Feb. 22, 1927. 1,618,594

J. KOENIG

HOT AIR MOTOR

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Fig. 1.

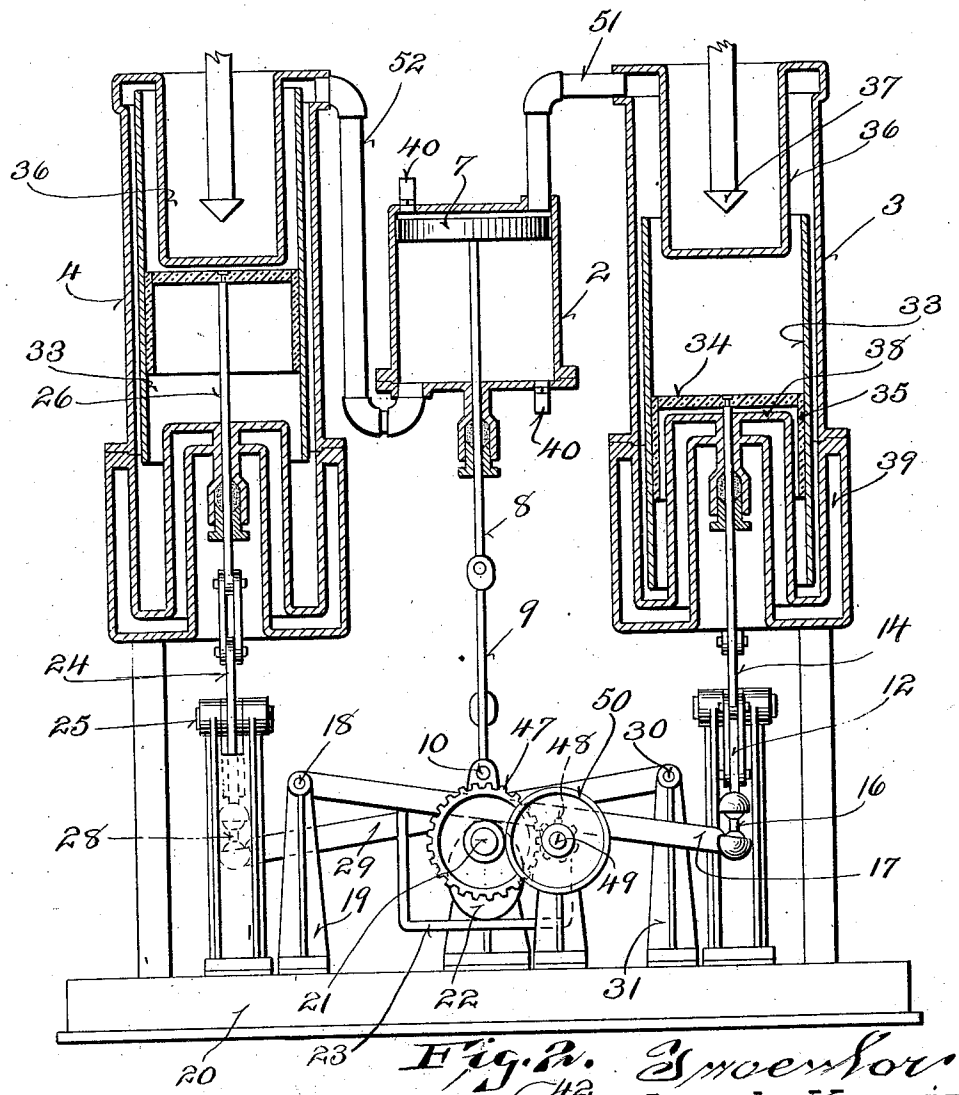

Fig. 2.

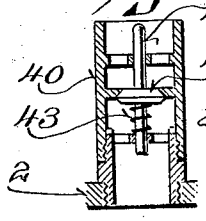

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Fig. 3.

