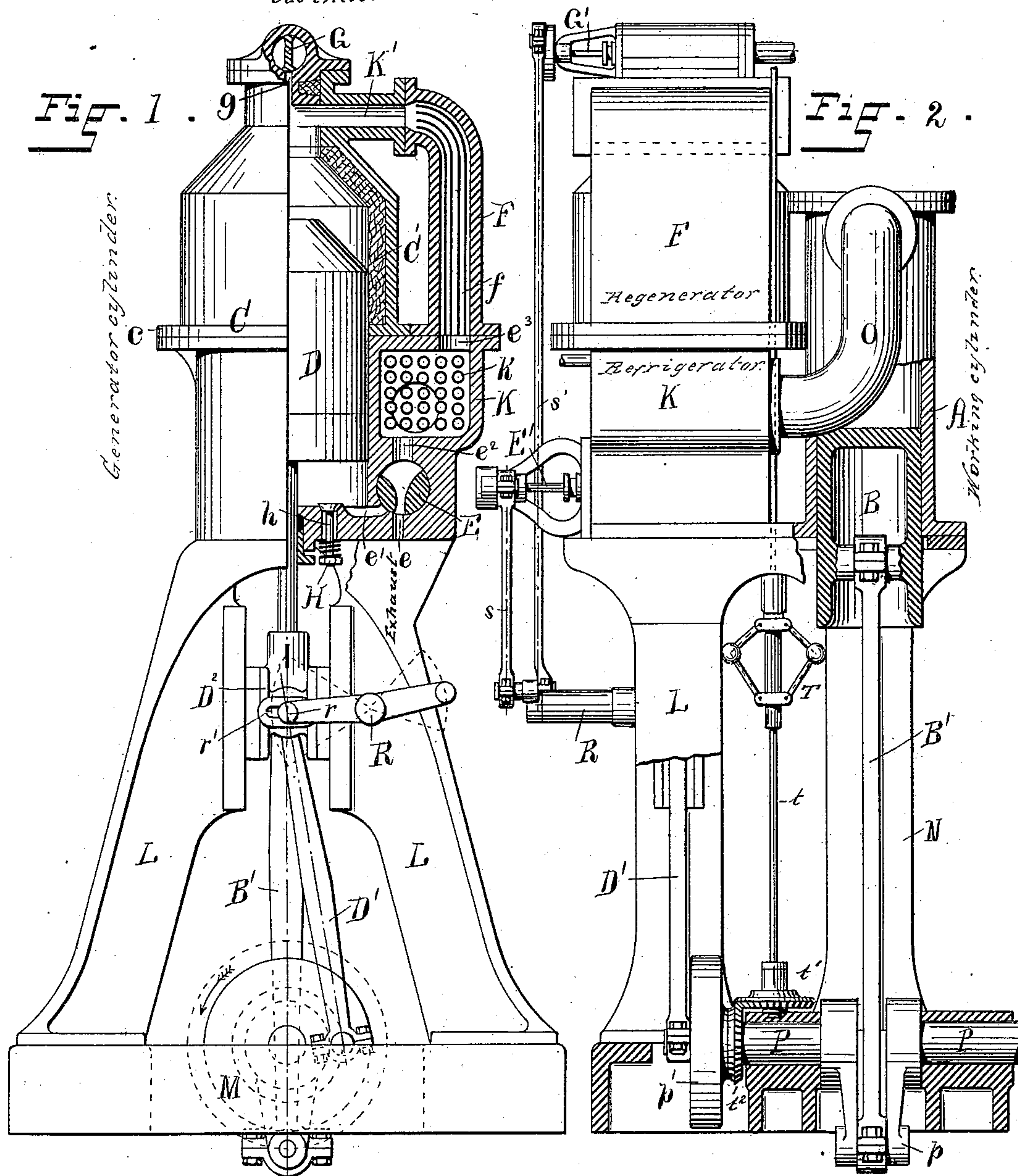


(No Model.)

G. C. ANTHONY.
GAS ENGINE.

No. 337,226. *Gas inlet.*

Patented Mar. 2, 1886.



