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J. KOENIG

HOT AIR ENGINE

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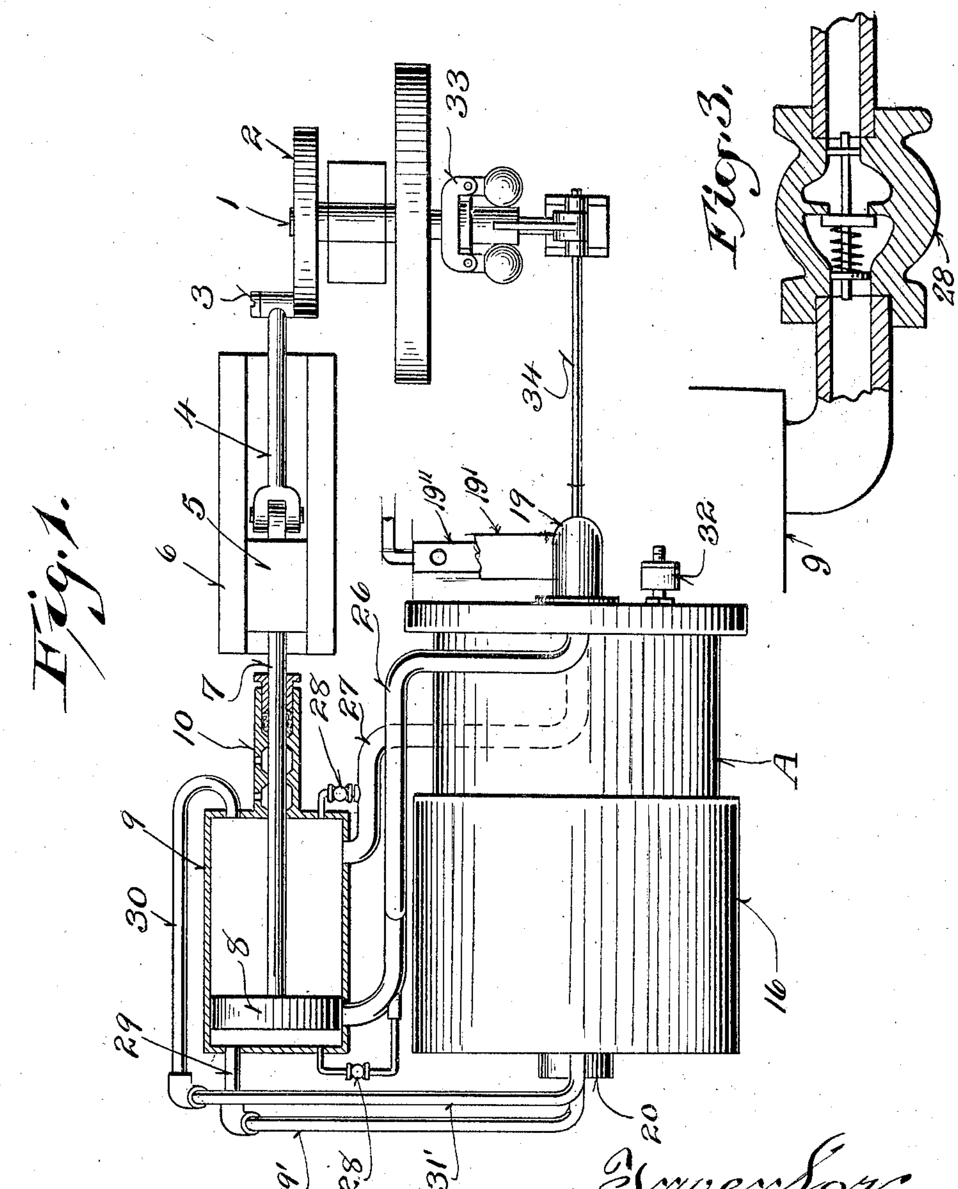

