L. HORST.

CARBONIC ACID MOTOR.

APPLICATION FILED APR. 20, 1909.

961,859. Patented June 21, 1910.

Fig. 1

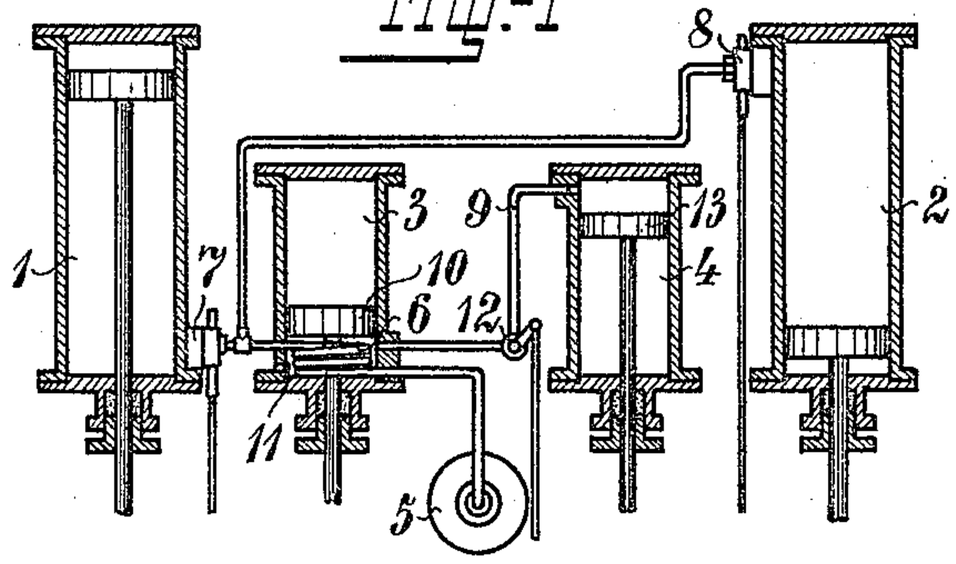


Fig. 2

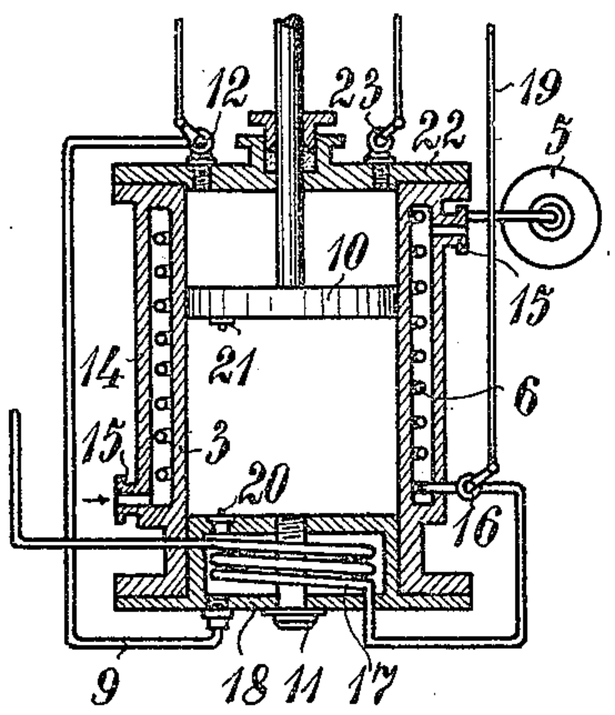


