Jan. 24, 1933. B. MONTERO 1,895,082

ENGINE

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Fig. 1.

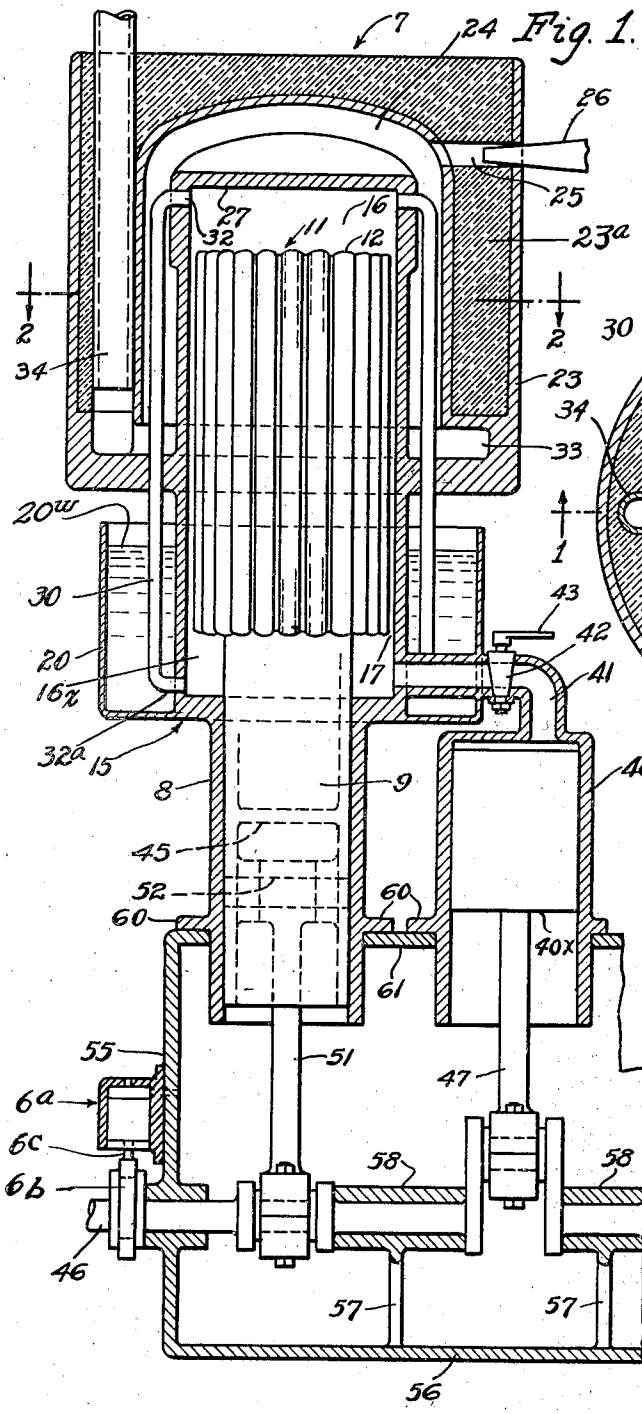

Fig. 2.

