(No Model.) 3 Sheets—Sheet 1.

C. H. PARSHALL.

VALVE GEAR FOR EXPANSION ENGINES.

No. 556,897. Patented Mar. 24, 1896.

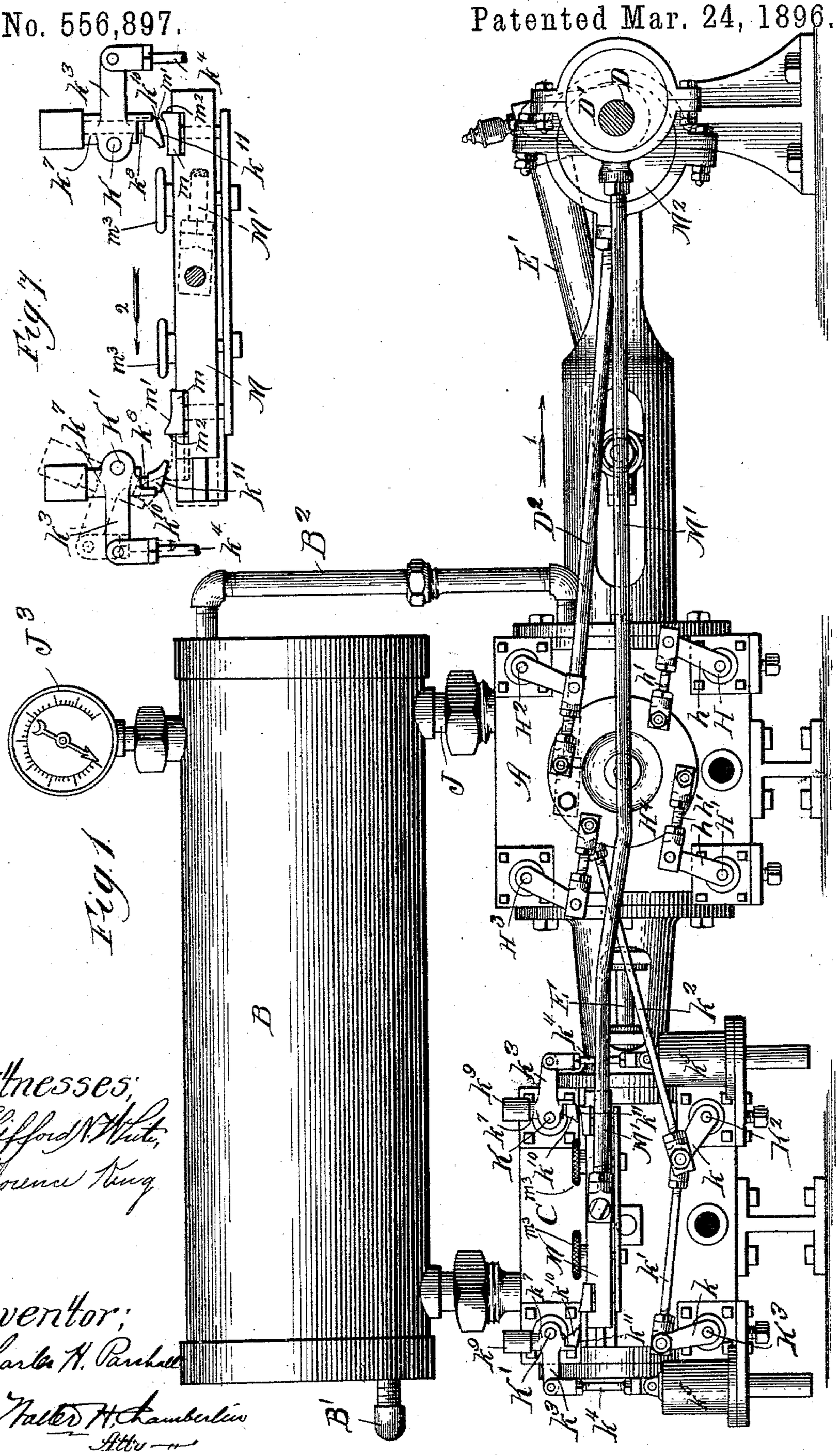

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Fig. 2.

