

(No Model.)

2 Sheets—Sheet 1.

B. F. McKINLEY.

HOT AIR ENGINE.

No. 356,147.

Patented Jan. 18, 1887.

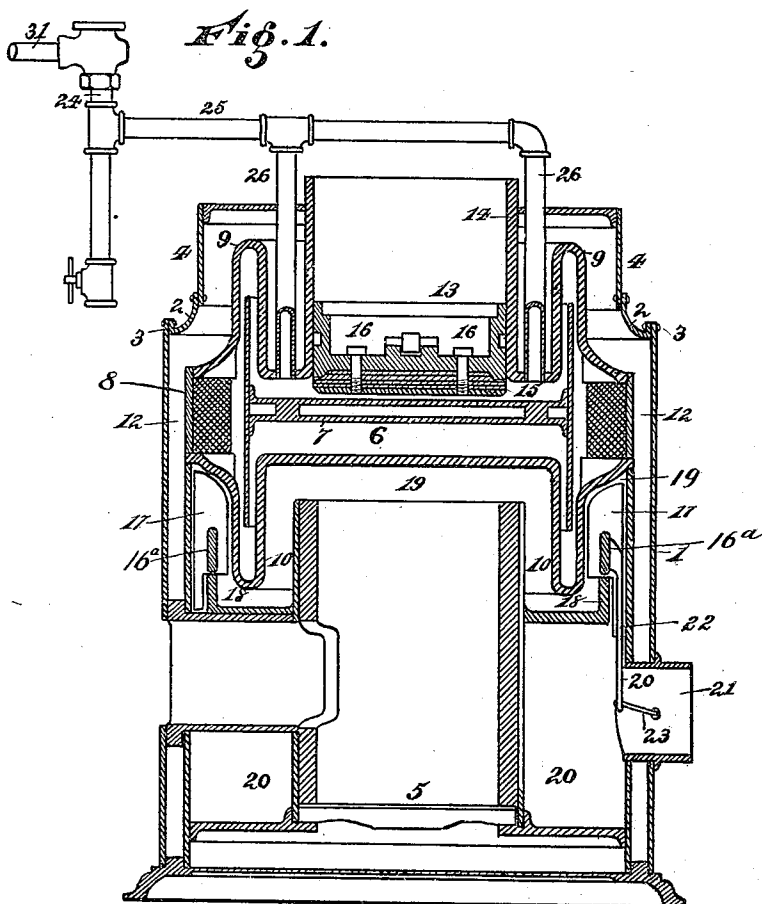
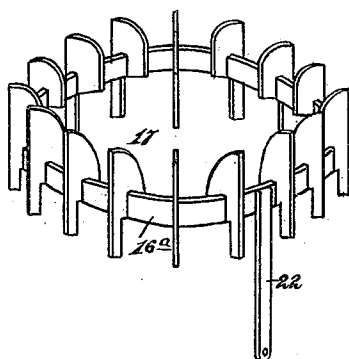


Fig. 2.



Attest

J. Watson Sims
Geo. S. Roebuck for.

Inventor

Benjamin F. McKinley
by Wood & Boyd
His Attorneys &c.

(No Model.)

2 Sheets—Sheet 2.

B. F. McKINLEY.

HOT AIR ENGINE.

No. 356,147.

Patented Jan. 18, 1887.

Fig. 3.

