No. 41,084. PATENTED JAN. 5, 1864.

H. MESSER.
HOT AIR ENGINE.

Fig: 5.

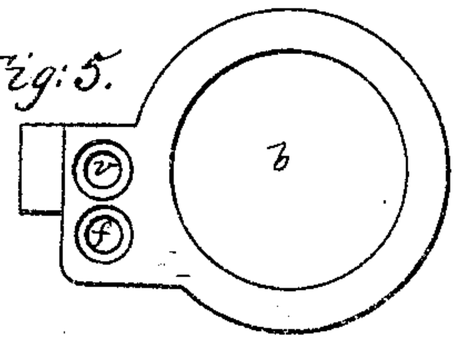


Fig: 7.

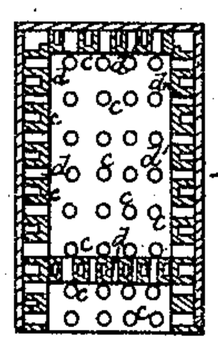
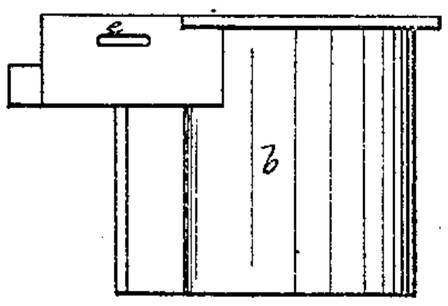


Fig: 6.

Fig: 4.



3 Fig: 3.

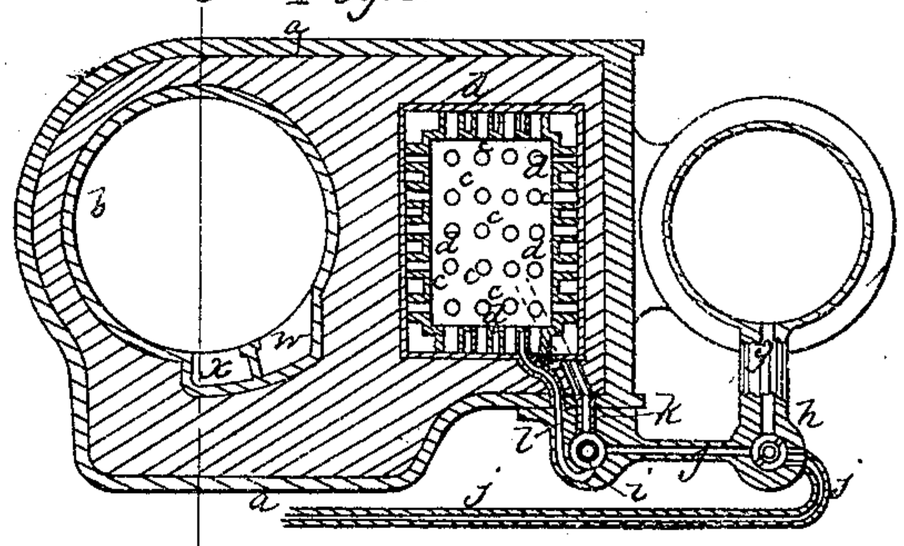


Fig: 2.

