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COMPRESSED AIR APPARATUS FOR OPERATING PNEUMATIC TOOLS.

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1,154,795. Patented Sept. 28, 1915.

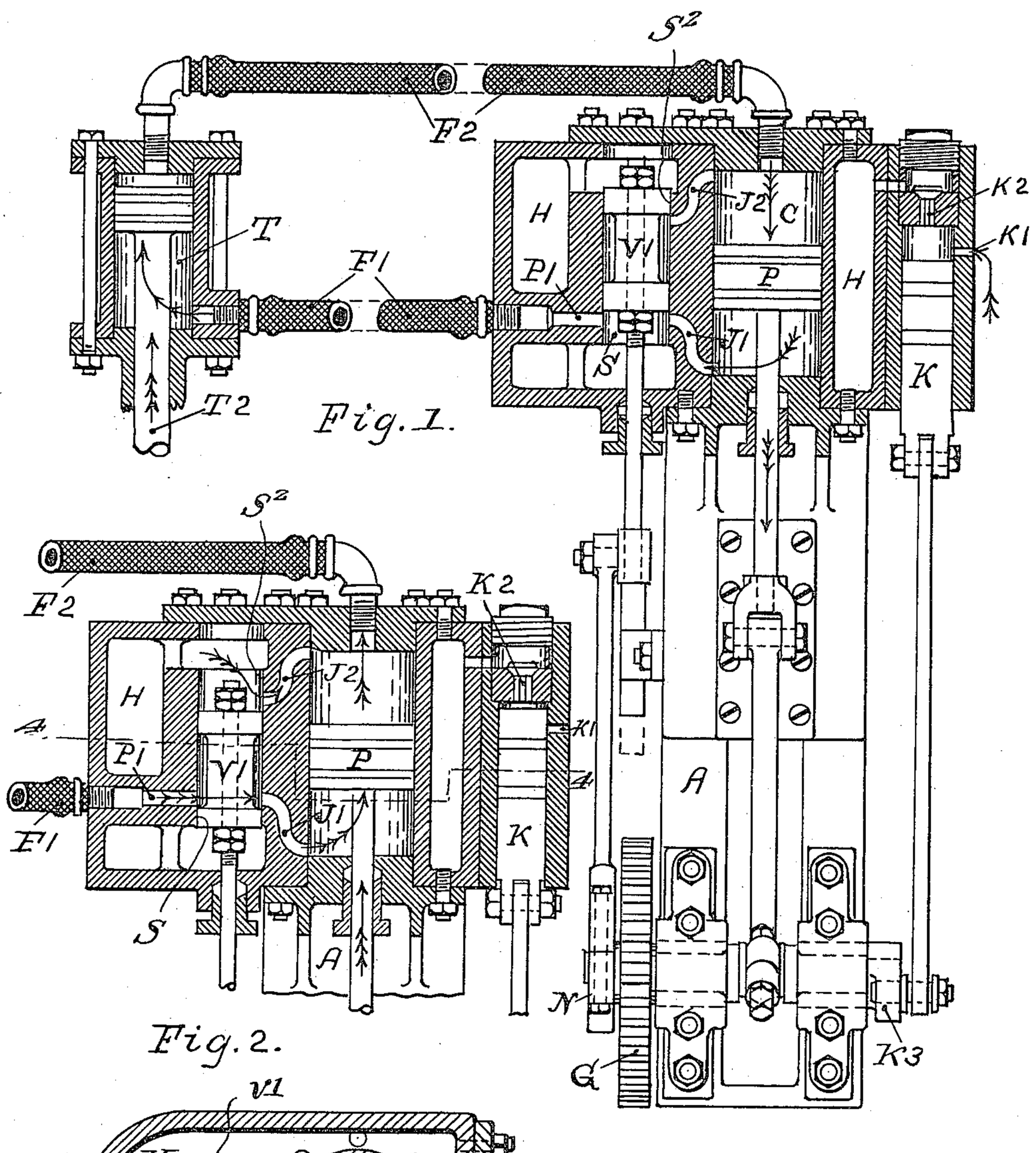

Fig. 1.

Fig. 2.

