B. F. McKINLEY.

HOT-AIR ENGINE.

No. 182,213. Patented Sept. 12, 1876.

Fig. 1.

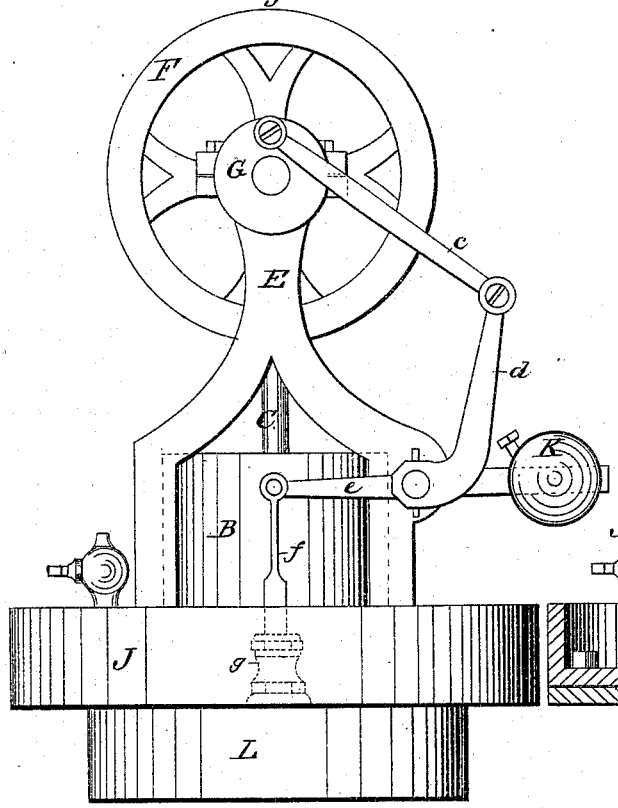


Fig. 2.

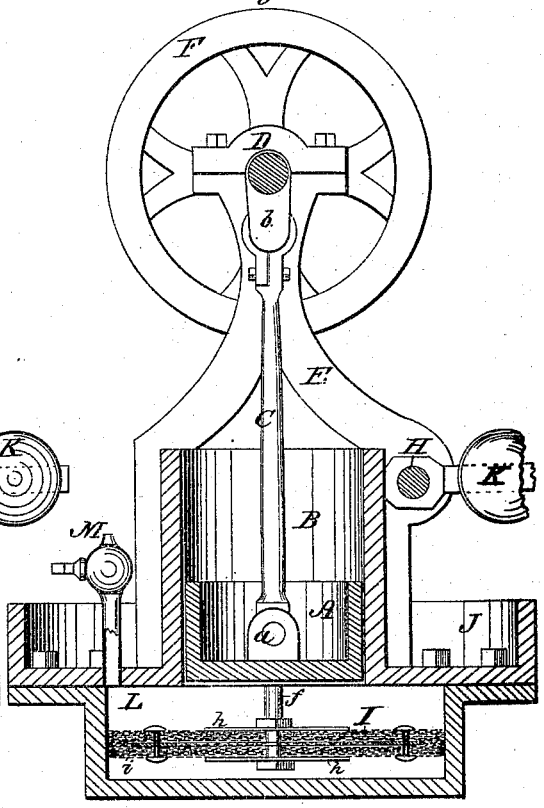
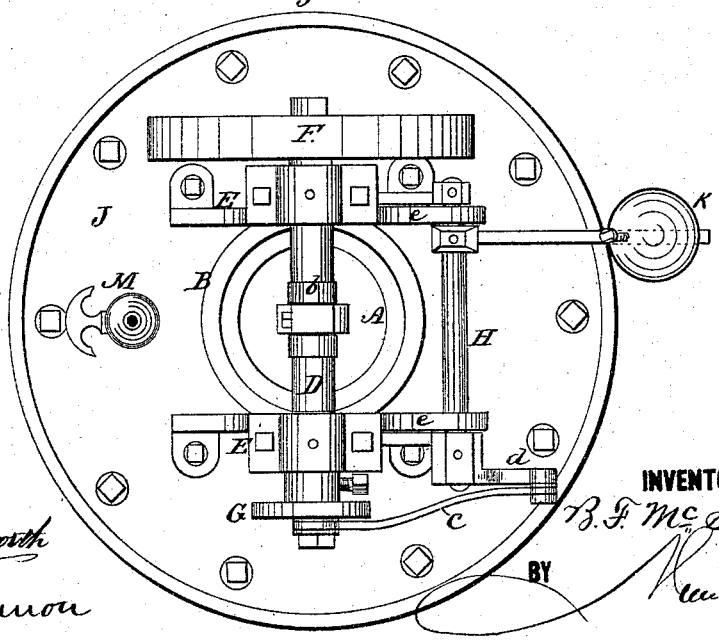