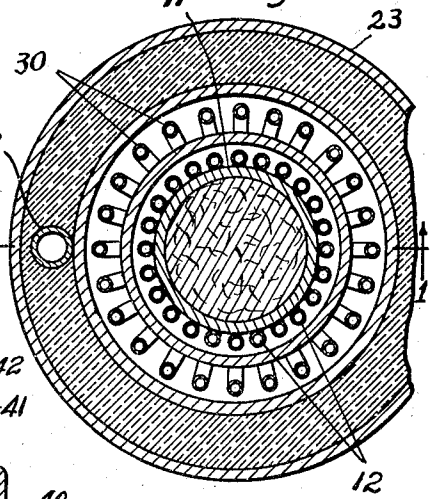

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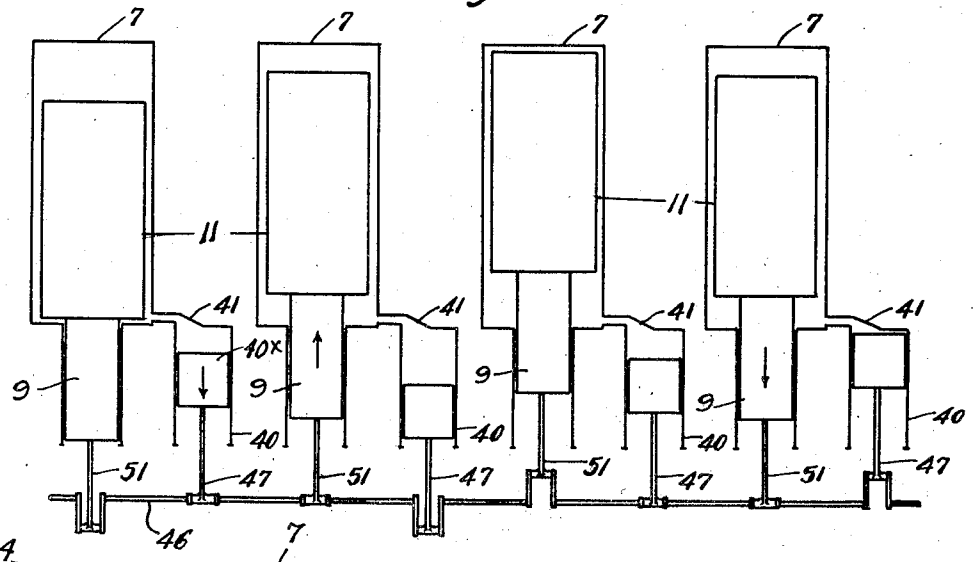
Fig. 3.



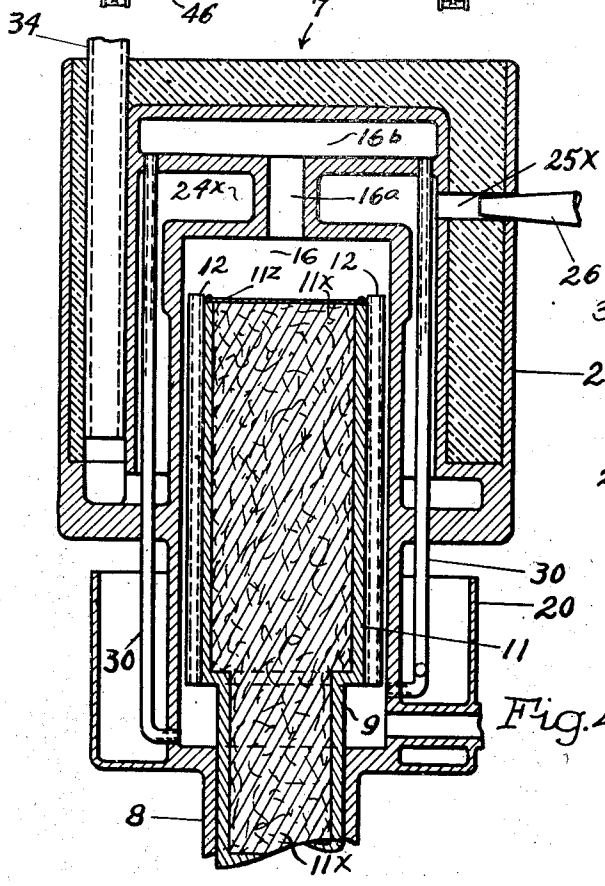
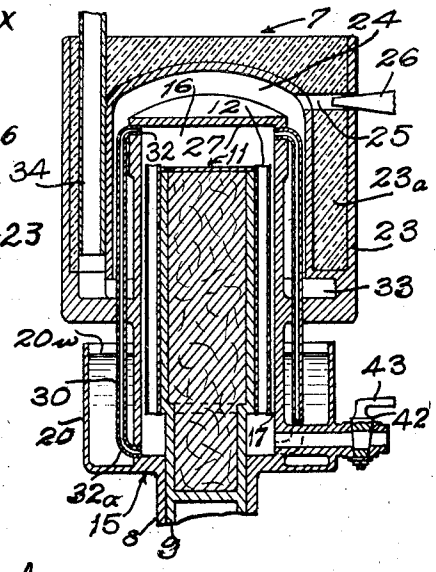


Fig. 4.

Fig. 5.



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Patented Jan. 24, 1933 1,895,082

UNITED STATES PATENT OFFICE

BRUNO MONTERO, OF LOS ANGELES, CALIFORNIA

ENGINE

Application filed October 14, 1931. Serial No. 568,755.

This invention relates to a hot air engine.

An object of the invention is to provide improved means to alternately heat and cool the air whereby the pistons of the engine are driven.

