Sheet 1-3 Sheets.

H. Messer,

Air Engine,

No. 46,689. Patented Mar. 7, 1865.

Fig 4.

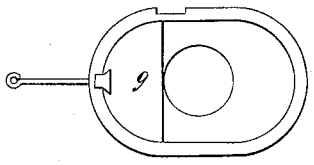


Fig 5.

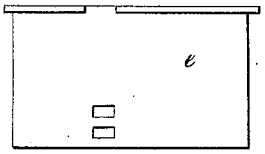
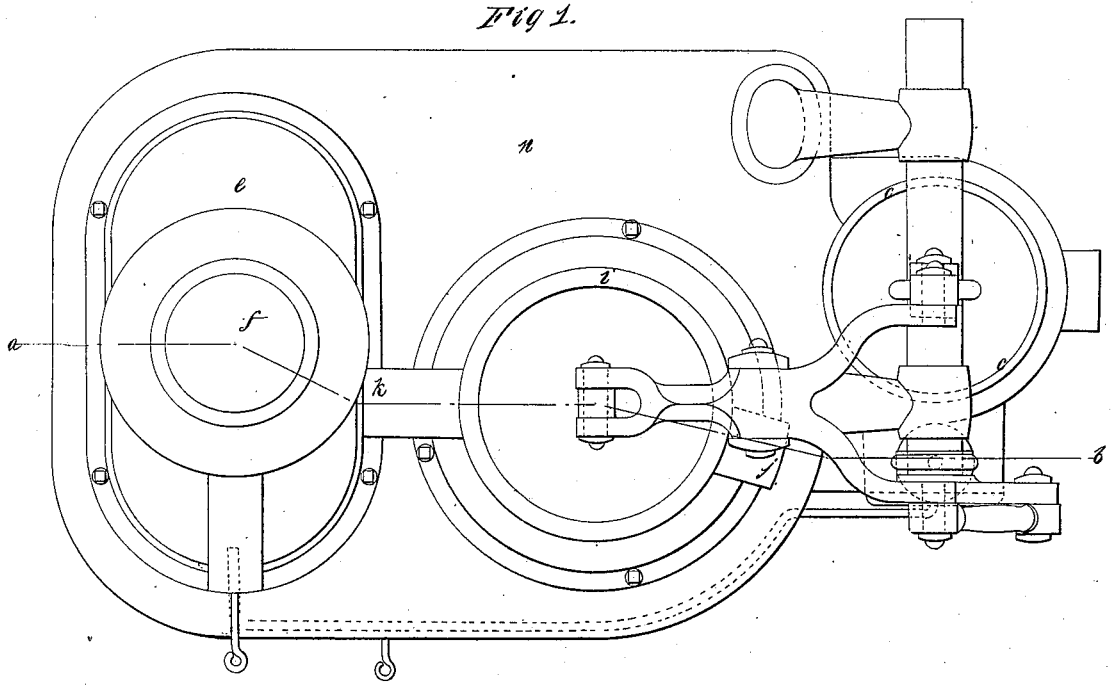


Fig 1.



Witnesses.
P. B. Crosby
T. Fowler

Inventor.
H. Messer

Sheet 2 - 3 Sheets.

H. Messer.

Air Engine,

No. 46,689. Patented Mar. 7, 1865.

Fig 8.

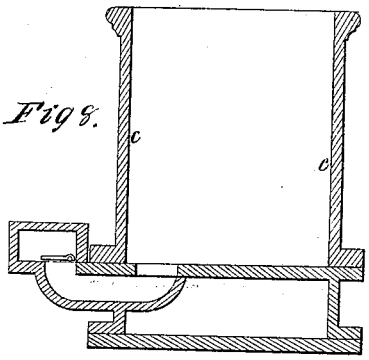


Fig 9.

