A. F. ROCKWELL.

COOLING MEANS FOR MOTORS.

APPLICATION FILED JAN. 11, 1906.

962,249. Patented June 21, 1910.

4 SHEETS—SHEET 1.

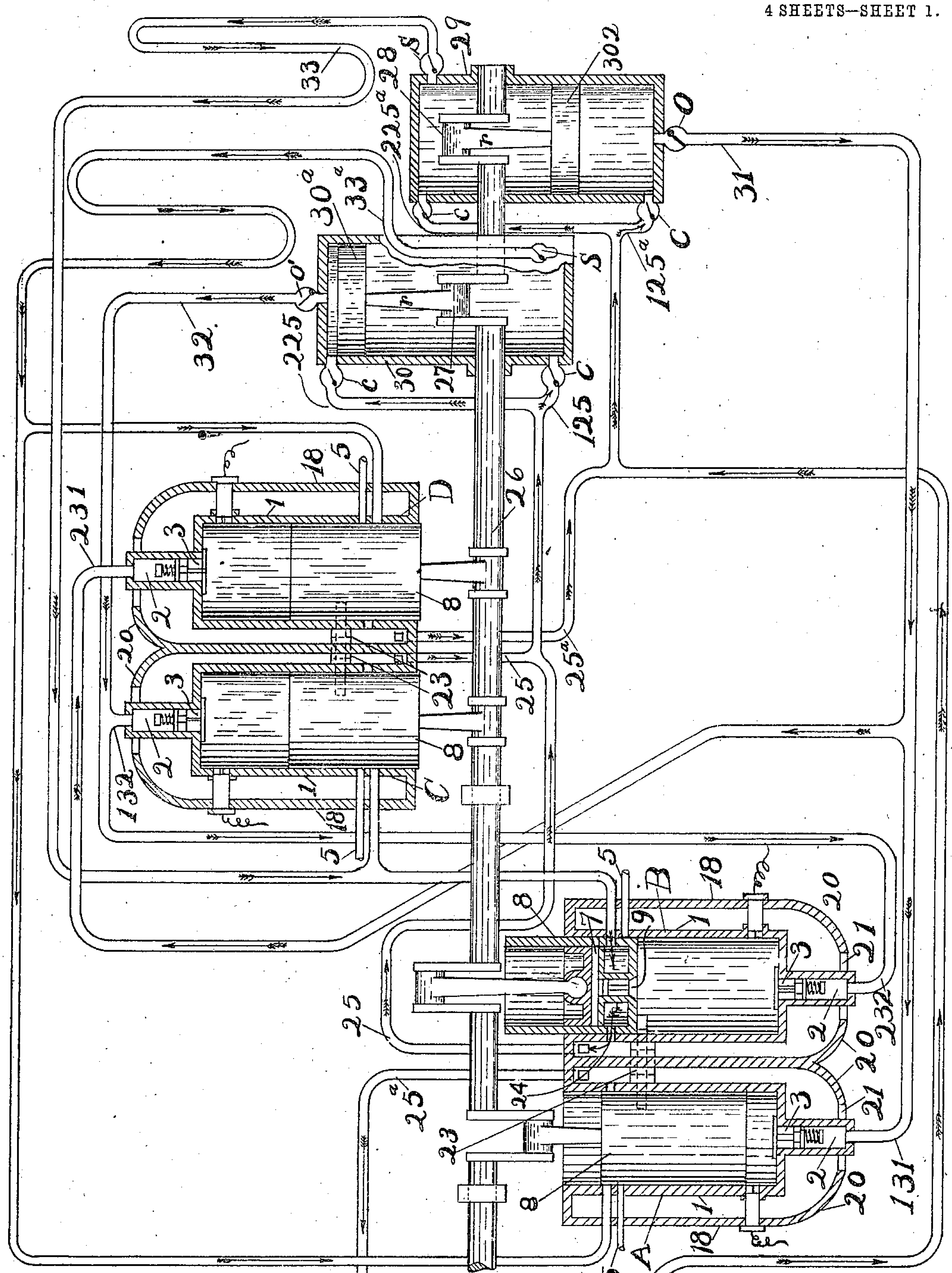

Fig. 1.