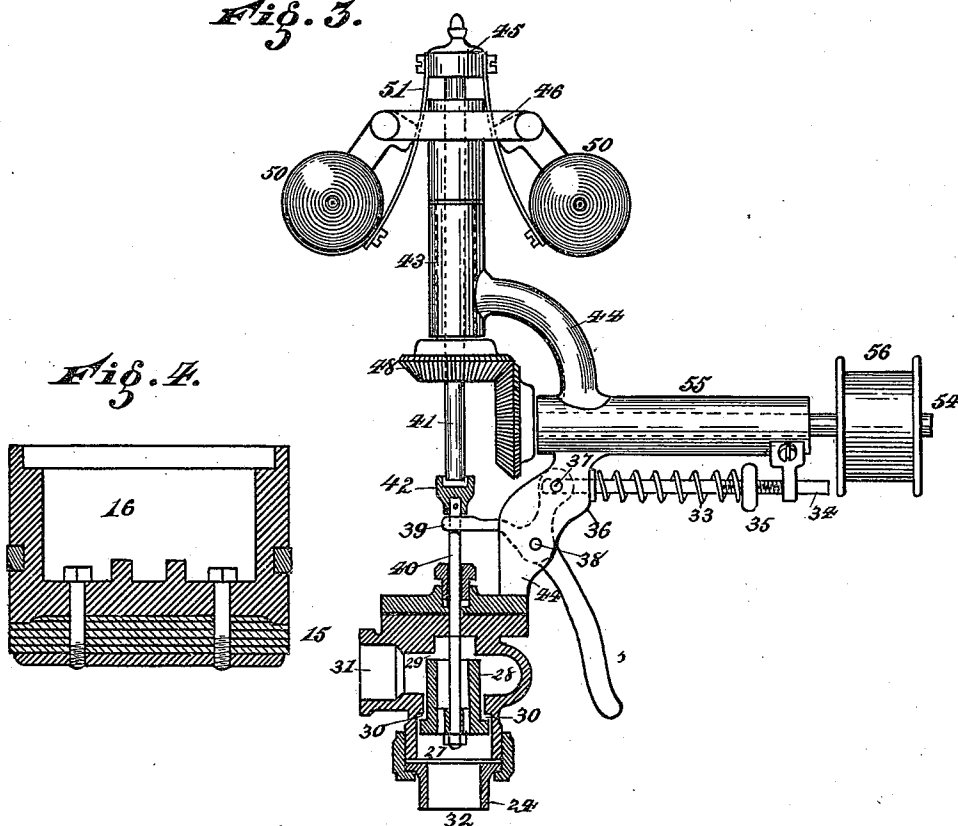


Fig. 4.

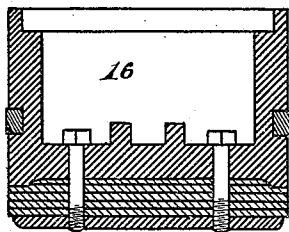
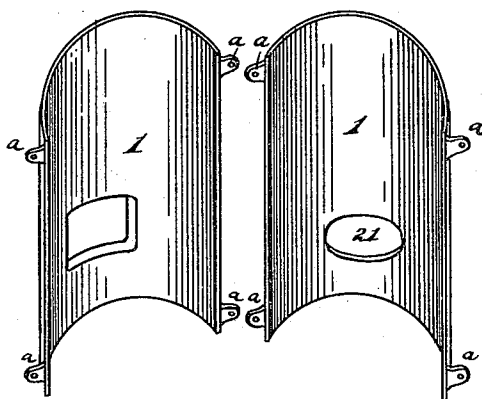


Fig. 5.



Attest

J. Watson Sims.
Geo. S. Probst.

Inventor

Burgman F. McKinley
by Wood & Boyd
His Attorneys &c

UNITED STATES PATENT OFFICE.

BENJAMIN F. MCKINLEY, OF CINCINNATI, OHIO.

HOT-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 356,147, dated January 18, 1887.

Application filed June 4, 1886. Serial No. 204,170. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN F. MCKINLEY, a resident of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Hot-Air Engines, of which the following is a specification.

My invention relates to an improvement in hot-air engines of the class shown and described in Letters Patent No. 206,597, granted me July 30, 1878, which employs a working-piston and a displacer in the regenerating-chamber.

The object of my invention is, first, to provide a suitable governor to regulate the speed of the engine; second, to so construct and arrange the working-piston that it projects down into the regenerating-chamber a sufficient distance to displace a considerable volume of air, thereby lessening the amount to be heated and cooled.

Another object is to place a non-conducting material on the face of the working-piston to prevent it from becoming unduly heated.