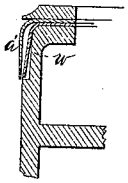
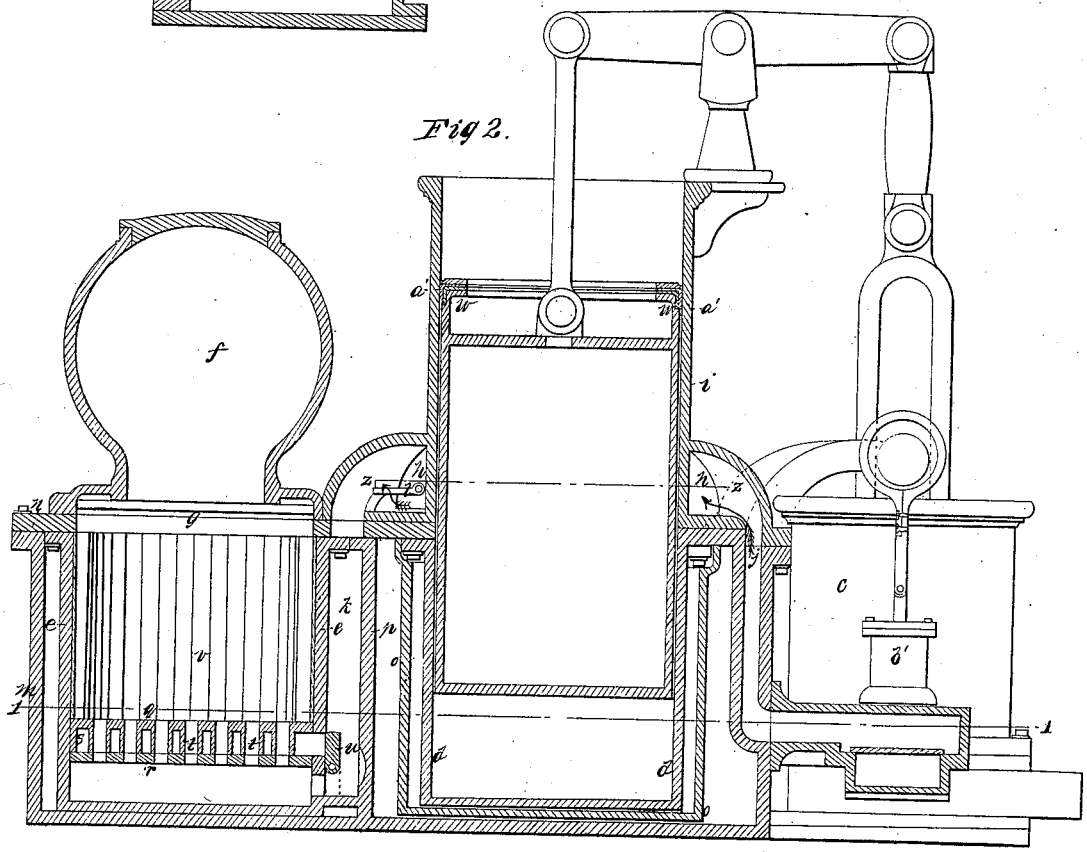


Fig 2.



Witnesses.
J. B. Bowley
Francis Gould

Inventor.
H. Messer

Sheet 3-3 Sheets.

H. Messer,

Air Engine,

No. 46,689 Patented Mar. 7, 1865.

Fig 6.

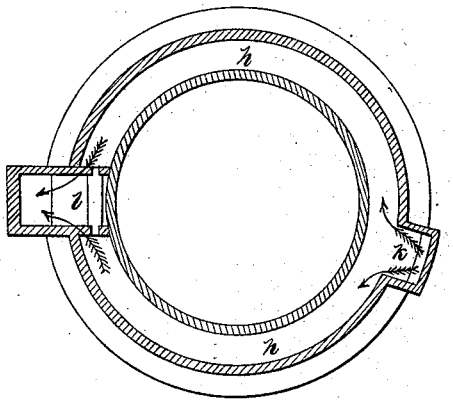


Fig 7.