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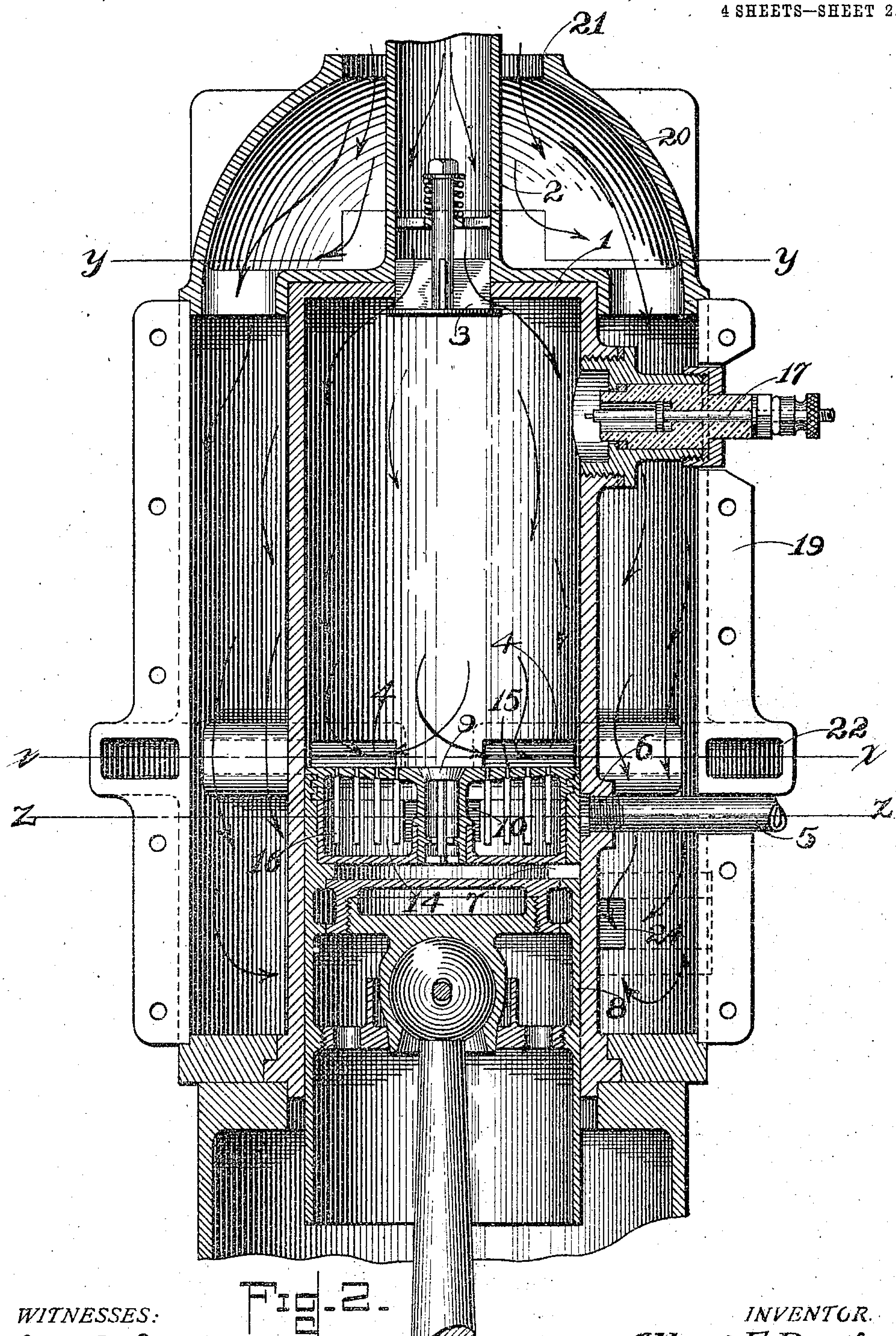

Fig. 2.