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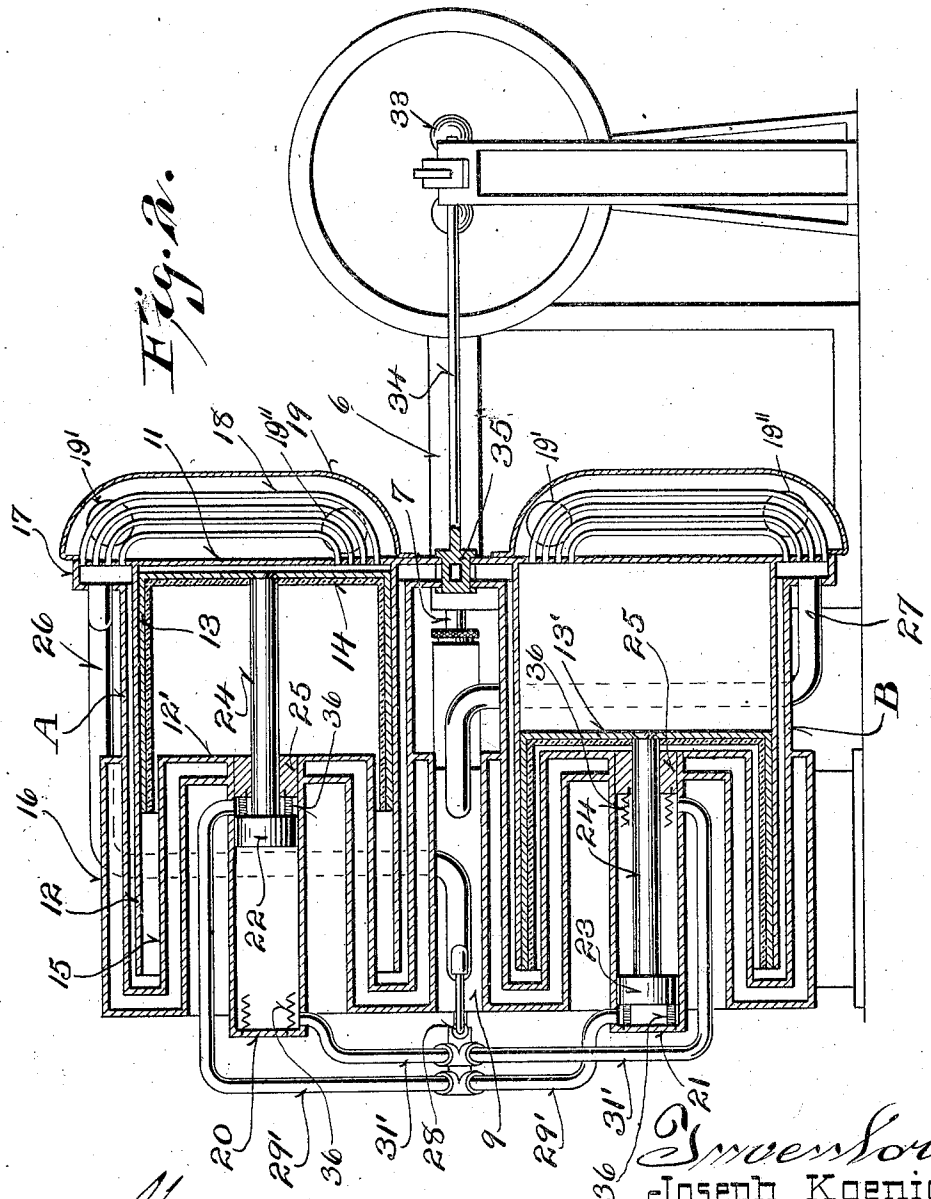
Fig. 2.



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UNITED STATES PATENT OFFICE.

JOSEPH KOENIG, OF MANITOWOC, WISCONSIN.

HOT-AIR ENGINE.

Application filed May 8, 1925. Serial No. 28,839.

This invention relates to hot air engines.

This invention is an improvement over my copending application Serial No. 22,682, filed April 13, 1925, for hot air engines, and has the same general objects as those disclosed in such application.

In a hot air engine in which air treating cylinders are employed, it is necessary to move the pistons in such cylinders to displace the air in accordance with the position of the working piston.

Objects of this invention are to provide means for moving the air displacing pistons in a simple and effective manner without requiring stuffing boxes for the air treating cylinders and without requiring any form of cam or crank mechanism for moving the air treating pistons.

Further objects are to provide a hot air engine in which the air treating pistons are moved by pneumatic pressure automatically generated by the operation of the working piston, and in which means are provided to insure the dwell of the pistons in the air treating cylinders at each end of their stroke.

An embodiment of the invention is shown in the accompanying drawings, in which:—

Figure 1 is a plan view of the engine with the working cylinder in section.

Figure 2 is a vertical sectional view through the air treating cylinders.

Figure 3 is an enlarged fragmentary sectional view showing one of the valves at one end of the working cylinder.

Referring in detail to the drawings, it will be seen that the engine is provided with a driving shaft 1 having a crank plate 2 thereon provided with a crank pin 3. This crank pin is connected by means of a pitman 4 with a cross head 5 carried in any suitable guide 6. The crosshead is connected by means of the piston rod 7 with the working piston 8 operating in the working cylinder 9.

It is to be noted that the working cylinder is provided with a stuffing box 10 adapted to receive packing and oil under pressure in the usual manner.