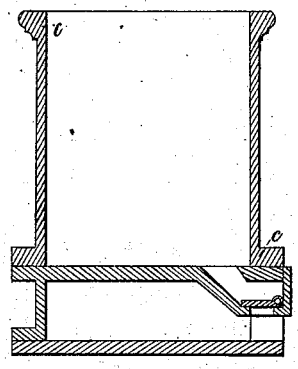
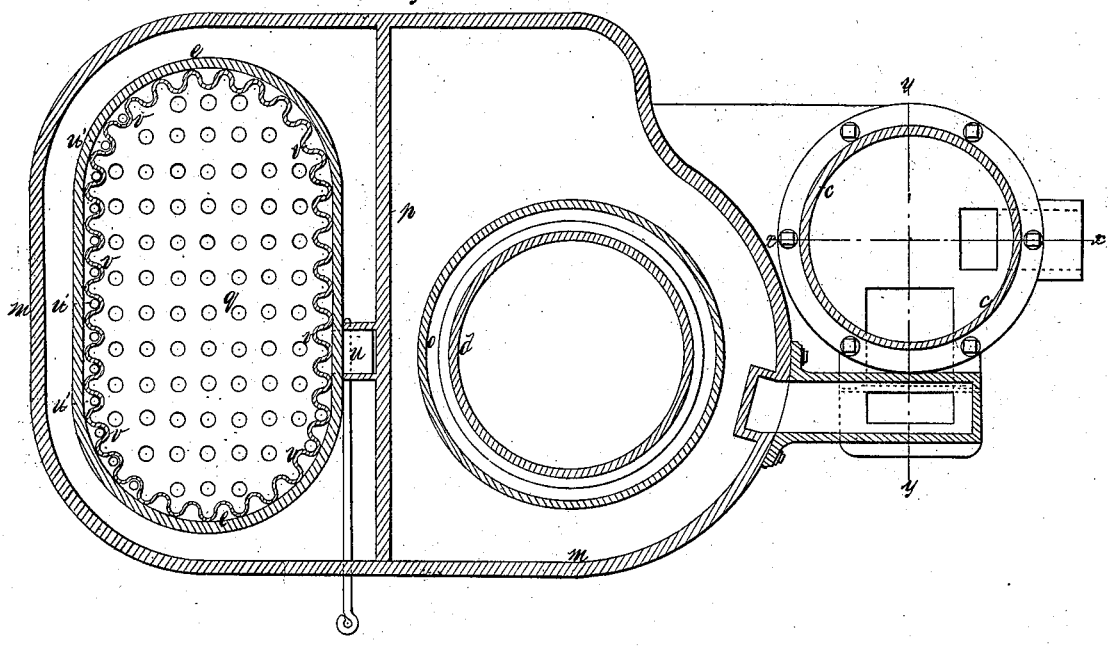


Fig 8.



Witnesses.
J. B. Brady
P. Gould.

Inventor.
H. Messer

UNITED STATES PATENT OFFICE.

HENRY MESSER, OF ROXBURY, MASSACHUSETTS.

IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. **46,689**, dated March 7, 1865.

To all whom it may concern:

Be it known that I, HENRY MESSER, of Roxbury, county of Norfolk, and State of Massachusetts, have invented certain new and useful Improvements in Hot-Air Engines; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention, sufficient to enable those skilled in the art to practice it.

My invention consists in improvements in the detail of construction and arrangement of hot-air engines, as hereinafter specified, and as illustrated in the drawings, of which—

Figure 1 represents a plan of a hot-air engine embodying my invention; Fig. 2, a vertical section of the same, taken on the line *a b*, seen in Fig. 1. Fig. 3 is a sectional plan of the main casing or foundation, the section being taken in the line 1 1 of Fig. 2. Fig. 4 is a reverse plan of the feed-box. Fig. 5 is an elevation of the fire-pot or furnace-box, showing the passages through which, and controlled by a valve suitably arranged, air is conducted either under the grate or between its parts, or into its honey-comb structure. Fig. 6 is a horizontal section taken across the lower part of the upper portion of the engine-cylinder in the plane of the line *z z*. Fig. 7 is a vertical section taken through the air-pump in the line *x x*, seen in Fig. 3. Fig. 8 is a vertical section taken through the air-pump in the plane of the line *y y*, seen in Fig. 3.