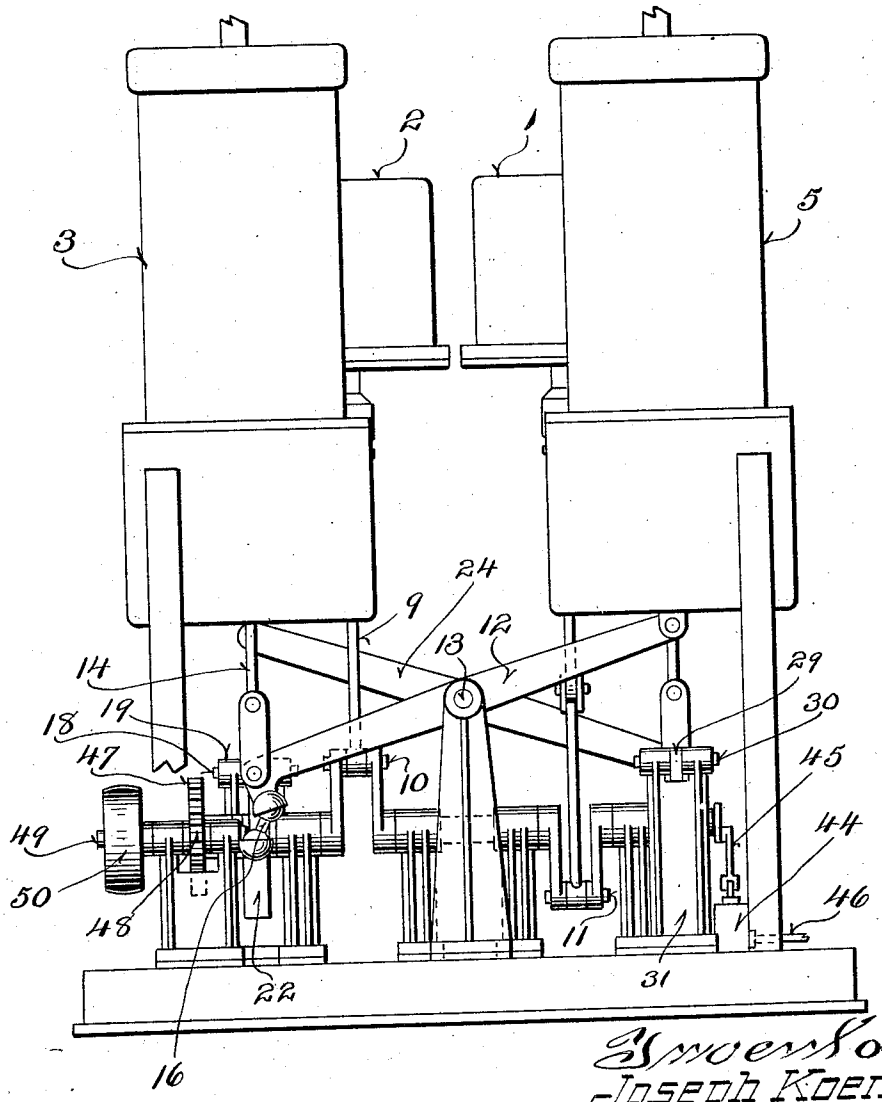

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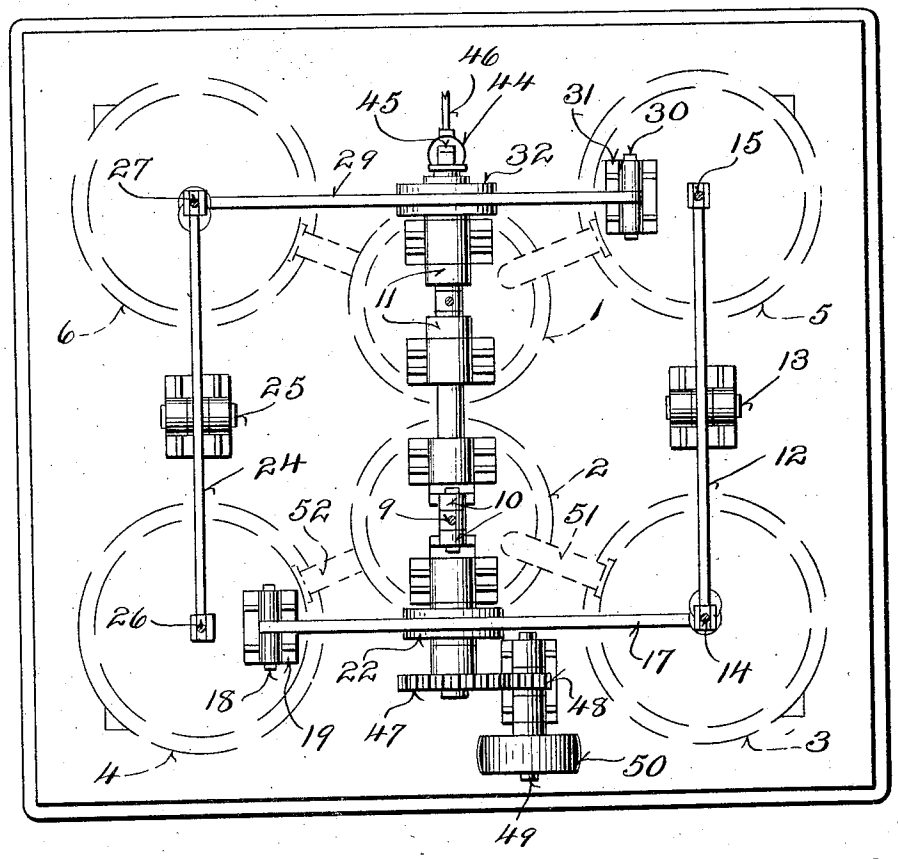
Fig. 4.



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Patented Feb. 22, 1927. 1,618,594

UNITED STATES PATENT OFFICE.

JOSEPH KOENIG, OF MANITOWOC, WISCONSIN.

HOT-AIR MOTOR.

Application filed December 1, 1925. Serial No. 72,506.

This invention relates to hot air motors.

Objects of this invention are to provide a hot air motor which is adapted to deliver a relatively large amount of power for its size, as compared with the usual hot air motor, and which may be made of any desired capacity.

Further objects are to provide a hot air motor which has a high degree of efficiency and which provides for quick interchanges of heat, and which is automatic in its action and devoid of valves which control the flow of the air to and from the working cylinder and the air conditioning or treating cylinders.

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

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

Figure 1 is a vertical sectional view showing one of the working cylinders and the associated air treating cylinders.

Figure 2 is an enlarged detail in section showing one of the check valves at the ends of the working cylinder.

Figure 3 is a side elevation of the motor.

Figure 4 is a plan view of the operating levers for the several cylinders, such view being taken with the cylinders removed to more clearly show this operating mechanism.

Referring to the drawings, it will be seen that the device comprises a series of units, two units being shown in this case, each comprising a working cylinder and a pair of associated air conditioning cylinders.

Referring, for instance, to Figure 3, it will be seen that the working cylinders are indicated by the reference characters 1 and 2 and, upon reference to Figures 1 and 4, it will be seen that the working cylinder 1, has associated therewith the air conditioning cylinders 5 and 6, and that the working cylinder 2 has associated therewith the air conditioning cylinders 3 and 4. The working cylinders 1 and 2 are of identical construction as are the air conditioning cylinders 3, 4, 5 and 6. Thus, for instance, the working cylinder 2, is shown in section in Figure 2. It is provided with a piston 7 and piston rod 8 which is connected by means of a connecting rod 9 with the crank 10. The cylinder 1 is similarly connected to the crank 11, as shown in Figure 3.