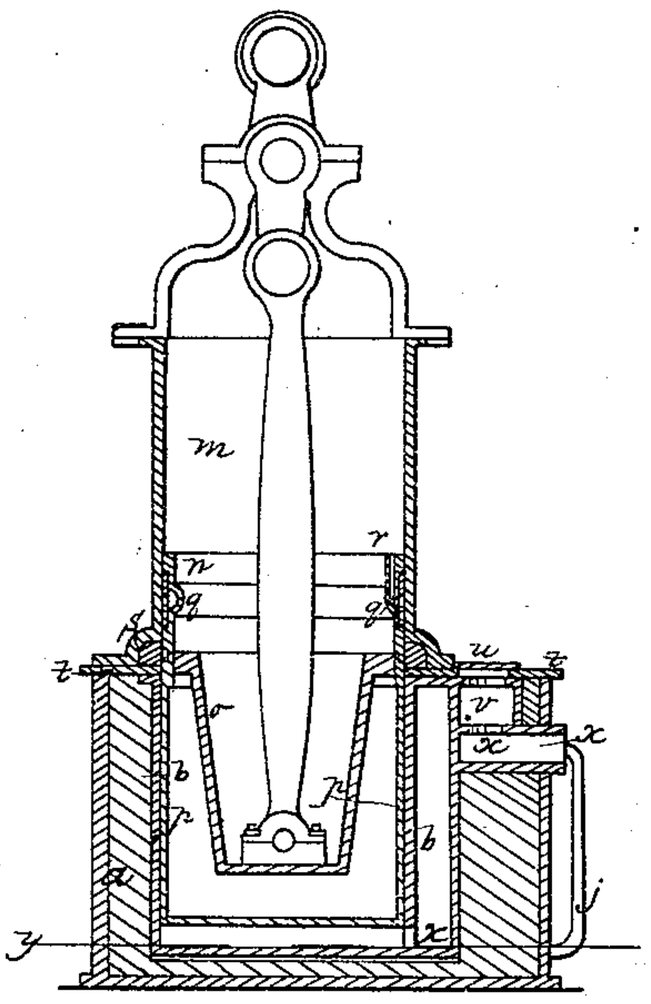
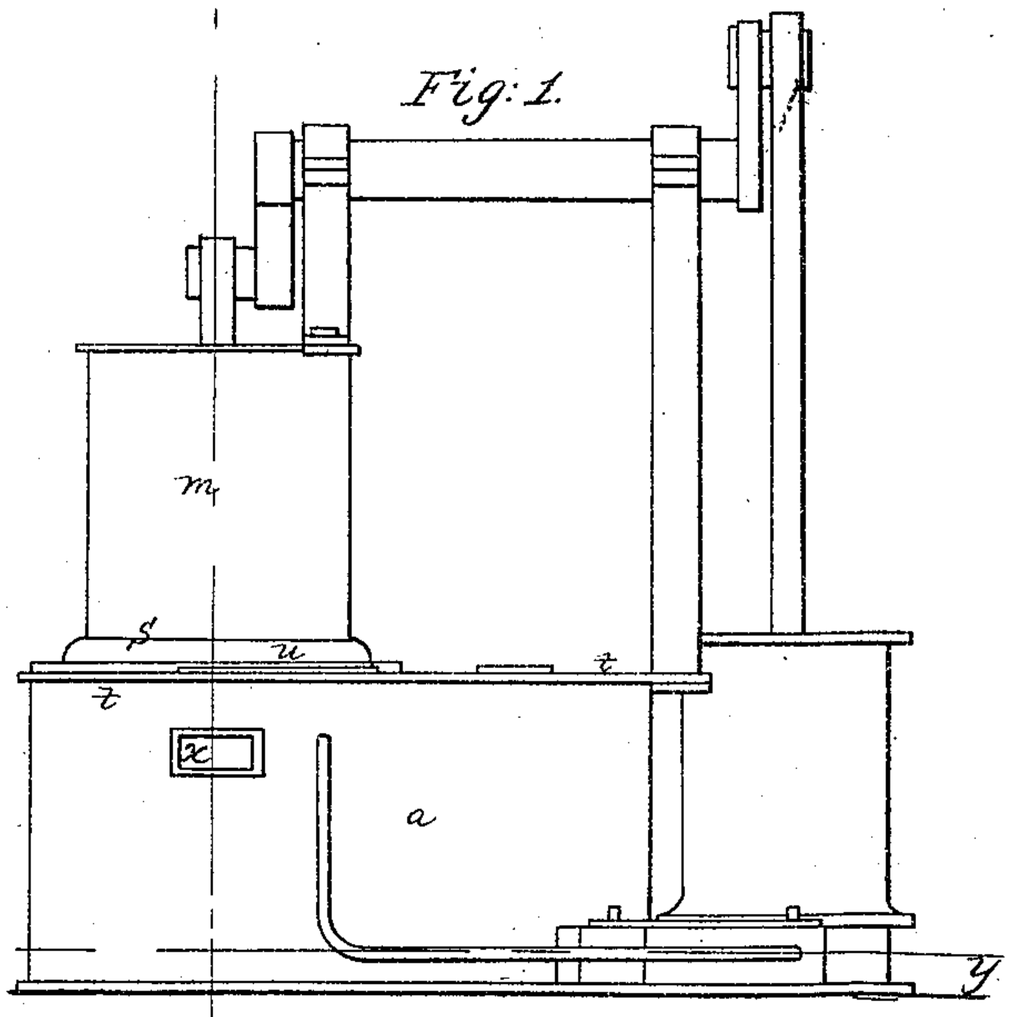