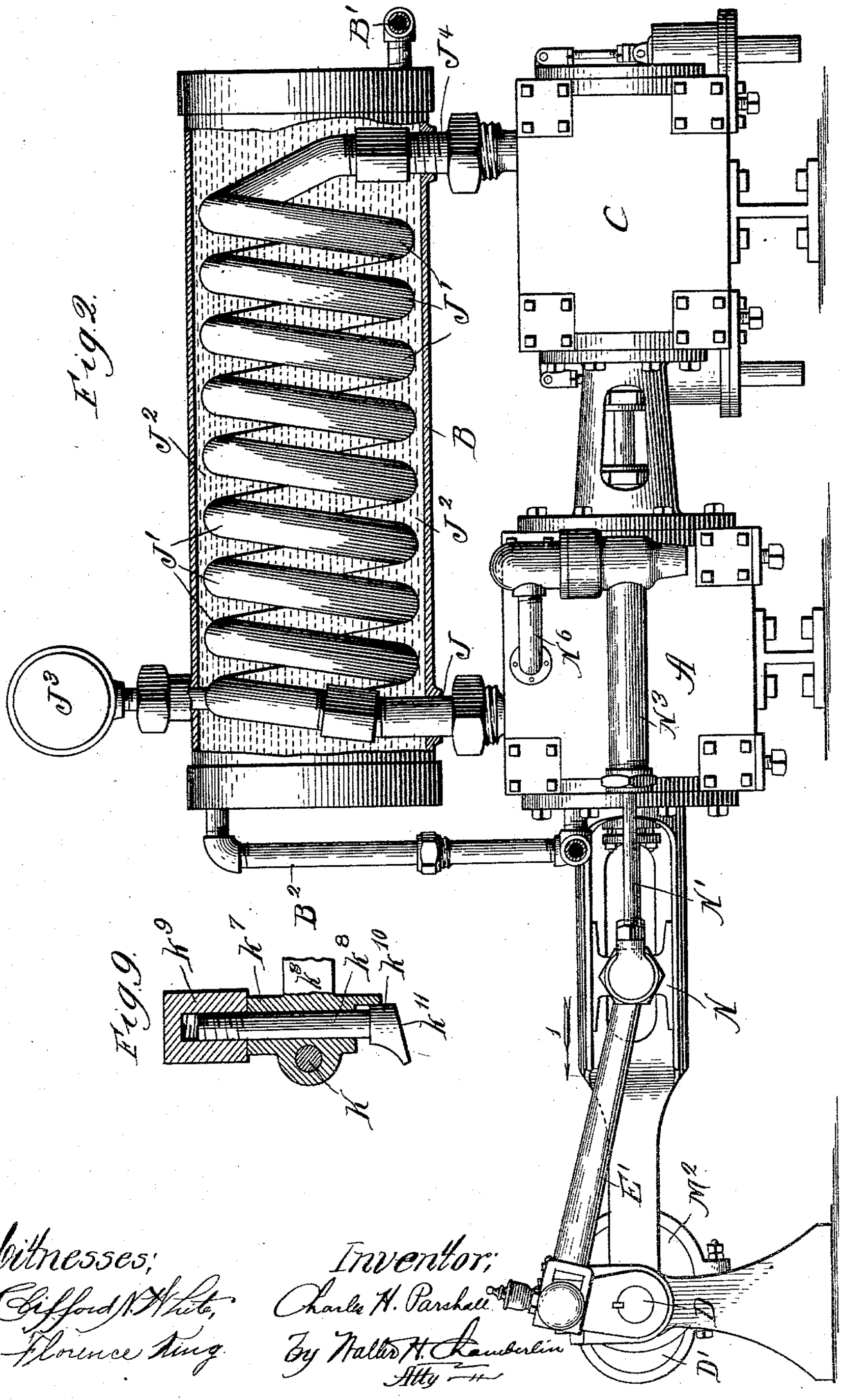

Fig. 9.