Fig. 3.



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UNITED STATES PATENT OFFICE.

BENJAMIN F. McKINLEY, OF NEW RICHMOND, OHIO, ASSIGNOR TO HIMSELF AND HENRY R. MATHIAS, OF SAME PLACE.

IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. **182,213**, dated September 12, 1876; application filed August 30, 1876.

To all whom it may concern:

Be it known that I, BENJAMIN F. McKINLEY, of New Richmond, in the county of Clermont and State of Ohio, have invented a new and Improved Air-Motor; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, forming part of this specification, in which—

Figure 1 is a side elevation; Fig. 2, a vertical section; Fig. 3, a plan view.

My invention relates to a novel construction of engines, to which I have applied the name of "thermal motor," the same being designed to utilize the alternate pressure and partial vacuum produced by the alternate heating and cooling of the same body of air.

Upon this general principle, which has heretofore been made use of, I have based the construction of my engine, which consists mainly in the combination, with a working-piston moving in a cylinder, of a piston made simply of woven wire, with free edges, operating consecutively with the working-piston, and located in a chamber communicating with the cylinder of the working-piston, and between the working-piston and the surface through which the heat is applied, as hereinafter more fully described.

In the accompanying drawing, A represents the working-piston, located in its cylinder B. This piston is made of a cup shape, to obviate the necessity of a piston-rod, and is jointed at *a*, directly at the pitman C, which latter is attached to the double crank *b* of the horizontal main shaft D. This shaft is journaled in bearings in the supporting-frames E, and carries at one end a fly-wheel, F, and at the other a disk, G, with a wrist-pin, in the place of which a cam or eccentric may be used. This wrist-pin is connected with one end of a pitman, *c*, which is pivoted at the other to the arm *d* of a rock-shaft, H, which latter is journaled in bearings in the frame E. This rock-shaft is provided with arms *e e*, to which are pivoted rods *f f*, that extend through packing-boxes *g g* in the base-plate J, and are attached to the wire piston I in such a manner as to give it a vertically-reciprocating alternative and consecutive movement with the working-piston through the mechanism G *c d* H *e f*; and in order to balance the weight of the wire piston, and cause it to be held in equilibrium and sensitive to the action of said mechanism, a counter-weight, K, is fastened to an arm of the rock-shaft. This said wire piston is made of a number of disks of woven wire or wire-cloth, which are held together by metal bars *h*, clamped by screw-nuts upon the ends of the rods *f f*, a metal ring, *i*, being interposed between the disks near their peripheries, to impart stiffness and form to the same.

The piston, as thus described, is arranged to fit nicely, and move in a chamber formed by the short cylinder L, which is of considerably larger diameter than the cylinder of the working-piston, and is bolted to the base-piece J of the same with a tightly-packed joint. M is a stop-cock, which opens or closes communication with the interior, for the purpose of regulating the amount of air or stopping the engines.

The operation of the engine is as follows: The bottom of the cylinder being heated by any suitable means, the wire piston is allowed to rest upon the said bottom for a few minutes, in order to become heated. After it has become sufficiently heated, it is lifted by turning the fly-wheel to give it the necessary initial start. Now, as the wire piston passes upwardly, it passes through the air above it, and the latter is forced through the numerous interstices and heat-radiating surface of the wire piston, and becomes highly rarefied, and, expanding, produces a pressure which lifts the working-piston. The impulse thus given to the working-piston sends the wire piston down again, and here follows the peculiar action which brings also the working-piston down.