Fig: 1.



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UNITED STATES PATENT OFFICE

HENRY MESSER, OF ROXURY, MASSACHUSETTS.

IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. **41,084**, dated January 5, 1864.

To all whom it may concern:

Be it known that I, HENRY MESSER, of Roxbury, in the 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 relates to improvements in hot-air engines; and it consists in making the walls or top of the furnace hollow, with projections into the space therein when said projections are tubular or take the form of depressions from the inner boundary of the furnace, and when the parts are arranged, as herein described, so as leave spaces in the walls or top connected with each other around said depressions and so disposed as to compel all the air entered into said spaces to come into contact with the heated projections which protrude into the hollow of the walls or top; also, in a new method of retarding the speed of the engine by forming a communication between the air-pump and the cylinder in such a way that when the engine moves at above its normal rate of speed the regulator, by its action on a valve in the passage between the air-pump and the cylinder, operates to let all or a portion of the cold air into the cylinder direct from the air-pump, thus supplying the space left by movement of the engine-piston with cold air, instead of wasting generated caloric by allowing the heated air to blow off, while its entrance into the engine-cylinder is throttled, as in the usual method of regulating, and instead, also, of allowing the compressed air to be blown off, as is the case in some arrangements; also, in the arrangement of a single valve in the passage between the furnace and air-pump in such a manner that by change in the position of the valve the supply of air from the pump may be made to pass entirely through the grate and fuel, or entirely into the furnace above the fuel, (first passing to be heated through the hollow spaces in the walls of the furnace,) or partially in both ways, as occasion may require; also, in the arrangement within one common passage of one valve connected with the regulator for the purpose before referred to, and of another valve used, as hereinbefore mentioned, to determine in what proportion air shall be supplied under or above the fuel; also, in so constructing a piston for hot-air engines that its upper end shall be packed with metallic ring or other suitable packing, and so that said end shall be open for the entrance and vibration of the connecting-rod, said end being made substantially and having a continuation therefrom projecting downward into space inclosed by the usual thin displacing-case attached to the piston and forming its extreme lower and outer part, the downward continuation of the upper part of the piston being made with a closed bottom of suitable proportions to receive the attachment of the connecting-rod thereto, and sufficient space being left between the interior and exterior downward elongations of the piston for reception of non-conducting filling; also, in the arrangement by which direct conduction of heat from the lower portion of the cylinder to the upper portion thereof is checked, keeping the upper portion cool where the packing works and the lower portion hot, so as not to diminish the temperature and consequent pressure of the impelling medium; also, in so arranging and combining the valve-seats, chambers, and passages, with the lower portion of the cylinder that they form an integral portion thereof and avoid the necessity heretofore existing of separate parts and of all joints, except that by which the lower part of the cylinder is joined to the upper part, with the intervention of the top or cover of the base or furnace-containing chamber, while at the same time access can be had to the valves in the most convenient manner possible; also, in the peculiar detail of construction by which the working joint or wrist connecting the piston with its connecting-rod may be adjusted to the requirements of the conditions caused by wear, expansion by heat, &c.

To enable those skilled in the art to practice my invention, I will now proceed to describe the details of a hot-air engine embodying it, referring to the accompanying drawings and the references thereupon marked.

