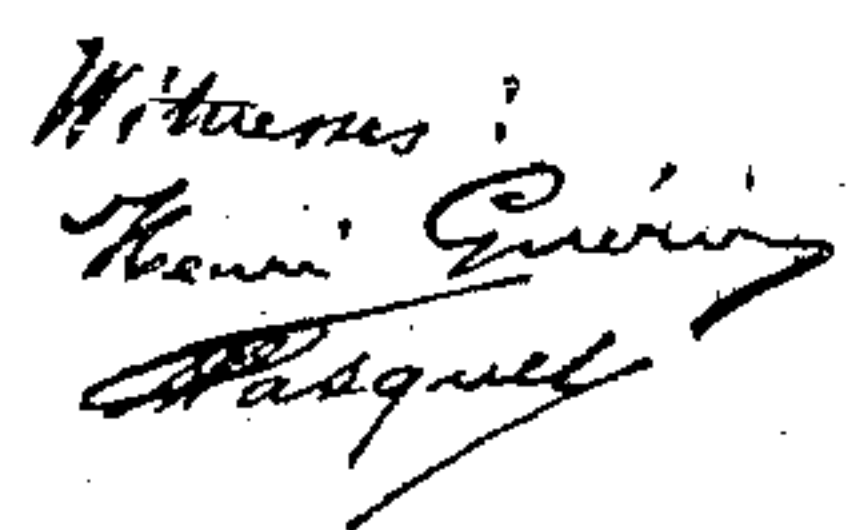


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# UNITED STATES PATENT OFFICE.

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## HOT-AIR MOTOR.

966,032.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, GUILLAUME MANN, a citizen of the French Republic, and resident of Paris, France, have invented certain new and useful Improvements in Hot-Air Motors, of which the following is a specification.

It is generally known that such motors are based upon the principle to alternately conduct a fluid, generally air, from a heated chamber where it expands into a cooled chamber where it contracts. The displacement of the fluid is effected by means of a piston. The increase of volume caused by the raising of the temperature of the fluid is utilized for pushing forward a driving piston which is moved back by the fly-wheel. Such motors have only very little efficiency and the principal reasons herefor are:—

1.—The fact that the cooling chamber is badly insulated from the heated chamber so that in order to destroy the heat which is transferred to the cooling chamber, various refrigerating means, blades, water circulation, etc., have to be employed for preserving between the two chambers the required difference of temperature. The heat uselessly destroyed corresponds however at a considerable loss of energy.

2.—The unavoidable loss of fluid has to be compensated by means of a valve which admits fresh liquid as soon as the internal pressure sinks below the pressure of the fluid generator, the atmosphere in the present case. Herefrom follows that the piston for a certain part of its travel absorbs work instead of doing work.

The present invention has for its object to obviate these defects by better utilizing the heat of the furnace and by better insulating the heating chamber from the cooling chamber and further by establishing free communication between the fluid generator and the interior of the motor cylinder at every stroke of the motor piston, that is to say at the moment when the expansion is nearly finished.

The improved hot air motor is shown in the accompanying drawing in vertical section.

1 is the cylinder which at its upper end is open and has near its upper edge an inlet orifice 2. In this cylinder move:—

1.—A working piston 3 whose packing consists of leather segments 4 and which has a central boring. Said piston has a double

connecting rod 5 articulated on its upper surface.

2.—A displacing piston which consists of a disk 6 of a diameter which is smaller than the inner diameter of the cylinder so that an annular space is formed between said disk and the wall of the cylinder through which the working fluid can circulate, and of a certain number of piston elements 7 which are completely closed. The piston rod 8 is guided through the central boring of the working piston 3.

The cylinder 1 has at its lower end a flange 9 between which and the upper edge of the furnace 13 the flange 11 of a cylinder 12 is inserted, a packing ring 10 of heat non-conducting material conveniently insulating the upper cylinder 1 which forms the cooling chamber from the lower cylinder 12 which forms the heating chamber. Said lower cylinder 12 is composed of as many small cylinders as there are piston elements 7, said piston elements moving freely in said cylinder elements, so that the working fluid can freely flow around each of the piston elements 7. The upper part 13 of the furnace on which said cooling cylinder is mounted communicates with the flue of the furnace through an orifice 14, baffle plates 15, 16 being arranged in said heating chamber for conducting the gases of combustion and the flames around said heating cylinder 12. A chimney 17 serves for the escape of the gases of combustion. The connecting rods 5 of the motor piston are on the other hand journaled on the driving shaft, the rod 8 of the displacing piston being actuated from said shaft by means of a cam and in such a manner that it is in advance of the working piston about 90°.

The hot air engine works as follows:—When the displacing piston ascends the motor fluid flows into the heating chambers 12, openings being provided in the disk 6 of said piston between the piston elements, said motor fluid, the air, expands and pushes the working piston 3 upward; hereupon the displacing piston which is about 90° in advance of the working piston descends compresses the motor fluid, the motor piston descends under the influence of the fly-wheel and so on. The work is solely produced by the expansion of the working fluid which precedes the cooling of the same. The difference of temperature is about  $\frac{1}{3}$ .

It would be unprofitable to let get lost



the heat which radiates from the walls of the cooling room, therefore, in opposition to all what has been always done, said walls of the cooling room are not cooled but on the contrary painted with a heat non conducting substance so that the temperature of the cooling room becomes the average temperature of the motor fluid and remains constant; in certain cases the gases from combustion could be conducted around said cooling chamber before they are allowed to escape.

When the motor piston arrives at the end of its stroke its lower surface just uncovers the orifice 2 so that as much of the working fluid is sucked in as has been lost in the preceding operation.

In order to obtain a better utilization of the heat from the furnace by increasing the heating surface for a given space, for the unique lower cylinder a great number of small cylinders 12 has been substituted each of which has its own displacing piston element 7. The displacing piston elements 7 have each a small hole at the lower end whereby the vibrations are suppressed so that a silent working of the engine is obtained, the compression becoming less brusque. The efficiency of the engine is greatly increased owing to the hereinbefore described improvements.

I claim:—

An improved hot-air motor comprising in combination with the flue of the furnace,

baffle plates in said flue, a cylinder forming the heater of the engine fixed in said flue by means of its upper flange, said cylinder being composed of a great number of small cylinders which are all open at the upper ends, the displacing piston which consists of a top plate having suitable apertures and of a great number of small piston elements fixed on the lower surface of said plate so that they penetrate each in one of the small cylinders, said piston elements being of smaller diameter than the cylinders, a piston rod fixed upon said disk, an upper cylinder open at its ends having an air inlet at the upper end and serving as cooling chamber and mounted upon the flange of said lower cylinder, a packing ring of heat non-conducting material between the flanges of the upper and the lower cylinder, said upper cylinder being of larger diameter than the disk of the displacing piston, and the motor piston in said cylinder which is connected with the shaft by means of two connecting rods and a cam on said shaft for operating the piston rod of the displacing piston which is in advance of about 90° of the motor piston, substantially as described and shown and for the purpose set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.  
GUILLAUME MANN.

Witnesses:

FERD. NUSCH,  
F. CARRALER.