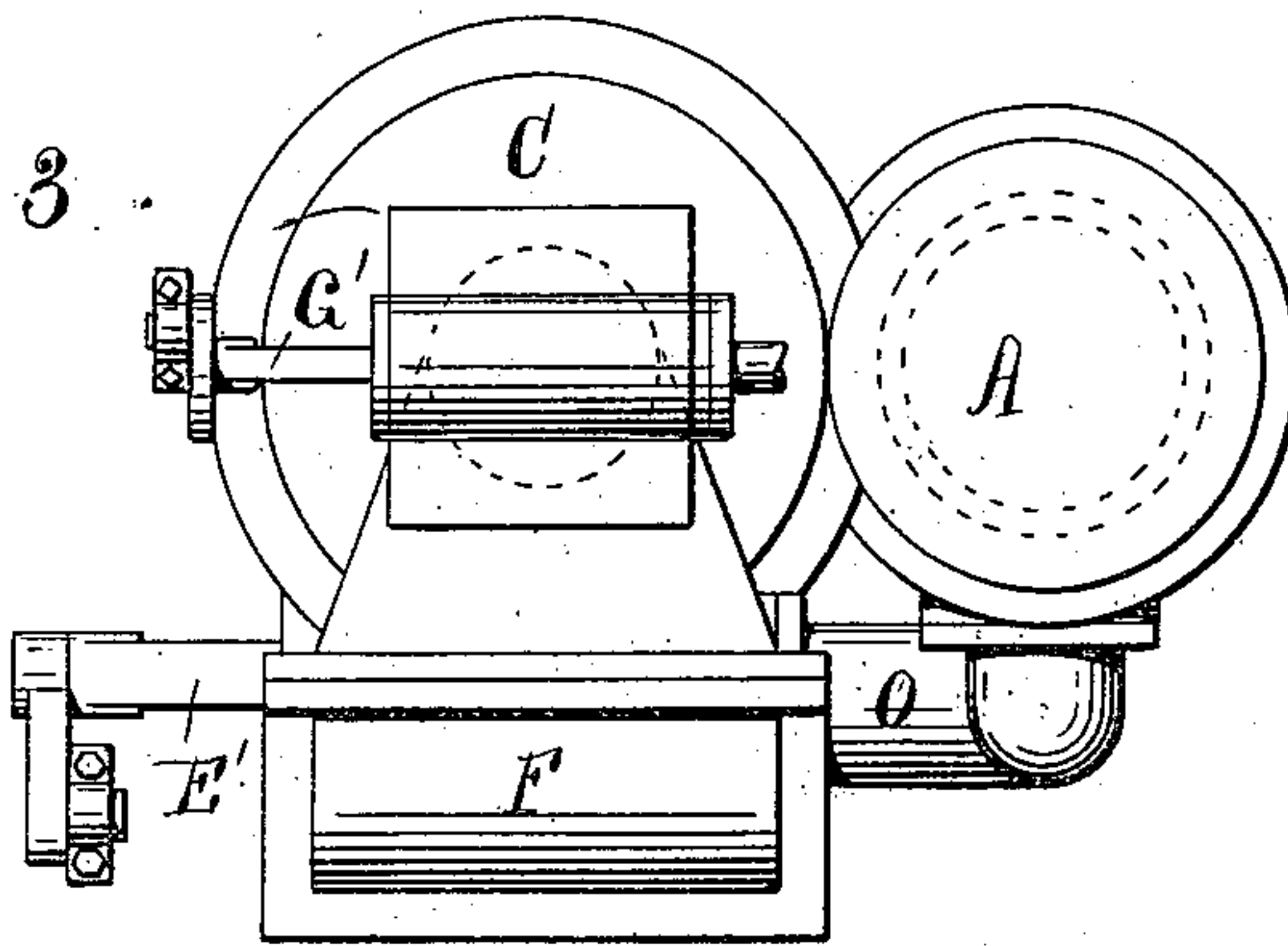
WITNESSES:

Fig. 3

Chas. H. Luther,
Jno. L. Condon,

INVENTOR:

Gardner C. Anthony
By Joseph A. Miller *Atty*



UNITED STATES PATENT OFFICE.

GARDNER C. ANTHONY, OF PROVIDENCE, RHODE ISLAND.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 337,226, dated March 2, 1886.

Application filed June 10, 1885. Serial No. 168,220. (No model.)

To all whom it may concern:

Be it known that I, GARDNER C. ANTHONY, of the city and county of Providence, and State of Rhode Island, have invented a new and useful Improvement in Gas-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to that class of gas-engines in which the combustion of the gas takes place in a cylinder or generator, and in which the pressure generated is utilized in a separate working cylinder.

The invention consists, first, in the construction and arrangement of the generator, the cylinder, and the piston, and the arrangement of the air and gas ducts, the restorer, and refrigerator, in combination with the working cylinder and piston, by means of which a combustible mixture may be exploded in a cylinder the piston of which is subjected to equal pressure on both sides during and after the combustion of gases, the pressure being utilized in a second cylinder.

The invention consists, secondly, in producing compression in the generator-cylinder previous to the combustion of gases by passing the air from one side of the piston to the other through the restorer, thus heating the same and augmenting the same by a reduction in volume due to the travel of the piston in the working cylinder.

My invention consists, thirdly, in the transfer of pressure by the combustion of gas to the working cylinder by means of an intermediate volume of air.

The invention consists, finally, in certain peculiar and novel features of general construction of parts and arrangement of connections, all as hereinafter described and claimed.

In order that my invention may be fully understood, I will proceed to describe it with reference to the accompanying drawings, in which—

Figure 1 is a view, partially in elevation and partially in section, of my improved engine. Fig. 2 is a similar view of the same on a plane at right angles to that of Fig. 1. Fig. 3 is a plan view of Fig. 2.