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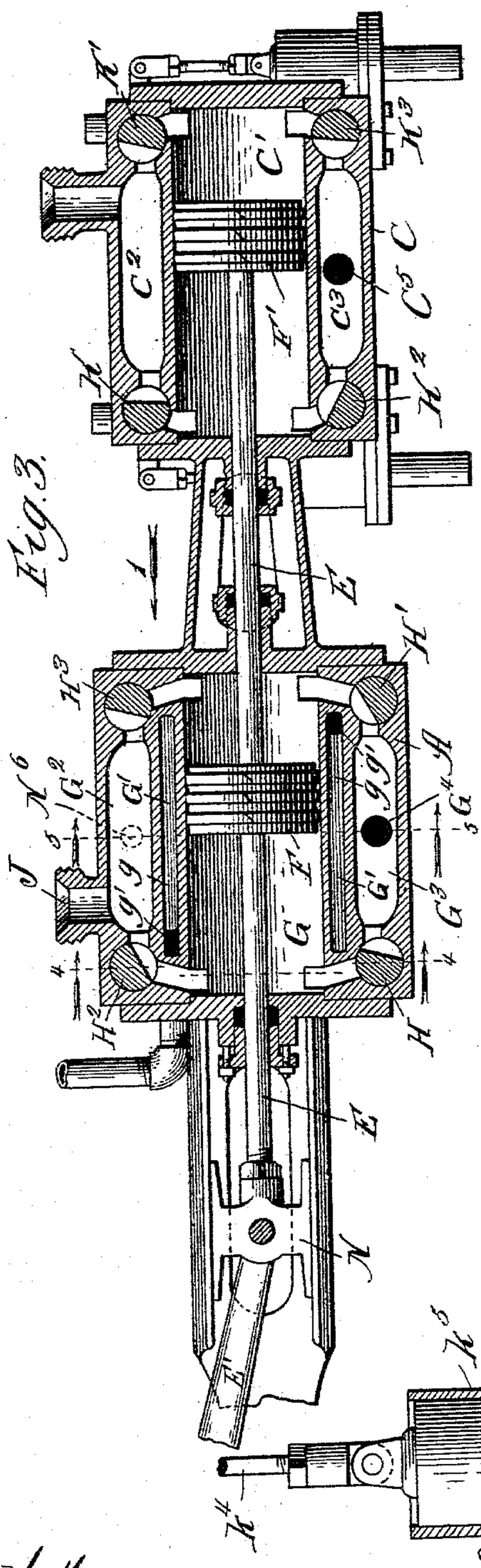

Fig. 3.