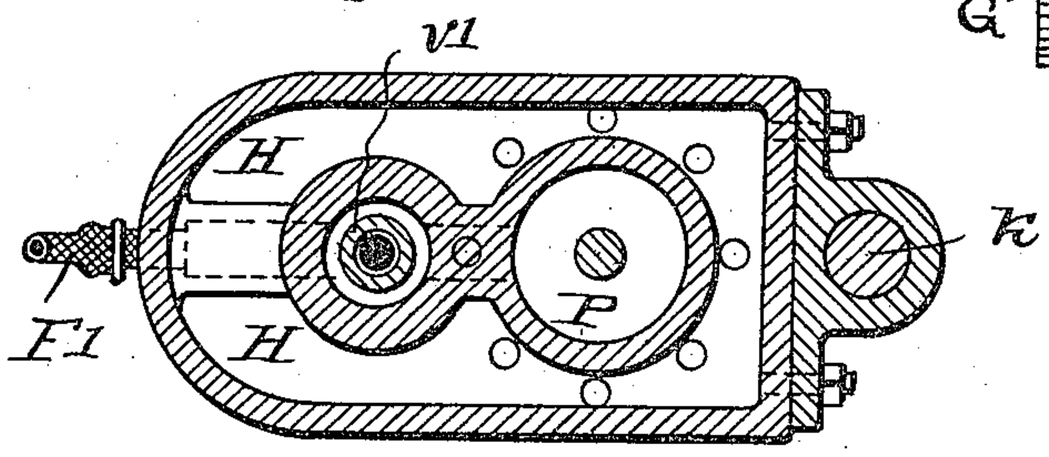

Fig. 4.

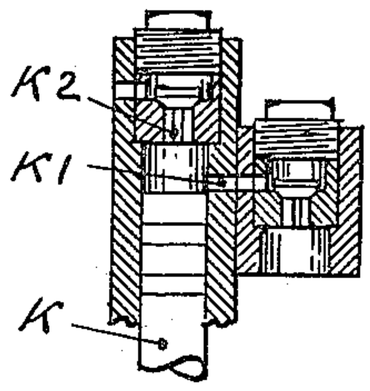

Fig. 3.

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UNITED STATES PATENT OFFICE.

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COMPRESSED-AIR APPARATUS FOR OPERATING PNEUMATIC TOOLS.

1,154,795. Specification of Letters Patent. Patented Sept. 28, 1915.

Original application filed August 21, 1909, Serial No. 514,029. Divided and this application filed April 18, 1914. Serial No. 832,920.

To all whom it may concern:

Be it known that I, CHARLES OTIS PALMER, a citizen of the United States of America, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Compressed-Air Apparatus for Operating Pneumatic Tools; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

My invention relates to closed air apparatus for operating pneumatic tools such as power picks, rock-drills, power hammers, etc., in which the motor is operated by reciprocatory columns of compressed air from the pulsator through pressure connections which connect the ends of the motor and pulsator cylinders. And is a division of my application Ser. No. 514029 filed Aug. 21, 1909 for compressed air apparatus for operating pneumatic tools, and is also a modification of the pulsator shown in my applications Serial No. 369,258 for a compressed air system filed April 20, 1907 and for a compressed air apparatus, Serial No. 393,386, filed Sept. 17, 1907.

Chief among the objects herein sought is to produce a pulsator that will raise the pressure in the motor cylinder especially in the beginning of its stroke and thereby make the motor more effective. The pulsator is operated by an electric motor while the air motor is run from the pulsator.

In the accompanying drawings Figure 1 is a plan view partly in section of the pulsator embodying my invention with the motor connected; Fig. 2 is the same section of the pulsator as Fig. 1 with the piston on the return stroke, Fig. 3 is a section of a valve on a smaller scale that may be used to admit outside air to the auxiliary compressor at the point K1 of Fig. 1 if so desired. Fig. 4 is a section on line 4—4 of Fig. 2.

The same characters denote the same parts throughout the several views. The arrows on the moving parts show the direction of their motion, and the arrows in the air passages the direction of the air, at the time shown and described.

Roughly stated my invention comprises an air (or gas) pulsator cylinder with its piston therein dividing its air space into two compartments, means to reciprocate said piston, an equalizer air chamber, ports connecting it with both ends of said cylinder, an equalizer valve in both of said ports and means to positively operate said valve from a moving part of the pulsator to open said ports alternately and in time with the pulsator piston, an air motor pressure connection opening into the air compartment on the front side of the pulsator piston, an air motor pressure connection opening into the air compartment on the rear side of said piston, one of said motor pressure connections being preferably in an aforesaid connecting port and the other in the end of the pulsator cylinder opposite from that of said port connection. Also in the details of construction of the aforesaid equalizer valve. All of which will be hereafter described and pointed out in the claims.