Fig. 3

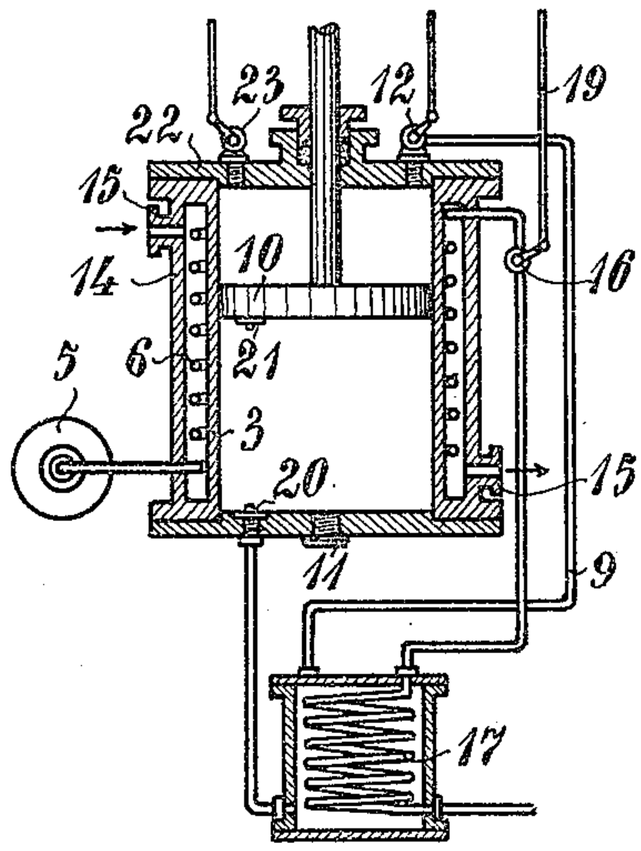
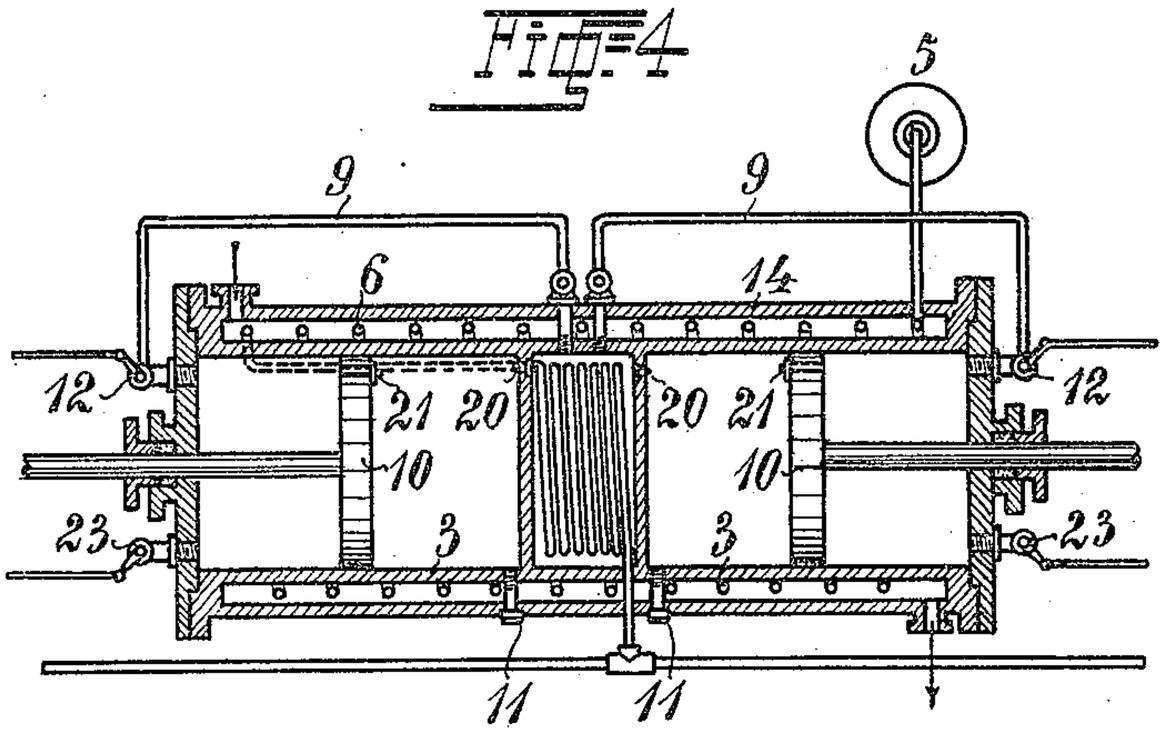


Fig. 4



WITNESSES

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CARBONIC-ACID MOTOR.