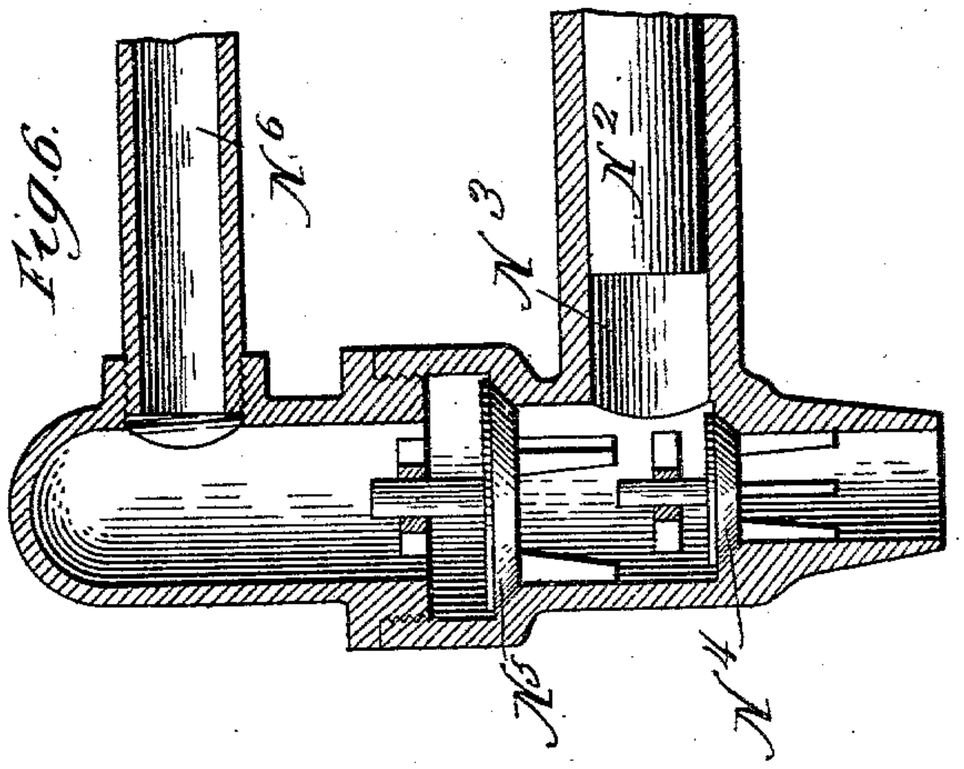

Fig. 6.

Fig. 7.

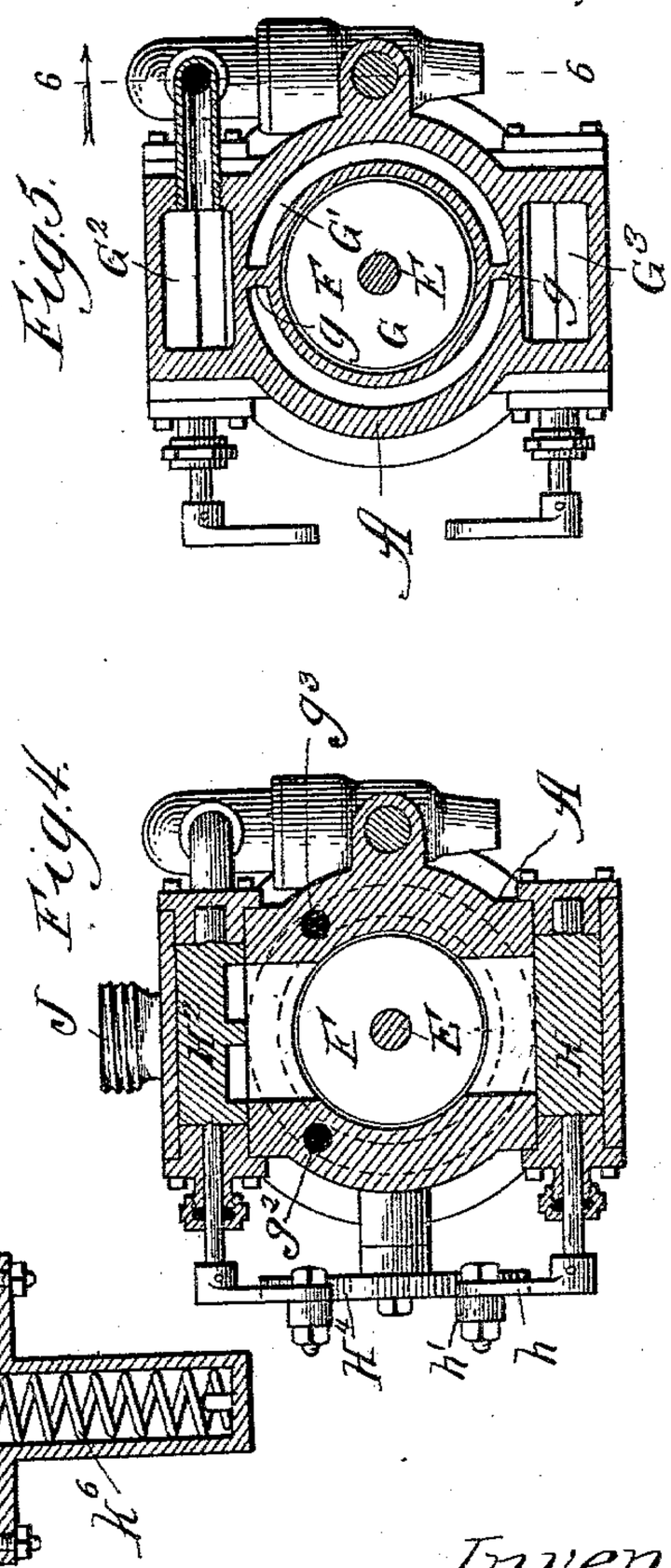

Fig. 5.