On inspection of the first three figures of the drawings it will be observed that there is shown in substantially the same plane the lower part of the cylinder, the air-pump, and the furnace, each occupying distinct locations in said plane which reduces the height of the engine from that required in previous constructions, where two, and sometimes all, of the parts named were located in different horizontal planes, one over the other, and this arrangement also enables me to place the feed-box directly over the fire-box, so that by gravity alone, without intervention of a piston or other devices, I am enabled upon mere working of valve to deposit a charge of fuel properly and directly into the fire-box.

The air-pump is represented by *c*, the lower part of the cylinder by *d*, the furnace by *e*, the feed-box or reservoir by *f*, and the plain slide-valve therein by *g*, and it is this relative arrangement of parts—viz., the furnace, the lower part of the engine-cylinder, and the air-pump in substantially the same plane, and with the feed-box arranged as described with reference to the furnace—that constitutes one part of my invention.

To prevent overheating the upper part of the cylinder in which the packed portion of the piston works, I form an annular passage around its base and provide that the air in its progress from the pump to the furnace, shall proceed through this passage, which is marked *h*. The upper portion of the cylinder is marked *i*, the passage from the pump into passage *h* is marked *j*, and that leading from passage *h* to the furnace is marked *k*, there being a check-valve, *l*, arranged to prevent back passage of air, &c., from the furnace to the pump-valve. In this arrangement of the passage *h*, and in impelling the air through it from the pump to the furnace as as to keep the upper part of the cylinder cool by absorption of the heat which would otherwise be transmitted and utilizing heat which would otherwise be lost by radiation, consists another part of my invention.

The foundation or bed *m* is made of wrought or cast iron, as may be desired, of any suitable form, as a reservoir, and is provided with a flange all around at its top edge, by which the top plate, *n*, is secured to the base *m*, and the space within the bed-plate not occupied by the lower part of the cylinder, by the furnace, and air-passages I propose to utilize by partially filling it with water from which steam is generated, which steam may be used to aid combustion direct, or as a source of power when applied in any well-known way. To protect the lower part, *d*, of the cylinder from direct contact with the water, by which heat would be abstracted thereform too rapidly, and too much steam generated, I surround *d* with a casing, *o*, and the space within *o* and between it and *d* may be left empty or filled with non-conducting material, and this incasing of the cylinder and utilizing the space in the bed for generation of steam by heat, which would otherwise be lost by conduction and radiation, constitutes another part of my invention.

Where a furnace is not made in or of a separate casting with a flange at the top by which it can be united to the top plate, *n*—as, for instance, the furnace *e*, (seen in Figs. 2

and 5,) or what would be equivalent thereunto viz., a furnace with a solid top and a flange all around the lower edge of its walls, so that by said flange it could be united to the bottom of the bed *m*—I make a partition, *p*, which may be integral with the bed *m*, having at its top a flange to which the cover *n* is closely secured, so that a perfect joint may there be had. If the furnace-pot *e* be used, linings within keep the fire from direct contact with it, and the water in *m* may come directly into contact therewith, *e* serving the same function with regard to the inner fire-box as the casing *o* serves relative to the part *d* of the cylinder; but where the partition *p* is used a furnace may be constructed in the space thereby shut off from the water, the material of the furnace being fire-brick or other suitable material. This division of the space in the bed by the flanged partition *p*, using said partition as a screen to protect the fire from too rapid loss of heat by generation of steam from the water contained in *m*, constitutes another part of my invention.

The grate is of peculiar construction, and is so made that air to support combustion goes directly through openings therein to and among the fuel or else circulates in the body of the grate and then escapes either among the fuel or above it; or the passage of the air may be partially in both ways.

My grate is of cast-iron, and may be said to be made of two plates, *q* and *r*. The upper one, *q*, having an edge flange, *s*, cast downward from and integral with it, and having apertures therein which are elongated or continued by pipe-like portions *t* of the same casting extending downward from plate *q* to the same plane with the edge of flange *s*. Plate *r* is securely fastened on the flange *s* and ends of tubes *t*. Provision is made in the air-passage *k* so that when the grate is in its place for use a damper or valve, *u*, can by its position be made to cause the air to pass under the grate and up through its tubular openings through the fuel, or else into the space between plates *q* and *r* and around tubes *t*. The air thus passing finds exit through a series of small holes *w'*, so located in *q* as to open behind the flutings of a corrugated lining, *v*, and may pass into the space above the fuel over the top of lining *v*, or through openings therein, and, if desired, some of the openings may be made low enough to admit the air through the lining *v* into the fuel. The air which thus passes through the compound structure of the grate out of the openings *w'* preserves the grate from burning out by abstracting the heat therefrom.