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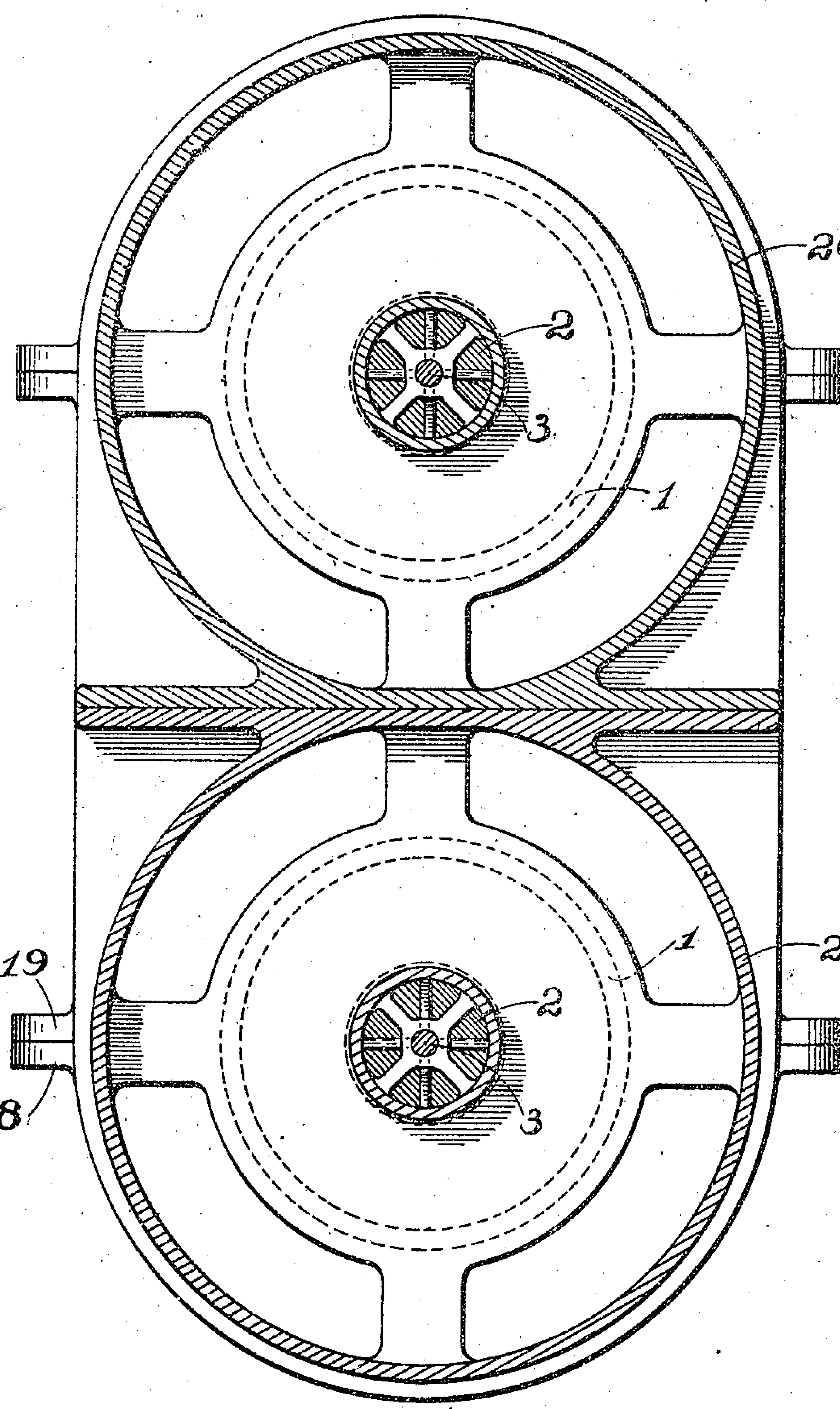

Fig. 3.