The air conditioning cylinders 3 and 5 have a walking beam or lever 12 located beneath them and pivoted, as indicated at 13. The lever 12 has its opposite ends connected by means of links to the piston rods 14 and 15 of the cylinders 3 and 5, as shown most clearly in Figure 4.

One end of the lever 12, for instance, its forward end is connected by means of a short link 16 with a transverse lever 17, as shown most clearly in Figure 1. This lever 17 is pivoted, as indicated at 18, to a standard 19 mounted on the base 20 of the motor and on the opposite side of the main or crank shaft 21 from the cylinders 3 and 5.

It is to be noted that the short link 16 has ball and socket joints at its end to permit the different angular movements of the levers 12 and 17.

The lever 17 is operated by means of a cam 22 carried upon the crank shaft 21, and preferably such lever is provided with a strap-like frame 23 enclosing the cam, as most clearly shown in Figure 1.

A second walking beam or lever 24 is pivoted intermediate its ends, as indicated at 25, and is joined by means of links to the piston rods 26 and 27 of the cylinders 4 and 6, as shown most clearly in Figure 4. This lever has its rear end connected by means of a short link 28 (see Figure 1) with a transverse lever 29 corresponding to the lever 17. This lever 29 is pivoted, as indicated at 30, to an upright standard 31 mounted upon the opposite side of the crank shaft from the standard 19. Similarly, the link 28 is equipped with ball and socket joints at its ends, as described, for the link 16. The link 17 is similarly equipped with a strap-like frame work which is hidden in Figure 1, and which encloses the cam 32 corresponding to the cam 22, previously described, see Figure 4.

It is to be noted from reference to Figure 3, that the cranks 10 and 11 are set opposite each other and from reference to Figures 3 and 4, it will be seen that the pistons in the air conditioning cylinders 3 and 5 work in opposite directions as do the pistons in the cylinders 4 and 6.

Each of the air conditioning cylinders comprises a piston which is of similar construction. These pistons are provided with sleeves 33 and with a transverse heat insulating member 34. This heat insulating member continues downwardly, as indicated

at 35 in Figure 1, towards the cool end of the cylinder. The transverse member 34 is connected to the piston rod, as shown, and cylindrical portions 33 are adapted to slide from one end of the cylinder to the other.

It is to be noted that the air conditioning cylinders are each provided with a downwardly extending shell 36 which is heated by means of a burner or other suitable member 37. The lower end of the air conditioning cylinder is provided with an upwardly extending shell 38 and this lower end, together with the shell 38, is water jacketed, as indicated at 39, so as to maintain such end in a cool condition.

The working cylinders 1 and 2 are each provided with check valves 40 at opposite ends so as to admit air in case the air pressure drops below atmospheric. Any suitable check valve may be employed. For instance, as shown in Figure 2, a valve disk 41 is carried by a guiding stem 42 and is urged by means of a spring 43 into closed position. This valve, however, is adapted to open inwardly towards the working cylinder and admit air in case the pressure drops below atmospheric at any time in the cycle.

Further, it may be found desirable, under certain conditions, to start the engine with all of the air system under initial compression. This is readily secured by supplying compressed air gas and vapor through the check valves 40. This air may be supplied in any desirable manner, for instance, as shown in Figure 3, a small air compressor 44 may be provided as a permanent equipment of the motor, and may be operated by means of a crank 45 on the main shaft 21. Its delivery pipe 46 may be connected in any suitable manner as by means of a hose, for instance, with the check valve 40 whenever it is desired, or else a permanent pipe may be employed. However, it is not thought necessary to show this piping as it is thought such showing would be confusing, as the sole purpose of the additional compressed air is to renew any loss of air in any portion of the system as needed, and also to supply air at a higher pressure than atmospheric at any portion of the system when it is desired to operate the engine under this condition.