Figure 1 is a side elevation of such an engine; Fig. 2, a vertical cross section taken in the line *z z*, seen in Figs. 1 and 3, and looking toward the furnace. Fig. 3 is a horizontal section taken in the line *y y*, seen in Figs. 1 and 2. Figs. 4 and 5 are respectively an elevation and a plan of the lower part of the

cylinder with valve-chambers, seats, and passages integral therewith. Fig. 6 is a vertical section taken through the fire box; and Fig. 7 is a vertical section taken through the journal-box, forming the connection of the engine-piston with the connecting-rod.

a is a case or base around the furnace, and inclosing, also, the lower portion, *b*, of the cylinder, all of the space in the base unoccupied by these parts and by the necessary passages, conduits, or pipes being filled with brick-work, plaster, clay, or other suitable non-conductor. The furnace, which is seen in Figs. 3 and 6, has a grate made of two plates of iron kept asunder and held together by tubes, these forming the apertures through which air forced under the grate passes to and through the fuel, supporting combustion. The sides and top of the furnace are made thick, but hollow with depressions from the inside of the furnace, extending into the hollow space of the walls. These depressions or tubes, closed at one end, are marked *c*, and the spaces in the walls and top of the furnace are marked *d*. These spaces and the space between the plates of the grate communicate with each other in such a way that when air is forced between the plates forming the grate it will pass from them into the space in and up one of the furnace sides, from there down the spaces in the ends, from there up the space in the other side and over the top or crown of the furnace, from and through which, through proper openings, it debouches into the upper part of the furnace, and, being heated in its passage by contact with the extended surface over which it has passed, it mingles with the heated air and volatile products of combustion in the furnace, and with them becomes the impelling medium which, through a proper opening in the furnace and conduit, is conducted to the opening *e* in *b*, which enters the chamber *f* of the inlet-valve.

In the construction of the air-pump there is nothing novel. It is worked direct from the main shaft and discharges into the passage *g*, in which are located the two-way valves *h* and *i*. *h* is connected in any suitable well-known manner (not shown) with the engine-regulator, (also not shown,) which so acts as to keep the valve in the position shown in the drawings, so long as the engine runs at or below its normal speed, thus letting air pass from the pump along passage *g* to valve *i*, from whence its course will be described beyond; but when the engine runs above speed, the regulator changes the position of the valve *h*, so that that part of passage *g* leading toward *i* is closed and free communication is established between the pump and the engine-cylinder through the pipe *j*, which terminates in the inlet-valve chamber *f*, and by the admission of cold air into the engine-cylinder from the pump-entrance of the impelling medium from the furnace is in some degree checked, and the speed of the engine is lessened by this and by the consequent reduction of temperature in the cylinder, which causes the regulator to act to place valve *h* in the position shown in Fig. 3. The air, being in this way prevented from flowing along *j*, proceeds through *g* to valve *i*, which is a distributing valve, and acts by its position to cause the air from the pump to flow through pipe *k* to the space under the grate, from whence it passes through the tubular openings of the grate up through the fuel to urge combustion; or valve *i* may be so turned by hand as to shut off the air from passing through *k*, and to compel the air to enter the pipe *l*, by which it is discharged into the space in the walls of the furnace, and thence by the route previously described, or any other equivalent thereto, it escapes into the combustion-chamber; or valve *i* may be so turned by hand as to leave passages *k* and *l* partly open, so that part of the air may be discharged below the grate and part above it into the furnace.

In some hot-air engines heretofore constructed the upper or packed part of the piston which fills the upper bored or finished part, *m*, of the cylinder is substantially made of cast-iron or otherwise suitably formed, so that a piston or connecting-rod can be so firmly connected thereto as to withstand the strain brought upon them; and attached to the bottom of this part of the piston is an extension made of light sheet metal and usually filled with some suitable non-conductor, this part nearly filling the lower part, *b*, of the cylinder when the piston is at the end of its downstroke. Now, to lessen the height of the engine to render it more compact, or to increase the length of the connecting-rod, I extend the upper rigid cast portion of my piston downward, so that there is but little space left between the end of it and the thin casing which makes the outside of the piston extension.