A pair of air treating cylinders A and B are provided and are mounted one above the other with the working cylinder substantially centrally positioned with reference to these air treating cylinders. The air treating cylinders are of identical construction and one only need, therefore, be described. For instance, the uppermost cylinder A.

The cylinder is provided with an outer head 11 and with an inner head 12′. It is further provided with an inwardly extending sleeve 12 which projects rearwardly from the head 11, as shown in Figure 2. A piston 13 slides within the sleeve 12 and is preferably provided with a heat insulating line 14 on its inner side, as disclosed in my above noted application. The cylinder is further provided with a rear shell 15 which extends forwardly and is positioned within the hollow piston 13 and spaced therefrom, as shown. The rear end of the air treating cylinders are water jacketed, as indicated at 16, so that such rear ends remain constantly cool. The forward ends of these air treating cylinders are provided with an annular chamber 17 which completely surrounds them and which receives the main air pipes from the working cylinder hereinafter described in greater detail.

The annular chamber 17 is in communication with the front end of the cylinder by means of a plurality of heated pipes 18. Preferably, these pipes extend from one portion of the annular member 17 and open through the head 11 into the cylinder at a diametrically opposed point. These pipes 18 may be heated in any suitable manner and, if desired, an enclosing hood 19 may be provided. For example, a burner 19″ may open into the casing 19 at the lower end, and a vent pipe 19′ may lead from the casing at the upper end.

The air treating cylinders A and B are provided with smaller cylinders 20 and 21, respectively, within which pistons 22 and 23 are adapted to work. The pistons 22 and 23 are connected with the pistons 13 and 13′, respectively, by means of piston rods 24, such piston rods passing through blocks 25 carried within the rear cylinder heads 12′.

It is to be noted from reference to Figure 1 that opposite ends of the work cylinder 9 are connected to the annular members 17 of the cylinders A and B by means of pipes 26 and 27. These pipes open into the working cylinder 9 at points spaced a slight distance from the ends of the cylinder and the openings from the pipes are adapted

to be closed off by the piston 8, as shown in Figure 1, as the piston nears the end of its stroke.

It is to be noted from Figure 1 that the extreme ends of the cylinder 9 are connected through valves 28 with the pipes 27 and 26. These valves are adapted to open inwardly towards the piston under certain conditions of operation, as will be described later.

It is to be noted further from reference to Figures 1 and 2, that a pipe 29 leads from the rear end of the working cylinder 9 and from reference to Figure 2 it will be seen that this pipe 29 has two branches 29′ which extend to the forward end of the cylinder 20 and to the rear end of the cylinder 21. Similarly, the forward end of the working cylinder 9 has a pipe 30 which is also provided with two branches 31′ extending to the rear end of the cylinder 20 and the forward end of the cylinder 21.

The air treating cylinders A and B are each provided with an inwardly opening valve 32, one of which appears in Figure 1, so that both sides of the system may be placed under initial compression.

Upon reference to Figure 1, it will be seen that the driving shaft 1 is provided with any suitable type of governor 33 which rocks the control shaft 34. This control shaft 34, as shown in Figure 2, is provided with a valve 35 which controls communication between the cylinders A and B establishing communication when the speed of the engine exceeds a predetermined value and normally shutting off communication between the cylinders.

The operation of the apparatus is as follows:—Assuming that the working piston 8 is approaching the rear end of its stroke, it has previously discharged air through the pipe 26 into the annular member 17 of the cylinder A and this air passes between the wall of the cylinder A and the sleeve 12, and thus is brought into intimate contact with the chilling end of the cylinder, such air discharging behind the piston 13. The air is contracted and thus the volume is reduced and accommodated in this portion of the system. Further motion of the piston 8 towards its rear end closes the opening from the pipe 26 and compresses the air behind it. This forces compressed air through the pipe 29 and through branches 29′. Such compressed air acts upon the forward side of the piston 22 and the rear side of the piston 23, thus forcing the piston 22 and the piston 13 rearwardly, and forcing the piston 13′ and the piston 23 forwardly.

Consider the air treating cylinder A. The rearward motion of the piston 13 forces the air between the sleeve 12 and the cylinder wall and into the annular chamber 17. The air passes through the heated pipes 18 and is expanded and discharged in front of the piston 13. However, this air is under pressure and is transmitted through the pipe 26 behind the forwardly moving piston 8, thus producing a working stroke of such last mentioned piston. When the piston 8 nears the other end of its stroke the reverse action takes place, as will be apparent from the previous description.