The main shaft 21 is provided with a gear wheel 47 (see Figure 1) which meshes with a small pinion 48 carried by a jack shaft 49. This jack shaft also carries a driving pulley 50 or other suitable power transmitting means, whereby power may be taken off from the engine.

In describing the operation of this engine, it is to be noted that the pairs of air conditioning cylinders associated with the working cylinders, are connected to opposite ends of the corresponding working cylinders.

For example, as shown in detail in Figure 1, the air conditioning cylinder 3 is connected adjacent its heated end by means of a pipe 51 with the upper end of the working cylinder 2, and the air conditioning cylinder 4 is connected adjacent its heated upper end with the lower end of the working cylinder 2 by means of a pipe 52.

The cycle of operation for each set of units is identically the same and it is thought that a detailed description of the mode of operation for the cylinders 2, 3 and 4 will be sufficient.

Assuming the engine is running and the parts occupy the position shown in Figure 1, the piston 7 is about to descend and it is noted that the piston of the cylinder 3 has already moved downwardly towards the cool end, thus forcing the air around the heated jacket 36, and heated end of the cylinder. This air, as it is heated, expands and drives the piston 7 of the working cylinder, downwardly.

Further, it is noted, that in the position shown in Figure 1, the piston for the cylinder 4, has moved upwardly prior to the downward stroke of the working piston. This position causes the incoming air delivered through the pipe 52 from the lower end of the working cylinder to pass between the walls of the cylinder 4 and the sleeve 33 of its piston and to the cool end of the cylinder. Here the air is chilled and contracted as the working piston moves downwardly, thus causing a decrease in volume of air below the working piston.

The cams are so arranged that prior to the upward stroke of the working piston 7, the pistons in the cylinders 3 and 4 are moved to their other extreme positions from that shown in Figure 1. Thus, the incoming air discharges from the upper end of the working cylinder on the upstroke of the piston 7, passes through the pipe 51 and between the sleeve 33 and the walls of the cylinder 3 and into the cool end of the cylinder. Thus, the air is chilled and contracted and thus the total volume above the working piston 7 is lessened permitting the rising of such working piston. Further, the stroke of the piston in the cylinder 4 displaces the air and causes it to circulate about the heated shell 36 and the heated end of the cylinder 4, thus expanding the air. This expanding air is presented to the underside of the piston 7 by means of the pipe 52 and thus forces the piston 7 upwardly. Identically the same action takes place for the cylinders 1, 5 and 6.

It will be seen, therefore, that a hot air motor has been provided in which continuous rotation of the crank shaft may be secured without the operation of valves or other elaborate mechanism and in a wholly automatic manner as long as heat is supplied

by means of the burners, the air being alternately chilled and heated by the air conditioning cylinders, and thus causing reciprocation of the work pistons.

It will be seen further that due to the peculiar lever and link mechanism described that a simple mechanical construction results from this invention, and one which readily lends itself to the production of a serviceable and practical hot air motor.

Although the invention has been described in considerable detail, it is to be understood that the invention may be variously embodied and the scope of the invention is to be determined as claimed.

I claim:

A hot air engine comprising a longitudinally extending main shaft having a pair of cranks thereon, a pair of working cylinders mounted above said main shaft and having pistons therein operatively connected to said cranks, a pair of air conditioning cylinders associated with each working cylinder and located on opposite sides and adjacent the corresponding working cylinder and connected to opposite ends thereof, said air conditioning cylinders each having means for heating one end and means for cooling the other end, air shifting pistons mounted in each of said air conditioning cylinders, a pair of walking beams paralleling the longitudinally extending shaft and located on opposite sides thereof and adjacent said shaft, the opposite ends of each walking beam being connected to the pistons of the air conditioning cylinders on the corresponding side of the shaft, a pair of cams carried adjacent opposite ends of said shaft, and levers operated by said cams and connected to said walking beams for rocking said walking beams to thereby shift the pistons in the air conditioning cylinders.

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

JOSEPH KOENIG.