Sheet 1-2 Sheets.

J. B. Atwater,

Air Engine.

№ 53,097. Patented Mar. 13, 1866.

Fig: 1.

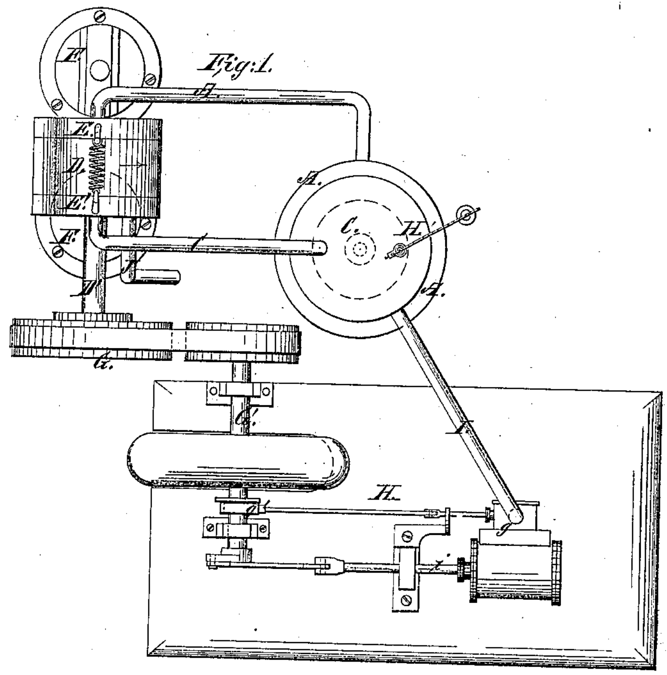


Fig: 3.

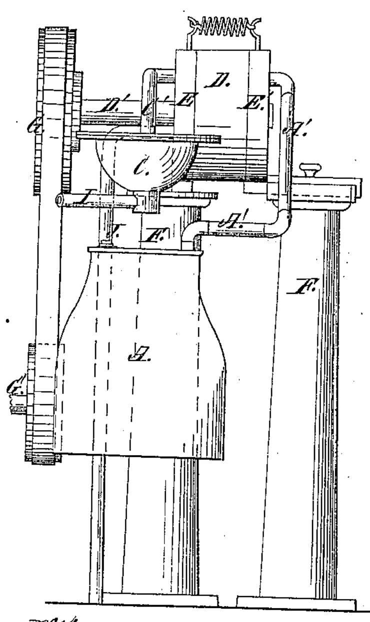
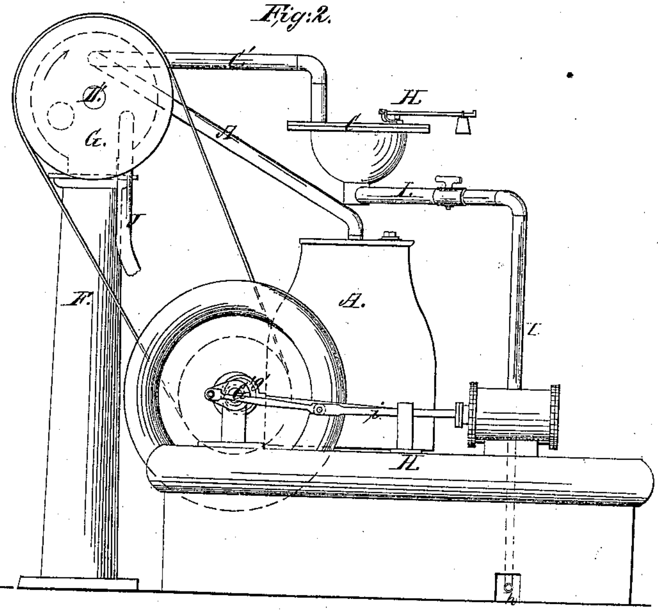


Fig: 2.



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Sheet 2. 2 Sheets.

J. B. Atwater,

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Fig: 9.

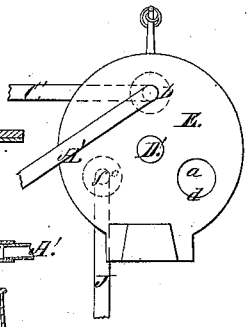


Fig: 3.