961,859. Specification of Letters Patent. Patented June 21, 1910.

Application filed April 20, 1909. Serial No. 491,169.

To all whom it may concern:

Be it known that I, LUDWIG HORST, engineer, a subject of the city and State of Bremen, residing at Altona, in the Kingdom of Prussia, German Empire, have invented new and useful Improvements in Carbonic-Acid Motors, of which the following is a specification.

My invention relates to a carbonic acid motor, in which the carbonic acid, before entering the working cylinder, is superheated and this superheating of the carbonic acid gas is carried to such an extent that the gas, after doing work, has still such a temperature and pressure that there is no danger of the outlets freezing. In motors of this kind, such heating of the carbonic acid by hot water or by an open heating device, before it enters the working cylinder, is known. The drawback of such methods of working consist in the fact that when hot water is used the carbonic acid cannot be sufficiently heated, while the use of a special flame, owing to the danger of fire and explosion, is much restricted. Further, it is known to highly compress atmospheric air in a working cylinder and to introduce carbonic acid into this compressed and highly heated air. That process however has the drawback that the carbonic acid cannot be won again.

The novel feature of the motor forming the subject-matter of the present application consists in the use of very highly compressed air for heating the carbonic acid in such a manner that the heat exchange takes place in a closed superheater, through which the carbonic acid moves in the opposite direction, (that is in counter current) to that of the superheated air. After the heat exchange has taken place the remaining energy of the compressed air is utilized in one or several working cylinders. The advantages of this new method of working are that, notwithstanding the high heat of the compressed air, all danger of fire and explosion is avoided, and that it is very economical, because, after the exchange of heat has taken place, the energy still remaining in the air is utilized in special cylinders, while, further, the carbonic acid can be obtained again in a pure condition.

In the accompanying drawing Figure 1 is a diagrammatic section of a carbonic acid motor adapted to work in accordance with my invention. Figs. 2, 3 and 4 show special constructions of the air compression cylinder, which also work in accordance with the same principle as the motor shown in Fig. 1.

1 and 2 are the working cylinders, in which work is done by the carbonic acid.

3 is the air compressing cylinder and 4 a cylinder, in which the compressed air after being deprived of its heat is utilized for doing work. From the reservoir 5 the gas passes through a coil 6, which is provided in the compression cylinder 3 and heated by the heat contained in the compressed air. From said coil 6 the heated carbonic acid is led through suitable pipes and the valves 7 and 8 or the like to the cylinders 1 and 2.

The air to be compressed is sucked into the cylinder 3 by means of the piston 10 through a suction valve 11 and is compressed by the return stroke of said piston. The bottom part of the cylinder 3, in which the carbonic acid coil 6 is contained, is suitably connected by a pipe 9 with the top part of the working cylinder 4. In the pipe 9 there is provided a cock 12, which is operated from the shaft of the motor by suitable means. In said cylinder 4 is provided a piston 13, whose crank rotates about 180° in advance of that of the piston 10. The cock 12 must be so operated that it is opened shortly before the piston 10 reaches the end of its stroke, so that the compressed air flows into the cylinder 4, whereafter the cock 12 is again closed. After the air has done work in the cylinder 4 it is removed through suitable outlets not shown in Fig. 1. In Figs. 2, 3 and 4 these outlets are shown at 23.

The constructions illustrated in Figs. 2, 3 and 4 differ from that represented in Fig. 1 by the compressed and highly heated air being forced from the air cylinder in a reservoir, in which the heat exchange device is provided, and that the compressed air, after the heat exchange has taken place, is led back to the opposite side of the compression cylinder, in which work is done on the piston contained therein, so that the remaining energy contained in the air is utilized. By this construction of the device space and manufacturing expenses are saved and a better transmission of the heat from the compressed air to the carbonic acid is obtained.

