No. 856,102. PATENTED JUNE 4, 1907.

O. RINGBOM.

HOT AIR ENGINE.

APPLICATION FILED JULY 17, 1905.

FIG. 1.

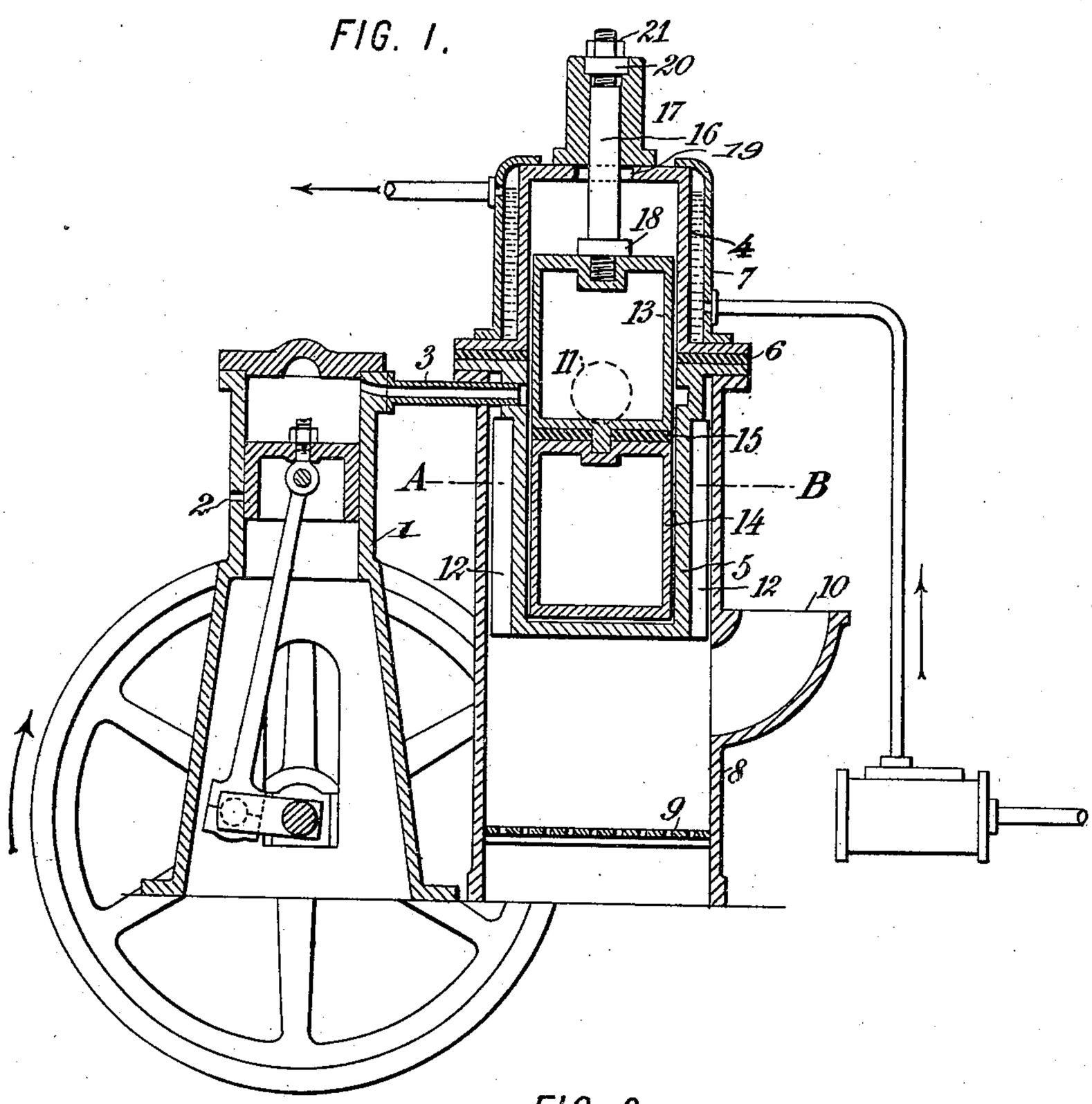
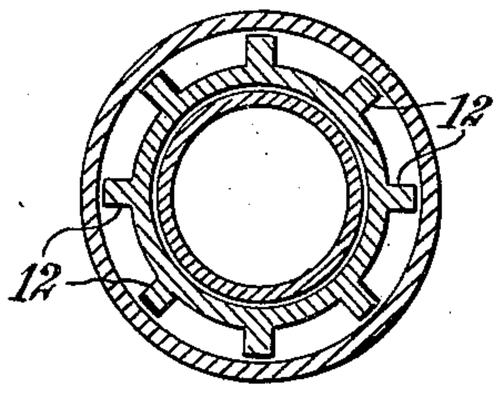


FIG. 2.