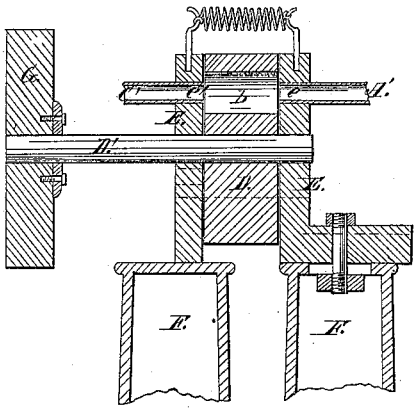


Fig: 4.

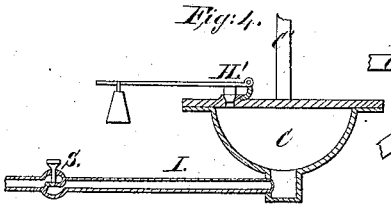


Fig: 5.

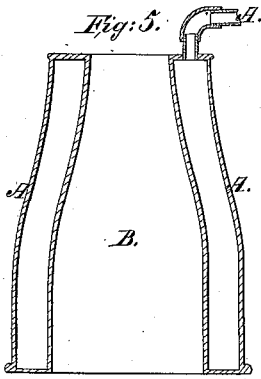


Fig: 10.

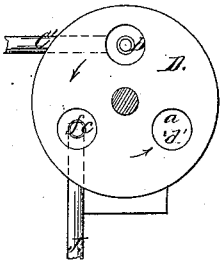


Fig: 11.

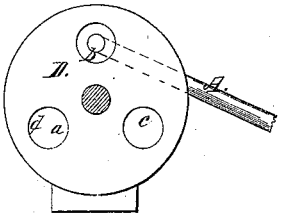


Fig: 6.

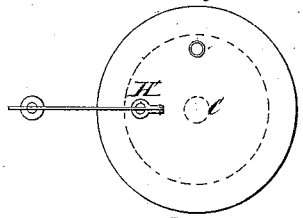
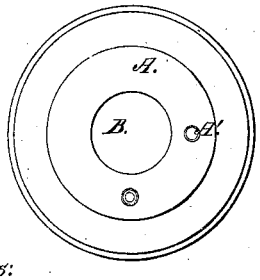


Fig: 7.



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UNITED STATES PATENT OFFICE.

JOHN B. ATWATER, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN AIR-ENGINES.

Specification forming part of Letters Patent No. **53,097**, dated March 13, 1866.

To all whom it may concern:

Be it known that I, JOHN B. ATWATER, of Chicago, Cook county, State of Illinois, have invented a new and Improved Caloric Engine; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1 is a plan view of the improved caloric engine. Fig. 2 is an elevation of one side of the engine. Fig. 3 is a side elevation of the apparatus for generating steam and heating air. Fig. 4, Sheet 2, is a vertical central section through the rarefier. Fig. 5 is a vertical section through the boiler. Fig. 6 is a top view of the rarefier. Fig. 7 is a top view of the boiler. Fig. 8 is a vertical section through the rotary air and steam cylinder. Fig. 9 is a view of that side of the face-plate of the rotary cylinder through which steam is introduced. Figs. 10 and 11 show the two ends of the rotary cylinder.

Similar letters of reference indicate corresponding parts in the several figures.

This invention relates to novel means of treating atmospheric air, and of introducing such air into a reheating or rarefying chamber, to be expanded and afterward employed as a motive agent for driving engines.

Under certain circumstances atmospheric air will not readily commingle with steam; hence air may be rapidly forced out of or compressed into a chamber by means of steam introduced into the chamber so as to act or impinge directly upon the air therein. This fact is taken advantage of by me in carrying out my invention for the purpose of forcing air into a rarefying-chamber, where it is subjected to a high degree of heat and then conducted off and employed for driving engines. I employ steam for two purposes: first, as a means for compressing air into a rarefying-chamber, where it is highly expanded, and, secondly, for imparting moisture and also a certain degree of heat to the air thus furnished to said chamber, the moisture being imparted after the effect of the first impulse of the steam on the air has been availed of.

To enable others skilled in the art to understand my invention, I will describe its construction and operation.

In the accompanying drawings, A represents a steam-boiler, which may be made in the form of the frustum of a cone, or of any other suitable form.