The pulsator comprises a frame A at one end of which is secured a cylinder C. In the ends of the pulsator cylinder are formed the clearance spaces J1 and J2 which are here considered as part of the cylinder. For the purposes of this description the confined air in the pulsator cylinder and its connections is divided into two compartments by the pulsator piston P. An equalizer chamber H is connected to both ends of the cylinder by the ports S and S2 that are controlled by the positively driven valve V1. The motor cylinder T is connected with the rear compartment through the tube F2 and with the front compartment through the tube F1 and channel P1. The spool shape equalizer valve I have found best adapted to the design necessary for fulfilling the various functions required of my pulsator as herein described.

The piston P is connected to the pitman which is operated by the main crank from the crank shaft, which is in turn driven by the gear G that engages a pinion on an electric motor (not shown). Or the gear may be driven in any other suitable manner.

The auxiliary compressor K may be operated from the crank K3 on the crank shaft as shown or by any other convenient means. A bit or chisel (not shown) of the required form is held by the end of the motor piston T2 and operates on the coal or other material.

The proper working of the motor is dependent on an approximate balance of pressure being maintained on the opposite sides of the motor piston. When this balance is not maintained the motor piston stays

nearer to one end of the cylinder than the other and does not have a long free stroke as it should. This loss of balance may be produced by leakage of air from one of the compartments to the atmosphere as by a leakage in a tube connection, or from one compartment to the other compartment, as by air slipping by the motor piston, etc.

To preserve the pneumatic balance several methods have been resorted to. In my improved pulsator shown in Fig. 1 the equalizer valve V1 connects the high pressure end of cylinder C with the equalizer chamber H as follows. The valve V1 is operated by the crank or eccentric N on the crank shaft through the valve rod as here shown or in any other suitable manner. On the return stroke of the pulsator piston P, the valve V1 is moved to its forward position (see Fig. 2) and the air chamber H is connected with the back end (now the high pressure end) of the pulsator cylinder. The equalizer chamber H is thus alternately connected, first through the port S with the front air compartment; and then by the port S2 of the pulsator cylinder C with the rear compartment. As each compartment is connected with the air chamber H it assumes the same pressure as said chamber H. Hence if each compartment has the same pressure as the air chamber H then each has the same pressure as the other compartment and the apparatus is balanced pneumatically. This supposes the pressure in the equalizer chamber H to be uniform, and for the purpose of balancing, it is sufficiently true.

There is this difference in the operation of the parts on the opposite ends of the pulsator cylinder. In the front (or lower end on the drawing) of the cylinder C when the valve V1 first opens, the air rushes from chamber H directly into the passage P1 and the tube F1 to the motor cylinder, without first entering and raising the pressure in the whole pulsator cylinder. In other words the cylinder C is being filled from chamber H at the same time that the motor cylinder is being filled so that no time is lost. But in the back (or upper end on the drawing) the air must pass from chamber H into cylinder C before it passes into the motor cylinder through tube F2, and therefore time is lost in raising the pressure in the whole pulsator cylinder before its full effect is felt in the motor cylinder. This loss of time in reaching the maximum pressure in the motor cylinder decreases the power in the motor cylinder (other things being equal) and thus lowers the effectiveness of the motor.

As already described the pneumatic balance is made by connecting the equalizer chamber H with the compartment that was on the high pressure side of the pressor piston. By turning the gear G in the opposite direction from that shown in Fig. 1 and above described what was the high pressure side of the pulsator piston becomes the low pressure side, and the air chamber H that formerly was connected only with the high pressure compartment is now connected only with the low pressure compartment. In other words now the pulsator in the beginning of its stroke, takes air from the chamber H and the low pressure side of the motor piston, and delivers it to the high pressure side of the motor piston, and the apparatus is equalized on the low pressure side of the pulsator piston in a corresponding manner to that already explained in connection with the high pressure side.

The piston rod end of the motor piston has a somewhat smaller working area (due to the area taken by the piston rod,) than the other end has, and it is near the end of this end connecting tube F1 that the valve is here shown. The force of the blow however is dependent largely upon the effective pressure on the back of the piston. The tube having the valve connection may be connected in the compartment at the other end of the motor cylinder by reversing the tubes F1 and F2 in either the pulsator or the motor end of their cylinder connections. The change in the air chamber connection from the high to the low pressure compartment or the reverse could also be made by setting the valve crank N half way around on the crank shaft.

As herein described the term "compartment" refers to the air space in communication with one side of the pulsator piston. There are two compartments one on each side of the said piston. The term "ports" refers to the pressure connections that join the equalizer chamber with the said compartments and are lettered S on the front end and S2 on the back end.