Fig. 4.

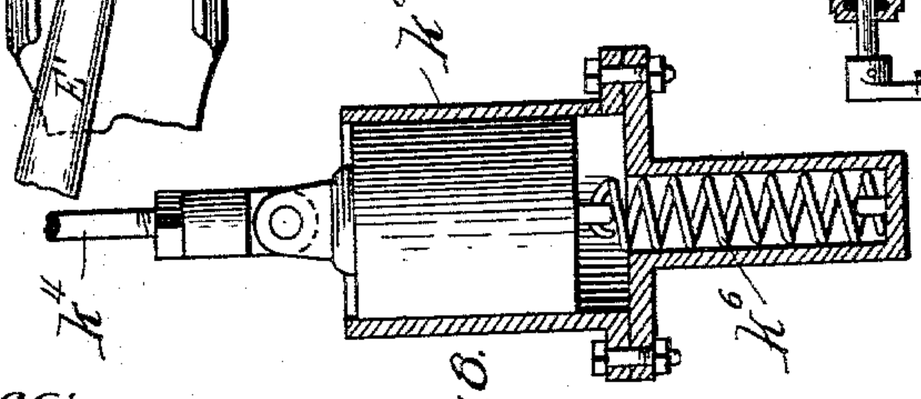

Fig. 8.

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UNITED STATES PATENT OFFICE.

CHARLES H. PARSHALL, OF CHICAGO, ILLINOIS.

VALVE-GEAR FOR EXPANSION-ENGINES.

SPECIFICATION forming part of Letters Patent No. 556,897, dated March 24, 1896.

Application filed April 26, 1894. Renewed November 22, 1895. Serial No. 569,862. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. PARSHALL, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented a certain new and useful Improvement in Refrigerating Apparatus; and I 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, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object the production of a refrigerating apparatus in which there is a suitable air-compressor, a suitable chamber in which the air after being compressed is cooled, a suitable expansion-chamber, and suitable valves for regulating the admission of air into and out of the compressor and into and out of the expansion apparatus. Incidental with the above mechanism I employ an auxiliary pump to introduce fresh air into the apparatus and also certain other mechanisms which will hereinafter be more fully described.

The invention consists in a combination of devices and appliances hereinafter described and claimed.

In the drawings, Figure 1 is a side elevation of an apparatus embodying my invention. Fig. 2 is a side elevation of the opposite side of the apparatus with the cooling-chamber in section. Fig. 3 is a longitudinal section of the compressor and expander. Fig. 4 is a sectional view on the line 4 4 of Fig. 3. Fig. 5 is a sectional view on the line 5 5 of Fig. 3. Fig. 6 is a sectional view on the line 6 6 of Fig. 5. Fig. 7 is a detail of the cut-off mechanism. Fig. 8 is a detail of the dash-pot used in connection therewith, and Fig. 9 is a detail of the valve mechanism.

In carrying out the invention I wish first to explain the fact that this apparatus may be used either for the purpose of making ice, in which case the air, after being cooled, is introduced into a suitable chamber where the ice is formed or the cool air may be passed through a system of radiators for the purpose of cooling a room or some specified object or the air may be introduced directly into a room or against an object.

I have not in the present drawings shown any particular application for the machine, since it is applicable to so many different purposes.

The machine consists essentially of an air-compressor A, a cooling-chamber B, and an air-expander C.

D is a suitable crank-shaft driven from any desired source of power.

E is the piston-rod connected with the crank-shaft by the pitman E′. The same piston-rod is employed for both the compressor and expander, although such an arrangement is not of course essential.

F F′ are the piston-heads of the compressor and expander respectively.

G is the compressor-cylinder surrounded by a water-jacket G′ having a partition *g*, and the openings *g′* in the partition being diagonally opposite each other, as shown in Fig. 3, so that when the water is introduced it is caused to circulate around the cylinder.