B is an opening through the center of this boiler, in which the fire-chamber may be suitably arranged, so that the heated gas and products of combustion will escape at the upper end of said opening and impinge upon a chamber, C, in which air is to be heated.

The object of constructing the boiler A of the form above mentioned is to obtain an economy of fuel and heat by employing the waste heat for heating the chamber C. Other modes of effecting this object may be employed.

The rarefying-chamber C may be constructed of the hemispherical form shown in the drawings, and it should be made strong and tight.

The boiler A communicates at certain times with chambers which are formed in a revolving cylinder, D, which cells or chambers communicate at certain times with the rarefying-vessel C. This cylinder has three chambers, *a b c*, through it, which are at equal distances apart and equal distances from the axis of the cylinder, as shown in Figs. 10 and 11, Sheet 2. The shaft D′, to which this cylinder D is keyed, has its bearings in two stationary disks, E E′, which are suitably secured to pillars F F. Said shaft passes through the centers of the disks and the cylinder, and projects out from the disk E′ so as to receive upon it a pulley, G, over which a belt passes that transmits motion to the cylinder D from the main shaft G′ of an engine, H, as shown in Figs. 1 and 2.

The flat faces of the cylinder D and impinging faces of the disks E E′ are properly smoothed and ground together so as to form tightly-fitting joints to prevent the escape of air or steam. The disk E has an opening, *d*, through it, which is equal in diameter to that of the chambers which are made through the cylinder D, and directly opposite to this opening *d* an opening, *d′*, corresponding in size to *d*, is made through the disk E′, so that when either one of the chambers in the cylinder D is brought opposite said openings *d d′* air will rush into it at both ends. Another opening, *e*, is made through the disk E, into which is screwed a pipe, A′, which leads to the boiler A, as shown in Figs. 1 and 3, Sheet 2, and directly opposite the opening *e* a corresponding opening, *e′*, is made through the disk E′. (Shown in Fig. 10.) Into this opening *e′* a pipe, C′, is

screwed, which leads to the rarefying-chamber C. When the chambers in the revolving cylinder D are arranged so that one of them is receiving air through the ports *d d'*, the other chamber above it will be brought in a line coincident to the two openings or ports *e e'*, and the chamber below it will be brought opposite the opening *f*, into which a pipe, J, is screwed that conducts off the exhausted steam from the chambers *a b c* as they are successively brought opposite said opening *f*.

The rarefying-chamber C is provided with a safety-valve, H', and also with a pipe, I, which latter leads off to the slide-valve chest *g* of the engine-cylinder, as shown in Figs. 1 and 2 of Sheet 1.

The engine which I have shown in the drawings is constructed in every essential particular like an ordinary high-pressure steam-engine, and does not therefore require a particular description. The air, after having expended its force upon the piston, escapes through the exhaust-pipe *h*. The piston-rod *i* operates by means of a crank to rotate the main shaft G', which shaft transmits motion to the chambered cylinder D, as above described. The slide-valve in the chest *g* receives its movements from the main shaft G' by means of the eccentric *g'*. Almost, if not all, of the well-known kinds of engines which can be driven by steam may be employed in carrying out my invention, highly-heated air being used as the motive agent instead of steam.

The manner of treating atmospheric air by my apparatus above described, preparatory to the admission of the air into the valve-chest of the engine, is as follows: Steam at a very low pressure is generated in the boiler A. At the same time that the water in the boiler is being heated the rarefying-chamber is also being highly heated, as before explained. During this heating up of the parts the stop-cock S is closed. It is now opened so as to form a communication with the engine. The steam from the boiler is conveyed through pipe A' to the rotating cylinder D, where said steam forces the air out of the chambers *a b c* as they successively come opposite the openings *e e'* in the disks E E', compelling the air by the impact of the steam to pass into the pipe leading to the rarefying-chamber C. The steam will also communicate a certain degree of heat to the air and also certain quantities of moisture, which moisture prevents the injurious effect consequent upon working heated dry air upon metallic surfaces.