It will be remembered that the wire piston is composed of a number of disks, and as there is a great degree of heat below the same and a comparative degree of cold above, there will be a considerable difference in the temperature between the upper and lower layers of the piston. Now, when the working-piston has been driven up by the elevation of the wire piston, the latter, through its gearing, is moved downwardly just before the descent of the working-piston, and as the air below it is hot and highly rarefied by the fire-heated surface be-

low the hot bottom layers of the elevated wire piston, the tension of the air is at its maximum just when the air-piston is about to descend.

As it descends by the last part of the upward stroke of the working-piston, the upper cool layers of the wire piston pass down upon the subjacent hot and intensely rarefied air, and the latter, in its passage through the interstices, gives up its heat to the cool upper part of the wire piston, and produces a cooling and contracting effect, which, with the natural radiation above, produces a partial vacuum, sufficient to bring down the working portion from atmospheric pressure. This descent of the working-piston elevates the wire piston, (at first raised by hand,) and the same action, just described, is repeated to render the operation of the engine automatic and continuous.

I am aware of the fact that an engine operating upon the same general principle of the alternate expansion and contraction of the same body of air by heat has been heretofore constructed, but in the case referred to there was no wire piston, but in the place of the same a displacer, which simply transfers the air, and leaves the cooling effect to a water-jacket.

The wire piston, it will be seen, when arranged as described, is the actual vehicle of heat for one movement, while for the other movement it takes away the heat. This enables me then to dispense with the water-jacket ordinarily employed, and yet, by reason of its position between the fire-heated surface and the working-piston, secures such a low temperature for the working-piston and its cylinder as to involve no bad effect resulting from the decomposition or burning of the lubricant.

In defining the limits of my invention more fully, furthermore, I would state that I am aware that a piston incased in a frame or containing-case is old; but said frame operates to some extent as a displacer, unless it be made to fit accurately the cylinder, and if it thus fits the cylinder, the expansion of the rigid metal causes it to bind; whereas, with a wire portion like mine, without a rigid metallic containing-case, and in which the edges of the wire-cloth itself bear directly against and fit the sides of the cylinder, the flexibility of the wire-cloth piston compensates for this expansion and operates as a packing—an important advantage, for the reason that the heat is such as to injure and decompose any ordinary packing. Moreover, when combined with a working-piston and located between the same and the fire-heated surface in a chamber having communication with the working-piston cylinder, certain peculiar and distinctive advantages result therefrom, which have no existence when the air is forced through the wire piston by pumps or other means, or when its location and relative arrangement are changed: first, the vehicle of heat itself moves while the non-conducting air is practically stationary, and, there being an entire absence of air pumps and displacers, there is an absence of currents of air flowing over fixed surfaces, which is objectionable, for the reason that they tend to equalize the heat and cold, instead of producing a differential effect; secondly, the provision, in the form of a wire piston of large diameter and short stroke, of an immense amount of surface, whereby the heat is alternately taken up and given out on an exceeding small percentage of differential temperature, and rendering unnecessary any special provision for carrying off any excessive heat, the temperature being kept down by the consumption, or, rather, conversion or transformation, of heat into motive effect, the furnace being required only to furnish after starting this amount of heat and that lost by radiation; thirdly, the absence of valves, passages, or contracted openings allows it to work at a speed unattainable in any other form; fourthly, the absence of pumps obviates back pressure and enables me to get an effective return-stroke.

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

1. In a hot-air motor, a piston constructed simply of layers of wire-cloth, fastened together, and which extends to the walls of the cylinder, substantially as and for the purpose described.

2. The combination, with a working-piston and its cylinder, of a piston made of wire-cloth with free edges, located in an inclosed chamber, communicating with the working-piston cylinder, and between the heated surface and the working-piston, and operated alternately with the working-piston through suitable gearing, substantially as and for the purpose described.

3. The combination, with the working-piston A and its cylinder B, having a base-piece, J, of the lower piston-chamber L, of greater diameter than the working-cylinder, and bolted to the base-piece J, together with the wire piston I, operating therein, substantially as and for the purpose described.

The above specification of my invention signed by me this 28th day of August, 1876.

B. F. McKINLEY.

Witnesses:

EDW. W. BYRN,
SOLON C. KEMON.