To more effectively transmit the reciprocations of the compressor piston to the tool piston, the density of the transmitting medium is increased by forcing more air into the chamber H by the small auxiliary air compressor K which is operated from the crank K3 as shown in Fig. 1, or in any other suitable manner. The air forced into the system by the compressor K might be delivered to one of the compartments instead of to the air chamber H and the equalizer valve V1 would still operate in the same manner to maintain the pneumatic balance between the compartments.

The above described method of pneumatic balancing which consists in placing the air chamber alternately in connection with each compartment, is used in the system set forth and claimed in my application Serial No. 369,258 already referred to and therefore is not herein so claimed.

As previously stated the motor cylinder is

only diagrammatically represented, in practice it is usually advisable in power picks to cushion the piston at both ends of its stroke. The size of the piston rod is also preferably smaller in proportion to the diameter of the cylinder than here shown (or a tail rod may be used on said piston) so that the effective pressure will act effectively on the piston rod side of the piston head as it will on the opposite side of the piston head.

Having described my apparatus I claim—

1. The combination in an air pulsator of a pulsator cylinder, a reciprocatory piston therein dividing the air space into two compartments, means to reciprocate said piston, an equalizer chamber, ports connecting it with both ends of said cylinder, an equalizer valve controlling both of said ports, means to positively operate said valve from a moving part of the pulsator to open said ports alternately and in time with the pulsator piston, and motor pressure connections opening into the said air compartments on both sides of the pulsator piston.

2. The combination in an air pulsator of a pulsator cylinder, a reciprocatory piston therein dividing the air space into two compartments, means to reciprocate said piston, an equalizer chamber, ports connecting it with both ends of said cylinder, an equalizer valve controlling both of said ports, means to positively operate said valve from a moving part of the pulsator to open said ports alternately and in time with the pulsator piston, motor pressure connections opening into the said air compartments on both sides of the pulsator piston, an auxiliary air compressor, pressure connections between the compressor cylinder and the above described air inclosure, and means to operate said compressor to introduce air into the inclosure.

3. The combination in an air pulsator of a pulsator cylinder, a reciprocatory piston therein dividing the air space into two compartments, means to reciprocate said piston, an equalizer chamber, ports connecting it with both ends of said cylinder, an equalizer valve controlling both of said ports, means to positively operate said valve from a moving part of the pulsator to open said ports alternately and in time with the pulsator piston, a motor pressure connection in one of said connecting ports, and a motor pressure connection in the end of the pulsator cylinder that is opposite from that of said port connection.

4. The combination in an air pulsator of a pulsator cylinder, a reciprocatory piston therein dividing the air space into two compartments, means to reciprocate said piston, an equalizer chamber, ports connecting it with both ends of said cylinder, a spool shape equalizer valve controlling both of said ports, means to reciprocate said piston and to positively operate said valve to open said ports alternately and in time with the pulsator piston, said means comprising a crank shaft, a main crank and a valve crank thereon, a driving connection between said piston and main crank, a driving connection between the equalizer valve and the valve crank, motor pressure connections opening into the compartments on opposite sides of the pulsator piston, an auxiliary air compressor, pressure connections between the auxiliary compressor cylinder and the above described inclosure, and means to operate said auxiliary compressor to introduce air into the said inclosure.

5. The combination in an air pulsator of a pulsator cylinder and piston therein, an equalizer chamber and ports connecting it with both ends of said cylinder, a spool shape equalizer valve controlling both of said ports, means to reciprocate said piston and to positively operate said valve from a moving part of the pulsator to open said ports alternately and in time with the pulsator piston, a motor pressure connection opening in one of said connecting ports, and a motor pressure connection in the end of the pulsator cylinder that is opposite from said port connection.

6. The combination in an air pulsator of a pulsator cylinder, a reciprocatory piston therein dividing the air space into two compartments, means to reciprocate said piston, an equalizer chamber, ports connecting it with both ends of said cylinder, a motor pressure connection opening into one of said port connections, a motor pressure connection opening into the compartment opposite to that of the preceding motor pressure connections, an equalizer valve controlling both the said port connection on one end of the cylinder and the intersection of the motor connection with the port on the opposite end of the cylinder and allowing the passage of air between the equalizer chamber and both the motor cylinder and the pulsator cylinder simultaneously, and means to positively operate said valve to open said connections on opposite ends of the cylinder alternately and in time with the pulsator piston.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

CHARLES OTIS PALMER.

Witnesses:
HARRY T. GETTINS,
V. C. LYNCH.