In Fig. 2, *n* shows the upper packed part of the piston; but instead of having, as usual, its bottom, to which the connecting-rod is jointed at or near the top of the extension of the piston, there is an inner extension, *o*, protruding downward, within and to the bottom of which the connecting-rod is journaled. This extension *o* is surrounded by a thin casing, *p*, and the space between *o* and *p* may be filled by any suitable non-conductor. The upper part, *n*, of the piston is provided with a metallic packing ring or rings, which may be made yielding and adjustable after any well-known manner common for metallic packings for cylinders. In the rear of this packing there is a groove formed in the piston at *q*; or there may be a number of grooves, which, by means of a rubber pipe or of a telescopically-joined pipe fixed to the passage at *r*, is supplied with water or steam or other lubricator, which, finding its way through apertures formed in or adjoining the packing, lubricates the surface of the piston and of the cylinder as the piston is moved within it. As the lower part of the cylinder receives most heat in the action of the engine, and as the upper part only has

the piston fitted tightly therein, it is a desideratum to keep the part *b* cool as possible, and to that end I prevent in a great measure transmission of heat by conduction from the lower to the upper part of the cylinder, as follows: Between part *b* and its base-flange a curvature, *s*, is introduced in the casting, as shown in Figs. 1 and 2, so that within the space inclosed by *m*, at the curvature *s* and on the plate *t* covering the bed or case *a*, there is afforded room for the interposition of plaster, fire-brick, or other suitable non-conductor. This, and the fact that the top flange of the lower part of the cylinder extends outward under the plate *t* not so far as the space for the non-conductor practicallly limits to the minimum amount conduction of heat from *b* to *m*.

To enable me to adjust the fit of the connecting-rod wrist-pin in its journal boxes in the interior of the downward elongation of the piston, I have invented the detail, which is shown in section in Fig. 7. In the cap of the box, on either side of the bearing, there are tubes large enough in bore to admit through them the studs or screws which hold the cap to the lower part of the box. These tubes have screw-threads cut on them which fit threads tapped in the cap, and the upper end of each tube is provided with plane faces on which a socket-wrench can operate. The lower ends of the tubes, when the boxes are newly fitted, project through the lower surface of the cap, so that when the journal fits its bearing the cap rests on the ends of the tubes which bear upon the upper surface of the lower half of the box, and the cap is held in its place by the screws or by the nuts on the studs which pass through the tubes. Now, when the bearings become worn the tubular screws can be turned back with a socket-wrench after first loosening the said screws or the nuts on the studs, which is also done with a socket-wrench, but of smaller size. Turning back the screwed tubes makes the cap approach the lower part of the box till it fits upon the wrist-pin, and then the studs are tightened by screwing their nuts down upon the tops of tubes. Without this arrangement the proper adjustment of the joint of the connecting-rod when located near the bottom of the extension of the piston is very difficult.

To avoid the troubles arising from joints liable to leak, and from expansion and contraction consequent on change of temperature, I construct the valve-chambers *f* and *v*, valve-seats, and induction and eduction passages *w* and *x* integral with the lower part, *b*, of the cylinder, with the chambers *f* and *v* open at the upper or open end of part *b*, and terminating flush with or in the same plane with the flange of *b*, so that by facing off the flanges of *b* and *m* and both surfaces of *b*, the joints between these parts can be cheaply and well made, while at the same time *b* can expand freely downward (the non-conducting filling being so arranged as to permit this) and *m* upward, and the valves and seats can be got at for inspection and repairs simply by removal of the cover *u*, and the whole of this part of the construction of a hot-air engine is thus made with greater economy and so as to be more durable and effective than heretofore.