WITNESSES:
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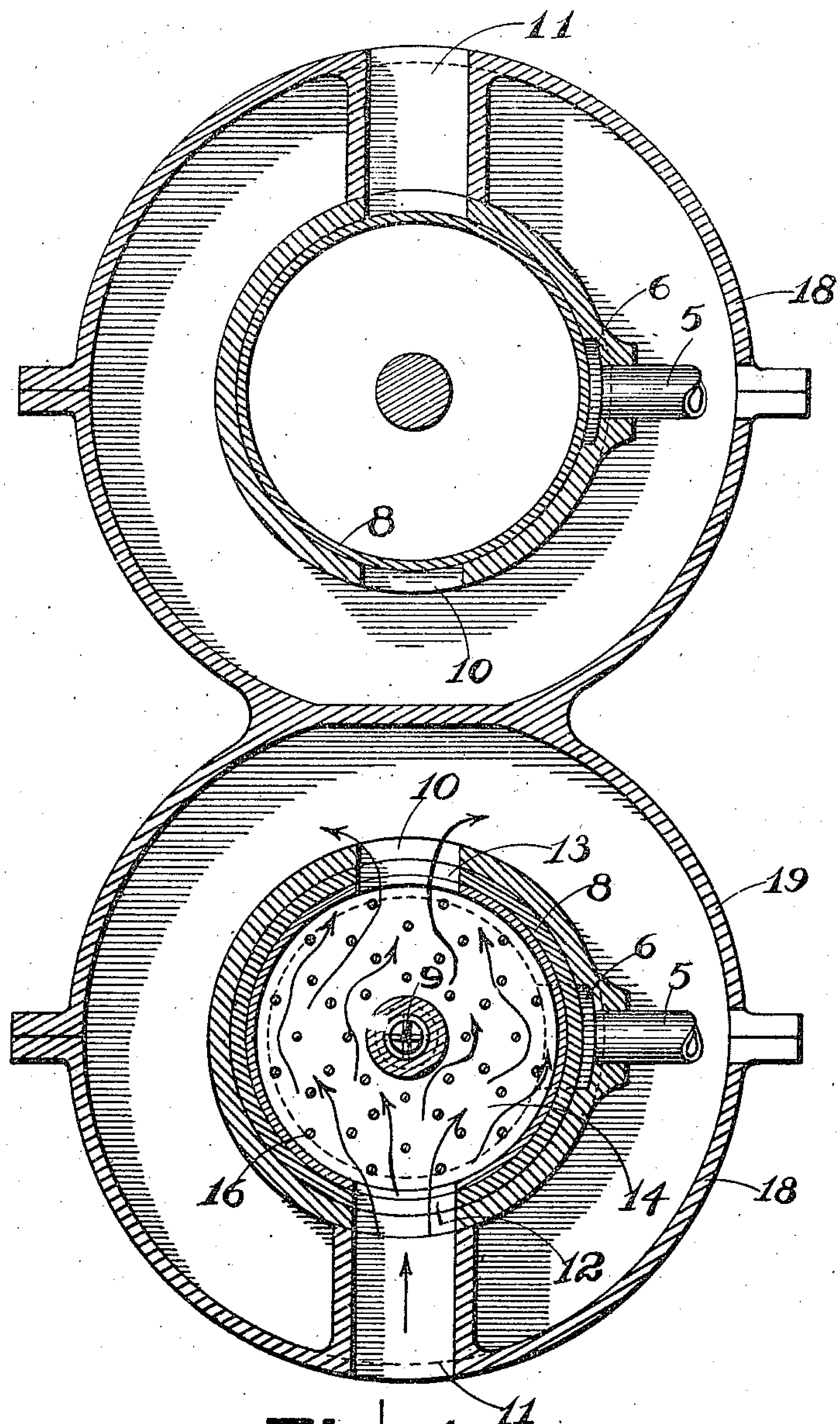

Fig. 4.

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UNITED STATES PATENT OFFICE.

ALBERT F. ROCKWELL, OF BRISTOL, CONNECTICUT, ASSIGNOR TO THE NEW DEPARTURE MANUFACTURING COMPANY, OF BRISTOL, CONNECTICUT, A CORPORATION OF CONNECTICUT.

COOLING MEANS FOR MOTORS.

962,249. Specification of Letters Patent. Patented June 21, 1910.
Application filed January 11, 1906. Serial No. 295,639.

To all whom it may concern:

Be it known that I, ALBERT F. ROCKWELL, a citizen of the United States, residing at Bristol, county of Hartford, State of Connecticut, have invented a certain new and useful Cooling Means for Motors, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to motors and particularly to explosion motors.

One of the objects of the invention is to provide means for efficiently cooling the parts of the motor which are liable to become heated owing to the explosion in the combustion chamber or from other causes.

Another object of the invention is to control the fluid supply means from the motor shaft.

Another object of the invention is to provide an efficient means for introducing the requisite amount of air into the combustion chamber so that said air may commingle with the fuel introduced into the combustion chamber from a separate source so that the proper proportions of the air and fuel will be provided prior to the ignition thereof.

Another object of the invention is to provide suitable mechanism for introducing a cooling fluid into certain ported parts of the piston.

A further object of the invention is to provide a single mechanism for cooling the exterior of the cylinder for introducing air into the combustion chamber of the cylinder to exhaust the spent gases and provide the sufficient amount of air for the proper mixture with the gaseous fuel, and furthermore to provide means for causing a cooling fluid to pass through the piston in each cylinder.