In Figs. 2, 3 and 4, the carbonic acid is led from the reservoir 5 through the pipe 6 to the space between the cylinder 3 and the

mantle 14. In this space the carbonic acid is heated by hot water, which enters through the inlet 15 and flows in the opposite direction to that of the carbonic acid. The latter is then carried through the mechanically controlled valve 16 into the superheated coil 17 proper, which, according to the construction shown in Fig. 2, is provided in the removable end plate 18 in a separate reservoir in the construction shown in Fig. 3, and, according to Fig. 4, in a space provided between two compression cylinders. In these compression cylinders the pistons 10 move in opposite directions. The inlet valve 16 is operated by the motor shaft through the rod 19. In the end plate of the compression cylinder is provided an air suction valve 11. According to the construction shown in Fig. 4 the air suction valves 11 are provided in the cylinder walls. The air sucked in, and then highly compressed, is forced through the valve 20 into the chamber, in which the superheater coil 17 is provided. The disk like piston 10 carries a set screw 21, by which the pressure valve 20 can be opened sooner or later. From the chamber, in which the highly compressed and heated air is forced, said air, after delivering its heat to the carbonic acid, is conducted through a pipe 9 to the end plate 22 of the compression cylinder and through the valve 12 mechanically operated by the motor shaft and enters the cylinder at exactly the moment in which the piston has completed its suction stroke and the compression stroke begins. After doing work on the piston said air is conducted away through the valve 23, which is also operated by the motor shaft.

The operation of the apparatus shown in Figs. 2, 3 and 4 is as follows: By the piston 10 air is drawn in through the inlet valve 11, then highly compressed air is forced through the valve 20 into the chamber, in which the coil 17 is provided. From this chamber the air, after giving off a part of its heat to the carbonic acid passing through the coil 17, is conducted through the pipe 9 and the mechanically controlled valve 12 to the opposite end of the cylinder, in which work is done on the piston 10, whereupon the air escapes through the mechanically controlled valve 23 into the atmosphere. The carbonic acid heated somewhat by the hot water passes through the valve 16 into the coil 17, where it is highly heated and is then conducted through suitable valves into the working cylinders.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A carbonic acid motor, comprising in combination, a carbonic acid gas reservoir, a coil connected with said reservoir, an air compressor to heat said coil to superheat the gas flowing therethrough, said air compressor being provided with an inlet port communicating with the atmosphere, working cylinders adapted to communicate with said coil, and means to utilize the pressure of the air compressed by said compressor after being deprived of its heat, substantially as, and for the purpose, set forth.

2. A carbonic acid motor, comprising in combination, a carbonic acid reservoir, a coil connected with said reservoir, a chamber inclosing said coil, a compressor adapted to force air into said chamber, means to conduct the air forced into said chamber back to the opposite end of the compressor, and working cylinders adapted to communicate with said coil, substantially as, and for the purpose, set forth.

3. A carbonic acid motor, comprising in combination, a carbonic acid reservoir, a compressor, a coil in connection with said reservoir and arranged in the jacket of the cylinder, a chamber in the end plate of said cylinder, a coil in continuation of said first coil arranged in said chamber, means to allow the air compressed by said compressor to pass into said chamber, and means to conduct said air after being deprived of its heat in the coil contained in said chamber and in said second coil to the opposite end of the compressor, substantially as, and for the purpose, set forth.

4. A carbonic acid motor, comprising in combination, a carbonic acid reservoir, two compressors provided in a line, a chamber between said compressors, a coil provided in said chamber and connected with said reservoir, means to conduct the air compressed by said compressor into said chambers, and means to conduct the air entering said chamber to the opposite ends of the compressor substantially as, and for the purpose, set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LUDWIG HORST.

Witnesses:
EMIL HAGER,
THEO OSCKE.