The general operation of this engine is substantially the same with others heretofore made which employ an air-tight furnace, into and through which air is forced, heated, mingled with the volatile products of combustion, and then employed as the impelling medium. I intend to arrange dampers or valves so that at will I can shut off the heated air in the hollow walls of the furnace from entering the combustion-chamber for the purpose of supplying the engine with an impelling medium in the form of the heated air from the said hollow walls whenever it is necessary to open the combustion-chamber to supply fuel upon the grate, so that thereby the engine may be kept in motion while so supplying the fuel by means of the heat received through the furnace-walls, and thus render unnecessary the valvular arrangement now in use for supplying fuel to air-tight fire-boxes when the engine is in motion. While the valve *i* is so arranged as to be operated by hand, it may also be connected with the regulator in such a manner that, when the regulator operates to shut the cold air off from direct communication between the pump and the cylinder, it will also operate the valve *i*, so as to cause the largest portion of the air passing from the pump to the cylinder, by or through the furnace, to pass under the grate, and thus intensify combustion, or so as to cause the air so passing from the air-pump to the cylinder to pass above the grates into the furnace-walls, or so as to cause the current from the air-pump to enter the furnace both above and below the fuel, according as the engine moves, respectively, below, above, or at its normal speed.

The space left for non-conducting filling between the upper and lower parts of the cylinder may be modified in any obvious way, so as to make an inclosed passage in and through which air may be made to circulate, being forced in and through the passage by the air-pump, said air intercepting, receiving, and conducting off the heat which proceeds or is given off by the lower part of the cylinder. The air which has been thus partially heated in its movement through said passage may be made to enter the furnace either above or below the grates, or may be made to enter the space in the walls or top of the furnace, or both, in its passage into the cylinder, and thus the heat abstracted from the cylinder (by the movement of cool air through the said passage around the cylinder) will be utilized. The cover *u* is made in whatever form it may assume to uncover a passage-way large enough to freely admit the valve as it is placed upon or is taken from its seat. In some cases it may be more convenient to make in two castings the lower part of the cylinder, and the

part connected therewith containing the eduction and induction passages, the valves, valve-seats, and valve-chambers, flanges being provided, so that by means of screws the two parts can be fixed together, the plane in which the outlets of the valve-chambers terminate being the plane of the top of the lower part, *b*, of the cylinder.

Modifications may be made in the way of joining the two parts of the cylinders togther, so that the cover or plate *t* is not interposed between them; but when it is arranged so that the plate *t* comes over the upper openings into the valve-chambers then holes must be cut through the plate large enough to admit freely the removal of the valves from their chambers.

I claim—

1. The construction of the walls or crown of the furnace, or both, in the manner and for purpose substantially as described.

2. Checking the motion of a hot-air-engine piston by connecting the air-pump with the cylinder in such a manner that the whole or a portion of the air condensed by the pump can pass into the cylinder without detention on its passage for the purpose of being heated, and by arranging in such a connection or passage a valve so connected with the engine-regulator that by the action thereof air may be admitted through said connection direct from the air pump into the cylinder for the purpose of checking the speed of its piston when moving too rapidly.

3. The arrangement of the valve *i* with respect to the pump, the space below the grate, and the space in the walls of the furnace, substantially as and for the purpose specified.

4. The arrangement in one passage of a valve operating to check the speed of the engine-piston, substantially as described, with a valve operating to determine in what proportion air shall be supplied to the furnace above or below the fuel.

5. A piston for hot-air engines constructed with packing therein at its upper end, this being open for entrance and vibration of the connecting-rod, and with an extension, *o*, downward therefrom, substantially as described, when this extension enters into and is surrounded by the casing *p*, so as to leave space between *o* and *p* for non conducting filling.

6. The arrangement and combination of parts, substantially as shown and described, by which conduction of heat from the lower to the upper part of the cylinder is materially lessened.

7. Constructing the cap of a wrist or journal box with tubular screws capable of adjustment, and surrounding the screws or studs which hold the cap to the lower part of the box, substantially as and for the purpose specified.

8. So constructing the lower part, *b*, of the cylinder and the valve-seats, chambers, and induction and eduction passages that they all form one and the same casting with the mouths or outlets of the valve-chambers in the same plane with the flanged open end of said part *b* of the cylinder, substantially as and for the reasons specified.

In witness whereof I have set my hand this 12th day of October, A. D. 1863.

H. MESSER.

In presence of—
J. B. CROSBY,
F. GOULD.