Other objects and advantages as well as the novel details of construction of this invention will be specifically set forth hereinafter, it being understood that changes in form, proportion and minor details of construction may be resorted to without departing from the spirit of the invention or sacrificing any of the advantages thereof.

In the drawings, Figure 1 is a diagrammatical view of an explosion motor to which my invention is applied; Fig. 2 is a vertical sectional view through one of the cylinders, its piston and the cooling jacket therefor; Fig. 3 is a cross section view on the line *y—y* of Fig. 2; and Fig. 4 is a cross sectional view on the line *z—z* of Fig. 2.

The motor cylinder 1 is illustrated as having at one end an inlet pipe 2, which provides a port for the introduction of air into the combustion chamber of the cylinder. The discharge end of the port and the air inlet end of the motor cylinder are normally closed by a spring retained valve 3, and this valve is preferably of disk form so as to diffuse the air in radial lines against the side of the inner portion of the cylinder to assist in cooling the same. The ports 4 in the side walls of the cylinder 1 are exhaust ports to permit the spent gases to be forced from the combustion chamber when the piston has reached the limit of its outward stroke. The ports 4 are closed by the wall of the piston during the compression of the fuel and during the time that the explosion is taking place. The port 5 is a fuel port through which the fuel, preferably gas, may find its way into the cylinder. At the end of the port 5 and in the wall of the cylinder 1 is a fuel pocket 6, which is adapted to register with the ported pocket 7 in the piston 8. The registration of the pocket 6 and the port 7 is intermittent, that is to say, the chamber or pocket 7 registers with the pocket 6 only at the proper time for the introduction of the gas into the combustion chamber. While the pocket 6 and the port 7 register when the piston is near the outward limit of its stroke, no gas will be permitted to enter the combustion chamber at this time for the reason that the pressure within the combustion chamber will be greater than the pressure of the gas. Upon the return stroke of the piston, however, the pressure of the gas will overcome the pressure within the combustion chamber and the gas will be admitted. The piston 8 is provided with a preferably gravitative valve 9 which is movable longitudinally in the piston head and adapted to be unseated only by the pressure of the gas which is being conveyed from the pipe 5. At all other times this valve will be closed and the piston-head will, in effect, be practically solid.

The port 10 in the wall of the cylinder is an exhaust port which is diametrically opposite an inlet port 11 in the cylinder and its jacket (see Fig. 4), said ports 10 and 11 registering with the ports 13 and 12 respectively in the piston 8, and which communicate with a cooling chamber 14 immediately in rear of the end plate 15 of the piston. Under certain conditions I may provide pins 16 or some other device having coefficients of expansion in excess of the coefficients of expansion of metal of which the piston is made. Owing to the conductivity of these pins the heat will have a tendency to pass from the piston through the pins and be carried off by the air which will be caused to circulate between the pins through the chamber 14, it being understood that said air will enter from the port 11 and exhaust through the port 10. The ports 10 and 11 are normally cut off by the piston wall but are intermittently permitted to register with the ports 12 and 13 when the piston is in a position to cause the exhaustion of the spent gases from the combustion chamber of the cylinder.

17 designates a sparking plug which is in suitable electrical connection with a generator or other source of electrical supply, so that when the piston 8 is in proper position with respect to said sparking plug the fuel may be ignited.

In the foregoing description I have described but a single cylinder, while in all the figures, except Fig. 2, I have illustrated a plurality of cylinders. It is to be understood, however, that the description which applies to the cylinder illustrated in Fig. 2 is equally applicable to all other cylinders serving the same purpose and which are not illustrated in detail in the remaining figures. The cylinders are generally arranged in pairs and a complete set of appurtenances is provided for each pair of cylinders. In the form illustrated in the drawings each pair of cylinders is provided with a casing or cooling jacket comprising sections 18 and 19 which are suitably fastened together, and said casing may comprise domes 20 having open ends 21, through which the cooling fluid may enter, while intermediate the ends of the casing is provided an exhaust conduit 22, in communication with the exhaust port 4 whereby the spent gases may be forced into said conduit and exhaust through an outlet port 23 in the casing, said outlet port 23 leading to atmosphere in the present example of my invention. The casing is also provided with separate exhaust ports 24, one for each cylinder.