To more fully explain the mode of operation of the cylinder D, suppose the chamber *a* to be opposite the inlet-ports *d d'* for receiving air, the chamber *b* to be coincident to the ports *e e'*, and the chamber *c* to be opposite the exhaust-port *f*. The relative motion of the rotating cylinder D and that of the engine will be such that the period of opening and closing of the valves of the engine will correspond with the opening and closing of the cavities in said rotating cylinder, so that the air, when once it is introduced into the rarefying-chamber C, cannot escape back, said rotating cylinder acting at certain times as a check-valve, but the air must find its exit through the exhaust-pipe J of the engine-cylinder.

The cylinder D is rotated in the direction indicated by the arrows in Figs. 1, 2, and 10, and the chamber *a* containing air is thus brought opposite the openings *e e'*, when the air will be forced into the rarefying-chamber C by the action of the steam from the boiler. While this takes place the steam which was left in the chamber *b* will exhaust through the opening *f* and air will be rushing into the chamber *c*. At the next change the chamber *c* will be brought in line with the openings *e e'*, the chamber *a* in line with the opening *f*, and the chamber *b* in line with the air-ports. During the passage of the chambers *a b c* from one opening in the disks to another the air which was forced into the chamber C will be quickly expanded and caused to act upon one side or the other of the engine-piston. This takes place when the cylinder D acts as a cut-off between the boiler and rarefying-chamber.

The rotating cylinder D being driven by means of a chain, belt, or gearing connected in any suitable manner with the main shaft of the engine H, it will be very easy to preserve the proper relative movements of the said cylinder and valve or valves of the engine. The number of revolutions of the rotating cylinder D will be regulated by the number of cavities or chambers in this cylinder.

Instead of employing a rotating chambered cylinder for bringing air under the influence of steam, as above set forth, other contrivances operating upon the same principle may be employed—such, for instance, as an oscillating or vibrating segment having suitable chambers in it.

The rotating or oscillating air-chambers may be used in connection with any of the well-known steam-engines by suitably applying said chambers to the pipe leading from the boiler to the steam-chest of the engine-cylinder and dispensing with the rarefying-chamber C shown in the drawings. In this case the air will be expanded by the caloric in the steam, the pressure from the boiler being cut off during this operation, as described, when the rarefying-chamber is used.

By my invention I avoid the danger of boilers exploding, for the reason that the steam used in conjunction with the reheating-chamber or rarefier need never exceed a very low pressure. Steam generated at 212° of heat is one atmosphere, and one-pound pressure to the square inch will instantaneously expel air from cavities or chambers. I obtain a saving of all fuel over and above the quantity which is necessary to raise steam to a very low pressure. I economize the waste heat which ordinarily escapes up the smoke-stack, utilizing it to expand the air in the rarefying-chamber C.

In carrying out my invention it is important to preserve a certain relation between the

speed of the slide-valve, if a slide-valve engine be used, and the speed of the cylinder B. This may be done by varying the size of the driving-pulley on the main shaft of the engine according to the diameter of the cylinder and the positions of the chambers therein. The cylinder D must make one revolution to that of the engine-shaft, or it must make two, three, or more revolutions to one of the engine-shaft. Whatever number is determined upon, such relative speed must be preserved.

When the rarefier is not used the air and steam will both pass to the engine under a high pressure; but when the rarefier is used air alone is conducted to the engine.

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

1. Working engines by the combined action of steam and air by means substantially as described.

2. The employment of steam acting directly upon atmospheric air for the purpose of compressing the air into a rarefying-chamber which communicates with the valve-chest of an engine through means substantially as described.

3. Heating and expanding air and communicating to it certain quantities of moisture by means of steam acting directly upon the air, and then further rarefying the air thus treated for the purposes of employing it as a motive agent through means substantially as herein described.

4. The combination of a chambered cylinder, D, with the ported plates E E′ and a steam-generator, said cylinder operating substantially as described.

5. The combination of air-supplying chambers, constructed and operating substantially as described, with a rarefying-chamber, C, or its equivalent, and a steam-generator, substantially as described.

6. Arranging the air-rarefying chamber C in such relation to the steam-generator that the same fire will heat both, substantially as described.

7. The arrangement, substantially as herein described, whereby either rotary or oscillatory motion is communicated to the chambered air-supplier D from the engine in such manner that the relative motions of the said supplier D and of the engine will be such that the periods of opening and closing of the valves of the engine will correspond with the opening and closing of the cavities of the air-supplier D, substantially as described.

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Witnesses:
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