Another object of my invention is to provide suitable devices for cleaning out the soot in the combustion-chamber, all of which will be fully set forth in the description of the accompanying drawings, making a part of this specification, in which—

Figure 1 is a central vertical section of my improvement. Fig. 2 is a perspective view of the soot-cleaner. Fig. 3 is a central elevation of my improved governor and connections. Fig. 4 is a central section of the working-piston and packing. Fig. 5 is a perspective view of the shell.

1 represents the outer shell of the engine constructed of two parts, which are united by means of ears *a*, which are pierced with holes, through which screw-bolts are inserted for securing the parts together. The top of the casing is connected to an upper section of the casing 2 by means of bolts 3. The section 4 is likewise connected to section 2 by bolts.

Sections 2 and 4 may be made of one piece, if desired. By this means of constructing the shell the bolts 3 and the bolts passing through the ears *a* may be removed and the shell opened, so as to get at the interior or working parts of the combustion and regenerating

chamber without having to lift them out through the top of the casing, as was hitherto the case.

5 represents the furnace-chamber; 6, the regenerating-chamber; 7, the displacer; 8, the cooling wire-gauze or plate section separating the upper from the lower half of the regenerating-chamber, through which the air is passed as it is moved by the piston 7.

9 represents an annular recess formed in the plate above the regenerating-chamber. 10 represents a similar annular recess in the plate at the bottom of the regenerating-chamber, separating it from the furnace, into which the annular ring 11 of the displacer reciprocates. These annular corrugations furnish a large amount of heating and cooling surface, preventing the breaking of the plate, due to its contraction and expansion under heat.

12 represents the annular flue, through which the cooling medium passes on its way to the combustion-chamber.

14 represents the cylinder, in which reciprocates the working-piston 13.

The regenerating-chamber, displacer, flue, and air-passages are constructed substantially as shown in my said former patent, to which the following improvements are added:

15 represents a non-conducting material for heat, attached to the lower face of the working-piston 13. This material is preferably sheets of asbestos paper, secured to the piston by screw-bolt 16. They serve two purposes: first, they prevent the face of the piston, which comes in contact with the hot air in the regenerating-chamber, from becoming unduly heated; and, second, they are caused to project down into the regenerating-chamber, so as to lessen the volume of air required to fill the chamber, thereby lessening the quantity of air required to be heated and cooled in the operation of the engine. This packing 15 projects down into the area of the regenerating-chamber, into the space which the displacer 7 also occupies on a part of its stroke; but as the piston 13 is raised in advance of the extreme upward movement of the displacer 7, the parts do not come in contact.

16^a represents an annular ring, to which is secured a series of soot-cleaners, 17, rigidly secured to the ring 16^a, of the proper shape to

partially fill the annular flues between the plates of the air-flue 12 and the annular corrugation 10 of the regenerating-chamber. The ring 16^a rests upon the top of ring 18, which is placed in the flue 19, leading from the combustion-chamber around the under surface of the regenerating-chamber, and thence to the air-flue 20 in the uptake 21.

As the products of combustion passing from the combustion-chamber to the uptake are liable to become cool and condensed near the outer surfaces of the air-flue, this soot-cleaner is introduced, so that it may be rotated and the soot knocked off. To accomplish this, I have provided the stem 22, attached to the ring 16, which projects down into the uptake 20, and connected to it a crank-arm, 23, projecting outside of the flue, so that it may be reciprocated back and forth. This soot-cleaner is an important feature when inferior bituminous coal is used, as it keeps the flues open and prevents impediment to the draft.

In order to effectually regulate the stroke of the engine, I have provided a governor-valve, which is located at the mouth of pipe 24, which pipe is connected by a T to branch 25, provided with connecting-pipes 26, which tap through the upper plate of the regenerating-chamber and communicate with the air in the interior. The air in the interior being expanded by the heat taken up from the combustion-chamber, tends to escape through the valve, and thereby lessens the pressure on the working-piston. In order that this escape may be regulated, and thereby control the pressure of the working-piston, I have provided the following instrumentalities:

27 represents a double-seated check-valve.