WITNESSES:
Fred White
Rene' Bruine

INVENTOR:
Ossian Ringbom,
By Attorneys,
Arthur C. Fraser & Co.

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

OSSIAN RINGBOM, OF BORGÅ, RUSSIA, ASSIGNOR TO ANDERS GUSTAF ADLERCREUTZ, OF SKURU, FINLAND, RUSSIA.

HOT-AIR ENGINE.

No. 856,102. Specification of Letters Patent. Patented June 4, 1907.

Application filed July 17, 1905. Serial No. 269,941.

To all whom it may concern:

Be it known that I, OSSIAN RINGBOM, a subject of the Czar of Russia, residing at Borgå, Finland, have invented certain new and useful Improvements in Hot-Air Engines, of which the following is a specification.

The aim of the present invention is to produce a hot air engine in which the movement of the displacing piston is obtained without the connection of rods or cranks or eccentrics or other mechanical parts of the engine, but solely by the expansion of the heated air and the weight of the piston; and to obtain at the same time a simple regulating device for the velocity. Such an engine can be cheaply manufactured and works very well where small power is required.

A construction embodying the invention is illustrated in the accompanying drawings.

Figure 1 of the drawings is a vertical section of the engine, and Fig. 2 is a cross-section on the line A—B of Fig. 1.

Referring to the machine illustrated, the working cylinder 1 is provided with the usual or any suitable piston connected by a link and crank shaft to a fly wheel. In one side of the cylinder 1 there is an opening 2 through which the air can enter the working chamber of the cylinder when the piston passes below the opening. The upper part of the working cylinder is connected with the pressure generator by means of a tube 3. The pressure generator consists of an upper half 4 and a lower half 5 which are separated from each other by a ring-shaped packing or heat insulator 6 of any suitable insulating material. The upper half is provided with a cooling jacket 7. Between the jacket and the inner shell water is circulated in order to keep the upper part of the generator cool. Any suitable means may be provided for circulating the water, such as the pump and connections indicated diagrammatically.

The lower half of the pressure cylinder extends into a furnace 8 which has a grate 9 and an opening 10 for introducing the combustible material. The combustion gases surround the lower part of the pressure generator and pass out through an opening 11 into any convenient chimney. In order to obtain a considerable heating surface the lower half 5 of the generator is provided with ribs 12 preferably cast thereon as indicated in Fig. 2. The generator is preferably a cylinder of circular cross-section and within it is a displacer in the form of a piston comprising two parts 13 and 14 separated by a heat insulator 15. The piston fits loosely in the cylinder so as to move freely up and down. The lower part of the piston is highly heated by the surrounding heated portion of the cylinder, and the upper part is similarly cooled. The heat insulator between the two parts of the piston prevents the transmission of heat to the upper part, whereby the lower part serves as an auxiliary heating means and the upper part as an auxiliary cooling means. The heating and cooling surfaces are thus nearly doubled even though the auxiliary heating means has a lower and the auxiliary cooling means a higher temperature than the adjacent portions of the cylinder.

The air-displacing piston is provided at its upper end with a guide rod 16 which passes through a guide 17 attached to the outside of the generator cylinder. The guide rod is provided at its point of connection with the displacer with a ring or collar 18 which fits exactly in a socket 19 provided in the end of the cylinder and the adjacent part of the guide 17. At the upper end of the guide rod there is a ring 20 which is fastened on the rod by means of a nut 21 and in its lowest position enters a corresponding hollow or socket in the end of the guide 17, and is carried at such a point that there is always a space between the displacer piston and the bottom of the generator chamber. By the manipulation of this nut a regulation of the out-put of the engine to any desired extent is made possible, as is described in detail hereinafter.

The operation of the engine is as follows:—The motor is started by means of the fly wheel. When the working piston in the cylinder 1 passes below the opening 2 air enters the cylinder 1 from the outside, and, on the return of the piston after the closing of the opening air is forced by the working piston into the pressure generator 4, 5, under slight compression. The greater portion of the air passes naturally to the cooled, upper, free chamber. By a proper proportioning of the dimensions of the working cylinder, the displacer piston and the guide rod, I can insure that at a suitable instant, when the working piston is near its dead point, the pressure on the bottom of the displacer piston is greater than the total pressure on the top (since the