In the said drawings, A designates the working cylinder, containing a piston, B.

C designates the generator or hot cylinder, containing a displacer-piston, D.

K designates the condenser or refrigerator, 55 and F the restorer.

The generator rests upon supports L, which rest in turn upon the bed M of the engine, while the working cylinder A rests upon supports N, also resting upon the bed. 60

The generating-cylinder C is made in two sections united by horizontal flanges c, as shown, so that the two parts are readily separable for cleaning and repairs. The upper section of the generator is provided with a lining, C', of refractory material, by means of which the cylinder and its piston are protected from the extreme heat of combustion. Said generator is also provided with a valve, E, working over an inlet-port, e, through which 65 and a channel, e', the air enters beneath piston D. At its upper end the generator is provided with a valve, G, for the admission of gas, and working over an inlet, g, through which the combustible gas enters above piston D. 75

The refrigerator K consists of a chamber containing a series of tubes, k, through which water is forced, and communicating with the lower end of generator C by the channel e' and 80 a vertical channel, e'', as shown. The restorer F communicates with the refrigerator K through a port, e'', and with the upper end of generator C by a channel, K'. Within the restorer are placed a series of plates, f, of heat-absorbent material. The working cylinder A communicates with the refrigerator K through a pipe, O, which enters the working cylinder above its piston B.

P designates the main shaft, which carries 90 a crank, p, and a crank, p'. A connecting-rod, B', extends from crank p to piston B, and a connecting-rod, D', extends from crank p' to the displacer-piston D, there being the usual cross-head, D'', for guiding the piston D. 95

R designates a rocking lever which is fulcrumed upon one of the supports L, and one end of which is connected to cross-head D'' by a pin, r, working in a slot, r', in the lever. The stem E' of valve E is connected by a rod, 100 s, with the outer end of lever R, and the stem G' of valve G is connected by a rod, s', with said lever, the arrangement of said rods being such as to impart the required vibratory

motion to the valves. The generator C is also provided with a series of check-valves, H, working in ports *h* in the bottom of cylinder C, for the admission of air, which is the principal refrigerator to cool the end of cylinder C.

A suitable pump is used for circulating water through the tubes of condenser K, and a second pump is also used for supplying the combustible gas to the generator.

From the above description it will be seen that, the piston B of the working cylinder A being at the lower end of its stroke, Fig. 2, the port *e* is open and connection with the lower end of cylinder closed, and the burned gases are discharged from above piston D through restorer F, causing an immediate reduction of pressure in both cylinders. At the same time fresh air is entering beneath piston D, through valves H, into the lower or cold end of the generator, and this continues until piston D has reached the upper end of its stroke. At this moment port *e* is suddenly closed, and the ends of the generator are placed in communication with each other through the condenser and restorer. The upward movement of piston B now sets up compression, which is augmented by the expansion of gases transferred from the restorer and refrigerator to the upper or hot end of the generator-cylinder. When such portion of the stroke of piston D has been made as is sufficient to transfer that portion of the burned gas as remained in the restorer, refrigerator, and clearance-space at the termination of the last upstroke of piston D, the gas-valve G opens and the combustible gas enters the generator, mixing with the heated air above piston D. This supply of gas is automatically controlled by a regulator, T, upon a shaft, *t*, carrying a beveled gear, *t'*, meshing with a similar gear, *t''*, on shaft P. When piston B has reached the upper end of its stroke and begins to descend, the piston D having nearly completed its stroke, the charge of heated air and gas in the hot end of the generator is ignited by electricity or contact with flame, and the

maximum of temperature and pressure is obtained, thus forcing piston B downward. The subsequent operations are a repetition of those above described. Thus it will be seen that the combustible gas is brought into contact with air highly heated by being passed from the cold end of the generator through a restorer, and the mixture is then exploded in the hot end of the cylinder to produce the required power; also, that the fresh air remaining in the restorer, condenser, and clearance-space not vitiated by mixture with burned products is to be returned to the cold end of the generator. The burned gases remaining in the restorer, refrigerator, and clearance space after the exhaust-valve closes are passed into the hot end of the generator previous to the admission of combustible gas.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. An improved gas-engine constructed and arranged substantially as described, whereby the piston of the generator-cylinder is subjected to equal pressure on both sides during and after combustion of gases, the pressure being utilized in a second cylinder, as described.

2. An improved gas-engine constructed and arranged substantially as described, whereby the air is passed from one side of the generator-piston to the other through a restorer to produce compression in the generator previous to combustion of gases, and heating the air and augmenting the pressure, as specified.

3. An improved gas-engine constructed and arranged substantially as described, whereby the pressure generated by the combustion of the gas is transferred to the working cylinder by means of an intermediate volume of air, as described.

In witness whereof I have hereunto set my hand.

GARDNER C. ANTHONY.

Witnesses:

M. F. BLIGH,
J. A. MILLER, Jr.