28 represents the cylinder of the valve.

29 represents the upper seat of the valve; 30, the lower seat.

31 represents the escape into the atmosphere.

32 represents the passage through pipe 24, leading to pipe 25, and thence to the regenerator. The valve is normally held closed by means of a spring, 33, which is wound around rod 34, seating at one end against collar 35 and at the other end against the frame of the governor 36. The inner end of rod 35 is pivoted to the arm of the bell-crank lever 37, which is pivoted upon axis 38 and the frame of the governor. The free end 39 of the bell-crank lever is forked or loosely connected to the valve-stem 40, the construction of the parts being such that the recoil of the spring pulls up the arm 39 and holds the valve up against its seat.

41 represents a supplemental valve-stem stepping upon the main valve-stem 42, which journals in the sleeve 43, which is supported upon the main valve-frame by arms 44.

45 represents the head of the governor-valve stem.

46 represents a cross-arm rigidly secured to the journal-sleeve 47, which seats upon the sleeve 43, and revolves with the supplemental

stem 41, provided with the hollow shaft extending through sleeve 43, to the lower end of which is rigidly connected the bevel-gear 48.

50 represents governor-balls pivoted upon cross-arms 46.

51 represents flexible springs, connected at one end to the governor-ball and at the other end to the valve-stem head 45.

53 represents a bevel-gear keyed upon the driving-shaft 54, which journals in the sleeve 55. Said shaft is driven by the pulley 56.

The governor is of the ordinary construction; but it is connected to a check-valve, opening and closing the passage communicating with the regenerating-chamber, and regulates the speed by regulating the escape of compressed air from the regenerating-chamber in the following manner: Said check-valve is held normally closed by the coiled spring 33. If the engine be running idle, the speed of the revolving balls 50 is such that as they expand or rise on their pivots the supplemental stem 41 is drawn down over the edge of the recoil-spring 33, depressing the valve 27 off of its seat, allowing the escape of the air from the passage 32, through the valve-passages, and out into the atmosphere through passages 31. As power is applied and the motion is slackened, balls 50 draw together and the valve is more or less closed in proportion to the slackening of their speed. Thus I am enabled to control the speed of the engine by regulating the pressure of the air within the regenerating-chamber.

It will be observed that the pressure of the air within the regenerating-chamber tends to keep the valves seated and the escape-openings closed; but should the speed of the engine decrease, so that the tension of the springs would not quite balance the centrifugal force of the ball, then, on the downstroke of the piston, when the pressure is low, the air in the displacer-chamber being less than the atmosphere-pressure, the check-valve will fall and air will enter the regenerating-chamber, which I find by experience increases the power of the engine.

It will be further observed that when the engine is working up to nearly its maximum power there is no escape of the compressed air within the regenerating-chamber, except in case of a sudden change of speed. Consequently there is no material loss of power by the escape of the heated air, which is the working medium.

I do not wish to claim the details of construction of the governor, but the manner of its connection with the air-passages and the controlling the entrance and exhausting of the air in the regenerating-chamber, which is the essence of this feature of my invention.

57 represents a handle attached to the bell-crank, by which the valve 27 may be operated by hand, if desired.

Having described my invention, what I claim as new is—

1. In a caloric-engine, the combination, with the piston, of a series of detachable non-con-

ducting-plates, 15, extending into and occupying part of the space of the regenerating-chamber, substantially as described.

5 2. In a caloric-engine, the soot-cleaner composed of the ring 16 and scrapers 17, arranged in the flue outside of the regenerating-chamber, substantially as specified.

3. In combination with the regenerating-chamber 6 of a hot-air engine, a check-valve,

24, connected to said chamber by pipe, in combination with the governor acting upon said valve, substantially as specified.

In testimony whereof I have hereunto set my hand.

BENJAMIN F. McKINLEY.

Witnesses:

ROBERT ZAHNER,
E. E. WOOD.