It is to be noted that during the time that the piston 8 is traveling forwardly and has closed off communication with either of the pipes 26 or 27 that suction will not be created back of the piston 8 as the appropriate valve 28 will open and relieve this condition. Thus the pistons 22 and 23 are not moved when the piston 8 starts from its extreme position.

It will be seen that a hot air engine has been provided which does not employ sliding valves or any movable type of valves for controlling the flow of air from the working cylinder to the air treating cylinders. Further, it will be noted that no link, cam or crank mechanism is employed for moving the pistons 13 and 13′, and that no stuffing boxes are employed for these piston rods. They are contained wholly within the cylinders and do not project outwardly therefrom. Further, due to the action of the auxiliary or small cylinders 20 and 21, reverse action of the pistons 13 and 13′ is insured.

Preferably springs 36 are positioned at opposite ends of the small cylinders 20 and 21 to cushion the shock of the pistons when they arrive at the limit of their stroke.

Although the invention has been described in considerable detail, it is to be understood that the invention may be variously embodied and is, therefore, to be limited only as claimed.

I claim:

1. A hot air engine comprising a working cylinder, a piston mounted therein, a pair of cylinders connected with opposite ends of said working cylinder, each of said pair of cylinders having air circulating pistons therein provided with piston rods and having heating and cooling means at opposite ends thereof, a pair of auxiliary cylinders into which said piston rods project, pistons fitting said auxiliary cylinders and carried by said piston rods, said auxiliary cylinders having their ends connected with the ends of said working cylinder.

2. A hot air engine comprising a working cylinder, a piston mounted therein, a pair of cylinders connected with opposite ends of said working cylinder, each of said pair of cylinders having air circulating pistons therein provided with piston rods and having heating and cooling means at opposite ends thereof, a pair of auxiliary cylinders into which said piston rods project, pistons fitting said auxiliary cylinders and carried

by said piston rods the ends of one auxiliary cylinder being connected to the reverse ends of the other auxiliary cylinder by means of pipes, and pipes leading from said first mentioned pipes to opposite ends of said working cylinder.

3. A hot air engine comprising a working cylinder, a piston mounted therein, a pair of air conditioning cylinders having at one end external heated means through which the air is adapted to pass, said pair of cylinders having the other ends cooled, pistons within said pair of cylinders and controlling the flow of air through said heating means, means connecting opposite ends of said working cylinder with said pair of cylinders, pneumatic means controlled by the piston of said working cylinder and causing simultaneous reverse motion of the pistons in said air conditioning cylinders, and mean for permitting the introduction of air under pressure to the air conditioning cylinders.

4. A hot air engine comprising a pair of air cylinders each having closed ends, a sleeve carried by one end and projecting into the cylinder and spaced from the walls thereof, an annular chamber surrounding such end of the cylinder and communicating with the space between said sleeve and the cylinder walls, a plurality of heated pipes extending from the annular chamber and opening through the head of the cylinder, a piston mounted within each cylinder and fitting within said sleeve, cooling means for each cylinder remote from the heating pipes, a working cylinder having opposite ends connected with the annular chambers of said pair of cylinders, a working piston within said working cylinder, and auxiliary cylinders associated with said air cylinders and having pistons connected with the pistons of said air cylinders, the ends of one auxiliary cylinder being connected to the reverse ends of the other auxiliary cylinder by means of pipes, and other pipes leading from the first mentioned pipes, to opposite ends of said working cylinder.

5. A hot air engine comprising a working cylinder, a piston mounted therein, a pair of cylinders connected with opposite ends of said working cylinder, each of said pair of cylinders having air circulating pistons therein provided with piston rods and having heating and cooling means at opposite ends thereof, a pair of auxiliary cylinders into which said piston rods project, pistons fitting said auxiliary cylinders and carried by said piston rods, said auxiliary cylinders having their ends connected with the ends of said working cylinder, and means for insuring a dwell at each end of the stroke of said air circulating system.

6. A hot air engine comprising a working cylinder, a piston mounted therein, a pair of cylinders connected with opposite ends of said working cylinder, each of said pair of cylinders having air circulating pistons therein provided with piston rods and having heating and cooling means at opposite ends thereof, a pair of auxiliary cylinders into which said piston rods project, pistons fitting said auxiliary cylinders and carried by said piston rods, the ends of one auxiliary cylinder being connected to the reverse ends of the other auxiliary cylinder by means of pipes, pipes leading from said first mentioned pipes to opposite ends of said working cylinder, and means carried by the auxiliary cylinders for cushioning said pistons at the end of their stroke.

In testimony that I claim the foregoing I have hereunto set my hand at Manitowoc, in the county of Manitowoc and State of Wisconsin.

JOSEPH KOENIG.