More specifically it is an object of the invention to provide an improved collection of heat radiating elements which heat the air in one portion of an elongated piston chamber and to combine with these heating elements an improved set of refrigerating or cooling elements which cool the air within the remaining portion of a piston chamber.

A further object of the invention is to provide a plurality of primary piston chambers wherein the heating and cooling operations above referred to are carried out, each of said primary piston chambers having combined with it a secondary piston chamber which is in constant communication therewith, and the piston of which is combined with the crank shaft in such a manner that the period of effective power generation produced by the expanding air in each set of piston chambers is lengthened.

Another object of the invention is to provide an improved heating radiating construction for a piston chamber of a hot air engine whereby a large piston chamber may be furnished without so great an expense as has heretofore been necessary.

Other objects, advantages and features of the invention may hereinafter appear.

Referring to the accompanying drawings which illustrate what is at present deemed to be a preferred embodiment of the invention.

Fig. 1 is a vertical mid-section of one of the primary piston chambers and its related parts, the view including also one of the secondary piston chambers, with which it cooperates. The primary piston chamber is sectioned on line 1—1 of Fig. 2.

Fig. 2 is a transverse section on line 2—2 of Fig. 1.

Fig. 3 shows in a diagrammatic manner a series of sets of piston chambers arranged according to the principles of the invention each primary piston chamber being shown associated with a secondary piston chamber which cooperates therewith.

Fig. 4 is a fragmental sectional view showing a modified form of the invention.

Fig. 5 is a longitudinal sectional view of Fig. 1, similar to Fig. 4.

Referring in detail to the drawings, the primary piston cylinder 7 comprises the piston cylinder proper 8 which contains a piston shank 9, said shank being extended upwardly and having its upper portion diametrically enlarged to form a hollow cylindrical member 11 which has its periphery covered with a series of longitudinally extending open-ended heat radiating tubes 12.

The piston cylinder proper 8 has a diametrically enlarged upwardly extending portion 15, the upper part of which forms the combustion or heating chamber 16 while the lower part thereof forms the cooling chamber 16x. Said chambers 16 and 16x are of greater diameter than the external diameter of the combined drum and heat radiating tubes 12 so that an annular clearance 17 remains around said heat radiating tubes.

Around about the lower third of the enlarged cylinder portion 15 is placed a cooling jacket or water tank 20 within which cold water is circulated. Around about the upper two-thirds of the cylinder portion 15 is placed a heating jacket 23, said heating jacket being provided with a combustion chamber 24 above the upper end of the cylinder 15, said combustion chamber having an intake passage 25 into which is projected a heating flame from a burner nozzle 26. It is to be understood that the heated chamber 16 is enclosed on all sides, a top closure wall 27 intervening between the combustion chamber 24 and the air chamber 16.

In order to accelerate the alternate heating and cooling of the air contained within the chamber 16, a series of circularly arranged fluctuation or surge pipes 30 are arranged, the upper portions of said pipes being surrounded by the heating jacket 23 and their lower portions being surrounded by the cooling jacket 20. Each fluctuation or surge pipe 30 is provided with an inwardly directed upper end portion 32 which communicates with

the upper portion of the chamber 16, and with an inwardly directed lower end portion 32*a* which communicates with the lower portion of said chamber 16.

The heating chamber 24 within the jacket 23, has near its lower end, a circular recess 33 and at one side of the jacket a discharge flue 34 conducting products of combustion from the heating jacket. The heating jacket 23 is provided with a filling 23*a* of fire-clay or like refractory material.

The secondary piston cylinder 40 of each pair or set of piston cylinders has within it a piston 40*x* and has its upper end connected by means of a pipe 41 with the lower portion of the air chamber 16, a valve 42 having an operating arm 43 being shown on pipe 41 to throttle or cut off the circulation of air through said pipe when it is desired to retard the speed of the engine or to stop its operation.

The primary piston cylinder 8 is provided with a piston having a head 45 which is connected to the crank shaft 46 by means of the piston rod 51 and pin 52. The piston rods 47 and 51 are shown connected with the crank shaft 46 at an angle of approximately 90° with relation to each other. This arrangement of the piston rods 47 and 51 which comprises each set of cooperating pistons is provided in order that the effective expansive force of the air in the chamber 16 during each period of expanse may be more fully utilized in the generation of power, as will hereinafter be more fully explained.