G^3 G^2 are the air-chests at the top and bottom respectively of the compressor-cylinder.

H H′ are the valves controlling the admission of air to the compressor-cylinder, and H^2 H^3 are the valves controlling the exit of air from the compressor-cylinder.

J represents the connection by which the air is carried to the cooling-chamber from the compressor air-chest. This cooling-chamber is shown in Fig. 2 and consists of a suitable coil or coils of pipes J′, so arranged as to be surrounded by a body of water J^2.

B′ represents the pipe for conveying water to the cooling-chamber, and B^2 the pipe for conveying the water away from the cooling-chamber.

J^3 is the gage connected with the coil J′, so that the pressure of air in the coil may be easily ascertained.

C′ is the cylinder of the expander, and C^2 C^3 are the air-chests at top and bottom of the same.

K K′ are the valves controlling the admission of air to the expanding-cylinder, and K^2 K^3 the valves controlling the exit of air from the expanding-cylinder.

Now by reference to Fig. 1 it will be seen that the valves H H′ H^2 H^3 are each provided with crank-arms *h*, which are in turn connected by suitable rods *h′* with the oscillating disk H^4, the latter made to oscillate

by a suitable eccentric D′ on the shaft D, connected with the disk by a rod M′. It will also be observed that the valves K^2 K^3 are provided with crank-arms *k*, connected together by a rod *k′* and connected with the disk H^4 by a rod k^2.

M, Figs. 1 and 7, represents a reciprocating block connected by the rod D^2 with the eccentric M^2 on the shaft D. On valves K K′ are crank-arms k^3, and pivoted to each arm is a rod k^4, extending down to a dash-pot k^5, (shown in detail in Fig. 8,) the dash-pot provided with the spring k^6. The crank-arm on each valve K K′ is provided with a socket or sleeve k^7. (Shown in detail in Fig. 9.) In this sleeve is a loose pin k^8, provided on its upper end with a nut k^9, whereby the pin may be adjusted higher or lower, as desired. This pin works freely up and down in the socket and is provided on its lower end with a shoe k^{10}, having a beveled under face k^{11}. On the block M, one for each valve K^2 K^3, is a projection *m*. The face of this projection is so beveled at *m′* that when it strikes the beveled face of the shoe k^{10} it will throw the latter up without affecting the valve; but when the face m^2 of the projection *m* comes in contact with the end k^{12} of the shoe it tilts the parts to the position shown by the dotted lines, Fig. 7, thus opening the valve. Pivoted to the cross-head N is a piston-rod N′, adapted to operate the piston N^2 in the cylinder N^3. (See Fig. 6.) This piston, together with the valves N^4 N^5, forms a pump for the purpose of introducing fresh air into the compressor air-chest through the pipe N^6 should it be found desirable, as would probably be the case where the apparatus is arranged with a complete circuit of pipes. When thus arranged, the air leaves the machine at a low temperature, passes through a series of pipes, taking up more or less heat, and then returns to the machine to be again reduced in temperature. This successive repassing of the air results in a large amount of leakage, and this auxiliary pump above mentioned supplies this shortage.

I will now describe the operation of the machine. Water is introduced at B′ and fills the cooling-chamber B, thus surrounding the coil J, and then passes off through B′, down to the water-jacket, around the compressor-cylinder, entering the same at g^2 and leaving at g^3, Fig. 4, and thence to the waste by the pipe C^4. A circulation of water is thus maintained through the cooling-chamber and around the compressor-cylinder. I will now describe the course of the air. We will suppose that the piston is traveling in the direction of arrow 1, Figs. 1 and 3. By so doing it will draw air into the air-chest G^2 through the port G^4, the valve H′ being open, as shown. This same travel of the piston is compressing the air in advance of it, and that compressed air is passing through the valve H^2, into the chest G^3, and thence up into the coil J′. When the piston reaches the end of its stroke in the direction indicated by arrow 1. the eccentric on the shaft will, through the oscillating disk H^4, change the position of the valves H H′ H^2 H^3, so that instead of being in the position shown in Fig. 3 the valve H will be open, the valve H′ closed, the valve H^2 closed, and the valve H^3 open, thus allowing air to be admitted behind the piston-head and compressed in advance thereof. The construction in this respect differs only in details from the ordinary air-compressor. This same movement of the disk H^4 also changes the position of the valves K^2 K^3, so that when the piston in the expanding-chamber is traveling in the direction of arrow 1 the valve K^3 will be closed and the valve K^2 open, and on the return stroke the valve K^2 closed and the valve K^3 open, thus having the valve in advance of the piston-head always open to allow the air already expanded to pass off through the port C^5 to the desired point.