The peculiar construction and arrangement of the grate with the flange *s* and tubes *t* integral with the top plate, *q*, and with the openings *w'* in said top plate constitute another part of my invention.

Hot-air-engine pistons are generally packed with the kind of packing known as "cup-leather" packing, which is too well known to need description here. This packing sometimes fails to work satisfactorily, because the air gets between it and its cylinder, instead of between the piston-head and its cup-packing, and very slight causes will put the cup-packing in a condition to operate in part contrary to the intent of its organization, especially where the diameter of the cylinder is large and where from use or absorption of oil the packing has lost its original outward spring and becomes flaccid. If the packing is always kept pressed outward, no matter how slightly, provided it is kept in contact with its cylinder, pressure within the cylinder will always act to expand the packing and not to contract it, as when the packing falls away from the cylinder, admitting pressure between said parts. This part of my improvement consists in the employment of springs between the cup-leather and the piston-head. These springs may be variously made. That shown in the drawings is similar to a cup-leather, but is not continuously cupped, like the leather, being cut often enough to let it spring outward, and by contact with the cup-leather keep this always slightly pressed up to the cylinder. This improvement is represented in detail by Fig. 9, where *w* shows the metallic spring which keeps the cup-packing *a'* pressed outward. The employment of spring-pressure acting to keep cup-packing pressed outward constitutes a part of my invention.

The fire-box being tight, and pressure being maintained therein, it becomes possible and convenient to make use of combustible fluid for fuel in connection with incandescent solid fuel, and to accomplish the introduction of such fluid (petroleum, for example) I make use of a force-pump, *b'*, to inject the liquid into the furnance, where it becomes decomposed, as in a gas-making retort, and burns as gas, and, mingling with the hot expanded air and the volatile products of combustion, increases their volume and pressure of the impelling medium which operates the engine-piston. By admitting more or less of this fluid the speed of the engine may be increased or diminished, and if the valve which controls the amount of fluid injected be operated by the engine-governor, the speed of the engine may be thus automatically regulated. This injectment of combustible fluid into the furnace of a hot-air engine containing solid incandescent fuel, when said furnace is tight and a pressure is maintained therein, constitutes another part of my invention.

I claim—

1. The arrangement, in a hot air engine, of the lower part of the cylinder, the air-pump, the fire-box, and the feed-box, substantially as specified.

2. The arrangement of the conduit around the cylinder, substantially as described, for keeping the upper part of the cylinder cool and utilizing the waste heat.

3. In connection with the space in the foun-

dation *m*, the separation of the cylinder therefrom by a casing, *o*, substantially as and for the purpose described.

4. The employment of the unoccupied space in the foundation *m* of a hot-air engine for reception of water, so that steam can be generated by utilization of radiated and conducted caloric, which would otherwise be wasted, substantially as described.

5. Dividing the space contained in the foundation *m* of a hot-air engine by means of the partition *p*, when provided with a flange, as shown, by which a tight joint between the partition and covering-plate *n* can be secured, substantially as and for the purpose described.

6. The grate as constructed when arranged with reference to passages admitting air both into or through it, and with provision for discharging the air between the fire-pot and its lining, substantially as described.

7. The employment, in combination with cup-packing, of springs by which the cup-packing is so held to its place as to operate as designed under pressure.

8. In a hot air engine having a tightly-closed fire-box, and working all the volatile products of combustion through the cylinder, the injection into the fire-box, in connection with ignited solid fuel, of combustible fluid, substantially as described.

In testimony whereof I have hereunto set my hand this 10th day of May, A. D. 1864.

H. MESSER.

Witnesses:

J. B. CROSBY,

FRANCIS GOULD.