pressure surface is reduced by the cross-sectional area of the guide rod) and the weight of the several parts of the displacer piston as well as the friction of the guide rod in its guide. At this instant the displacer rises. The collar 18 enters the socket 19, whereby the air cushion formed in said socket takes up the shock. Whereas the heat of the lower part of the generator cylinder previously had proportionately little influence on the compression of the air, since the air was chiefly in the upper cooled part of the cylinder, now on the other hand the proportion changes. The greater part of the air being in the lower part of the generator cylinder the degree of compression rises quickly, acting as a brake on the working piston, and when the working piston with the help of the fly wheel has passed its dead point, driving the working piston down again. In this downward movement of the working piston the air expands again. It is to be observed that the heating and expansion of the air occur particularly at the moment when the displacer rises and the air falls between the heated walls constituting the lower portions of the displacer piston and its surrounding cylinder. Also, however, while the air continues to drive the working piston and to expand, there occurs, though to a less extent, a considerable heating of the air in the lower part of the generator; which heating makes up for the loss of pressure by expansion in the working cylinder. When the sum of the pressure on the top of the displacer and the weight of the several parts thereof exceeds the sum of the pressure from below and the frictional resistance of the guide, the displacer again falls back to its starting position and the ring 20 forms an air cushion in the socket in the top of the guide 17, which reduces the shock. The instant at which the falling of the displacer shall occur can be determined by a proper dimensioning of the collar 18 and the corresponding socket 19. This easy and desirable determination of the instants when the displacer rises and falls is an especial advantage of the present engine. When the displacer falls the air in the generator again goes to the top and is here again cooled and made more dense. Just as in the downward passage of the air in the narrow way between the displacer and the generator cylinder a quick heating and expansion took place, so the opposite action now takes place quickly in the upward passage of the air between the two cooled surfaces. This occurs, however, at the latest at the instant when the working piston passes the opening 2. By reason of the cooling of the air in the upper part of the generator and the further movement of the working piston a vacuum is obtained within the apparatus and new air is sucked in. The working piston is carried past the dead point with the help of the fly wheel, and moves again upward past the opening 2 and the previously described operation is repeated.

This hot air engine possesses the peculiarity of having no mechanical connection between the displacer piston and the working piston. In my machine the movable masses are reduced,—a matter of great importance for obtaining high speed. The thing requisite for the working of the engine is only that the fire shall be strong enough to secure the quick heating in the lower part of the pressure generator. By means of the nut 21, as above explained, a certain regulation of the piston velocity and of the out-put can be obtained, since the starting point of the displacer can be made higher or lower. This regulation depends principally on the fact that the greater quantity of air under the displacer when the latter is at a higher point, causes a greater increase of compression than when the displacer is in its lowest position. The compression will therefore be of a degree corresponding to the height of the displacer. The resulting strong increase of pressure, corresponding to the compression and back pressure of a steam engine, occurs sooner and acts more strongly as a brake against the working piston.

The cylindrical heating surface of the generator is in direct proporton to the extent to which it dips into the fire box. If it dips to a less extent the heating surface is also less, and the quantity of heat which the air will receive and the quickness of the expansion are less. To be sure the air, if the displacer be supposed arranged at a higher point in the furnace, will remain somewhat longer in the bottom of the generator cylinder, which is in the top of the fire box, and will thereby receive a longer and more effective heating than otherwise. Nevertheless it is apparent from the several considerations mentioned that the less deeply the generator dips into the fire box the greater the reduction of efficiency. The out-put of the engine becomes less and the velocity also. The exact position of the insulating layer 15 for greatest efficiency of the engine may be modified according to circumstances.

Various other modifications may be made in detail and in the arrangement and combination of the parts without departure from the invention.

What I claim is:—

1. A hot air engine, including, in combination, an air displacer and a working piston disconnected mechanically from each other, a pressure generating chamber in which said displacer works, a working cylinder in which said piston travels, and a conduit for transmitting the excess of pressure in the generator to the working piston to drive the same, said working cylinder being provided with an orifice at a suitable height such that air

is sucked in through said orifice at the end of the driven movement of the working piston and said piston during its return stroke serves to compress air for the generator.

2. A hot air engine, including, in combination, an air displacer and a working piston disconnected mechanically from each other, a cylindrical pressure generating chamber in which said displacer works, a working cylinder in which said piston travels, and a conduit for transmitting the excess of pressure in the generator to the working piston to drive the same, said displacer comprising a piston fitting loosely in the cylindrical pressure generator and guided by a rod 16 extending outside of said generator, and a nut 21 on said rod for determining the height of the lowest position of the displacer.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

OSSIAN RINGBOM.

Witnesses:
F. KOLSTER,
OSCAR EKSTROM.