Referring to certain details of construction, the crank shaft 46 preferably extends through a crank case 55 having the floor portion 56 upwardly from which extends a plurality of webs 57 which support the bearing sleeves 58 for the crank shaft 46. The piston cylinders 8 and 40 are preferably provided with external flanges 60 and these flanges rest upon the top wall 61 of the crank case, openings being provided in said wall 61 into which the lower end portions of the piston cylinders 8 and 40 are fitted.

The crank case 55 is of a nearly air-tight character, means being provided to maintain within said crank case during the operation of the engine, considerable air pressure preferably about ten atmospheres. For this purpose a pump 6*a* may be mounted upon or adjacent to the crank case, said pump being shown in Fig. 1 as operated by the eccentric 6*b* which is secured to the shank 46, a rod 6*c* forming an operating connection between said pump and said cam.

In Fig. 4 is shown a modified construction for a primary piston cylinder 7. In said view the chamber 16 communicates by means of a passage 16*a* with an auxiliary air chamber 16*b* which forms the upper portion of the chamber of the piston cylinder. Said chamber 16*b* is of a sufficiently great diameter to be vertically above the body portion of each of the surge pipes 30 so that said pipes may be straight throughout their upper portions and yet may be connected with said chamber 16*b*. This construction avoids the necessity of providing each surge pipe with a deflected or bent upper end portion.

In this modification the heating chamber 24 of Fig. 1 is replaced by an annular heating chamber 24*x* which surrounds the passage 16*a* and through which the upper portions of the surge pipes 30 extend. The burner passage 25*x* communicates with said chamber 24*x*. The other parts shown in Fig. 4 are constructed in the same manner as shown in Fig. 1 and will aid in understanding the latter view. The cylindrical member 11, which is of greater diameter than the piston shank 9, is filled with mineral wool 11*x* the filling thereof also extending down to the piston shank 9. A closure plate 11*z* is shown secured to the upper end of the cylindrical member 11 to keep the mineral wool in place. By using mineral wool or like material which is non-conductive of heat, the heat is prevented from being transferred to any considerable extent from the heating jacket 23 to the cooling jacket 20.

In the operation of the engine, while the primary piston is moving downwardly, the air in the upper portion of the chamber 16 is expanded isothermically, heat being conveyed to the air from the heat radiating elements within the heating jacket 23. Work done by the portion of the air within the heat radiating pipes 12 causes such air to give up its specific heat as the piston moves up and to recover its heat as the piston moves down. When the piston moves up the air in the lower portion of the chamber 16 is contracted isothermically, work being done on the air by cooling it. Within the piston cylinder 40 the air expands adiabatically, doing work and loosing heat.

While the primary piston is completing its downward movement and beginning its upward movement, the secondary piston 40*x* travels downwardly through the greater part of its movement thereby lengthening the period of effective power generation produced by the expanding air within the chamber 16.

The multiplicity of open-ended heat conducting tubes 12 which surround the extension 11 contributes to the quick change of temperature in the air thus producing a very efficient engine of the class to which the invention pertains. Said tubes perform this function by absorbing the heat from the air as it descends through them, and then returning to the air this heat as the air is forced upwardly from the cooling area.

I claim:

1. In an engine of the kind described, a piston cylinder having a diametrically enlarged end portion which forms an air cham-

ber, a piston member having a shank portion which has a working fit within the part of said piston cylinder which is not enlarged, said piston having an extension occupying said chamber, said extension being provided with temperature radiating elements, the end portion of said chamber which is farthest from said piston being provided with a contracted neck portion, and a jacket provided with a heating chamber which surrounds said contracted neck portion.

2. In an engine of the kind described, a piston cylinder having a diametrically enlarged end portion which forms an air chamber, a piston member having a shank portion which has a working fit within the part of said piston cylinder which is not enlarged, said piston having an extension occupying said chamber, said extension being provided with temperature radiating elements, the end portion of said chamber which is farthest from said piston being provided with a contracted neck portion, there being beyond said end portion of said chamber an air chamber which communicates with the body portion of the piston chamber through said contracted neck portion, and a jacket provided with a heating chamber which surrounds said contracted neck portion and supplies heat thereto and also heats said air chamber at one end of said neck portion and the part of said piston chamber adjacent to the other end of said neck portion.

In testimony whereof, I hereunto affix my signature.

BRUNO MONTERO.