J^4 is the connection between the coil J and the expanding-chamber air-chest C^2, and the pressure will of course be the same in the chest C^2 as it is in the coil J and in the chest G^3.

I will now describe one of the important features of the machine—viz., the admission of air from the air-chest C^2 to the expanding-chamber. The relative position of the parts is such that except at the beginning of the stroke of the piston-head F′ the valves K K′ are closed—that is to say, the reciprocating block will reach the end of its stroke while moving in the direction of arrow 2, Fig. 7. after the piston-head F′ is midway its stroke in the direction of arrow 1, Fig. 3. Now the block opens one of the valves K K′ only as it nears the end of its stroke—that is, it begins to open the valve about the middle of its stroke, or, in other words, the projection *m* will come into contact with the shoe k^{10} as the block passes the middle of its stroke and will tilt the valve and open it, thus allowing compressed air to pass from the chest C^2 to the small space behind the expander-piston head, which by this time has started on its stroke. As the block M reaches the end of its stroke the projection *m* passes the shoe and the spring k^6 returns the valve to its normal or closed position. Thus after the piston-head F′ has started on its stroke, or, in other words, when it reaches about the relative position shown in Fig. 3, the valve K′ is closed, and that compressed air which has entered behind the piston-head is allowed to expand in the vacuum created by the stroke of the piston-head. The same operation takes place on the return stroke of the piston-head. Thus, as will be seen, compressed air at the desired pressure is constantly maintained in the air-chest G′ of the compressor, in the coil J′ and in the air-chest C^2 of the expander with a constant circulation of water surrounding this compressed air both in the coil J′ and in the compressor. The air while thus compressed is thus relieved of a certain number of heat-units, and consequently when ex-

panded is much cooler. This cool air can then be circulated, as above set forth, in any desired way. The same reciprocation of the cross-head which operates the pistons operates the auxiliary pump, (shown in Fig. 6,) thus introducing, if desired, a constant supply of fresh air into the circulation. In order that the parts may be properly adjusted, I have made the rods h' adjustable, so that the valves could be properly regulated and also the rods k' k^2 adjustable. So, also, I have made the projections m adjustable by means of the thumb-screws m^3. This latter adjustment is important for the reason that the successful operation of the machine depends on the cut-off mechanism controlling the admission of air into the expander. By making this projection m adjustable vertically the valve may be released at the proper time and the air cut off when desired.

It is of course obvious that the mechanism above described may be materially altered without departing from the spirit of my invention. For instance, the coil J, instead of being a circular coil, such as shown, might be any other form of coil, or instead of the water surrounding the coil maintaining the compressed air the compressed air might surround a coil through which there was a circulation of water. Again, instead of the compressor and expander being connected together on the same piston-rod, they might be disconnected, although I prefer the construction shown. Again, while I have shown a spring for operating the valves K K′, yet they might be so constructed that gravity or any other means independent of the moving parts would act to close them. So, also, the various parts of the machine might be altered in many ways without departing from the spirit of my invention.

What I claim is—

The combination with an expansion-cylinder, of the rotary valves K K′ in the side of the cylinder, cranks on the stems of the valves K K′, dash-pots connected to the outer ends of the cranks, stems on the cranks arranged at an angle thereto, the adjustable pins in the stems having inclined lower ends, the slide-block M on the expansion-cylinder between the valves K K′, means for sliding the block, the inclined projection m on the block, and means carried by the block for vertically adjusting the projection, substantially as described.

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

CHARLES H. PARSHALL.

Witnesses:
W. H. CHAMBERLIN,
FLORENCE KING.