In the type of motor illustrated in Fig. 1 of the drawings in which four cylinders are employed, a single conduit 25 is provided for opposite cylinders of opposite pairs, that is to say, the exhaust port 24 of one of the cooling jackets and the exhaust port of the opposite jacket of the coöperating pair will discharge into a common conduit 25. Correspondingly the remaining discharge port 24 will be coupled up with the one opposite it in the coöperating pair by a conduit 25ª, these conduits leading into a pump casing or exhauster which is operated preferably from the motor shaft 26. On this motor shaft are shown a plurality of cranks (two being illustrated); these cranks are indicated by numerals 27 and 28. Said cranks work in an exhauster or pump casing, illustrated as having two pump cylinders 29 and 30. The pump cylinders are what might properly be termed double-acting pump cylinders for the reason that they take in and discharge a fluid during both the forward and rearward stroke of each piston. The conduit 25 has valved branches 125 and 225 respectively; the branch 125 is in communication with the cylinder 30 in rear of the piston 30ª, while the branch 225 is in communication with the cylinder 30 on the opposite side of the piston 30ª. The conduit 25ª is provided with valved branches 125ª and 225ª, similarly connected to the cylinder 29 and both of the branches of each conduit 25 and 25ª are provided with inwardly opening check valves *c*, not only to allow a fluid to pass from said conduits into the pump cylinders, but said check valves prevent the return of the said fluid from the cylinder into the said conduits 25 and 25ª. The pistons are connected to the crank by piston-rods *r*.

Leading from the cylinders 29 and 30 are pipes or conduits 31 and 32 respectively; the pipe 31 is provided with branches 131 and 231, which branches are in communication with the pipes or ports 2 of the cylinders in opposite pairs of the motor. This pipe is provided with an outwardly opening check valve *o*, so that on the outward stroke of this piston 302 in the cylinder 29 the fluid will be forced through the pipe 31 and into the pipes 2 of the opposite cylinders. If it is found desirable the pipes 31 and 32 may be of sufficient length to permit portions thereof being coiled so as to allow the fluid which has been forced from the pump cylinder or cylinders to be reduced to the proper temperature before it enters the combustion chamber or chambers of any of the cylinders.

It will be understood that the respective pistons have reciprocatory movement alternating in their actions with one another; in other words, when one of the pistons is moving in its inward stroke the opposite piston will be having an outward stroke imparted thereto, and the reason for this is to time the introduction of the fuel, cooling etc., of the various parts to provide for the sequence of operations of the motor.

Pipe 32 is provided with branches 132 and 232 connected to opposite cylindes and the pipe 31 is provided with branches 131 and 231 also conected to the remaining opposite cylinders. An outwardly opening check valve o' controls the pipe 32. Leading from the respective pump cylinders 29 and 30 are pipes 33 and 33^a; these pipes are provided with outwardly opening check-valves s, and said pipes may be provided with a number of coils for the purpose of cooling the fluid which passes therethrough. However, these coils will not be essential in every case, although they may be found convenient under certain conditions. These pipes lead to and are properly connected up with the ports 11 to cool the pistons.

In the operation of the motor the pumps draw air through the jackets to cool the cylinders and then force said air under pressure into the tubes 31, 32, 33 and 33^a, such compressed air in such tubes being unable to immediately enter the explosion chambers because of the pressure upon the under side of the valves 3, and being unable to escape from the pipes 33 and 33^a because their exit ends are closed by the motor pistons. The charge being compressed and exploded in a cylinder, its piston moves outwardly until it assumes the approximate position shown in Fig. 2, thus uncovering the exhaust ports 4 of such cylinder and bringing the piston ports into alinement with the ports 11 and 10. Thereupon the compressed air in the pipe 33 or 33^a, as the case may be, quickly passes through the piston head, and also the compressed air in the pipe 31 or 32, as the case may be, forcibly enters the combustion chamber and expels the spent gases, a sufficient amount of air remaining in the cylinder to combine with the gas for the next explosion. The actuation of the shaft 26 will actuate the pumps so that the cooling fluid will be drawn into the casing from the open end 21 and down around the exterior of the cylinders of each pair, for example, through the pipe 25. As the piston in one of the pump cylinders moves in an outward direction, air which has been sucked into the cooling jacket and out through the port 24 will be drawn into one of the pumps at the rear of the piston and into the other pump in front of the piston. During the next half revolution of the shaft 26, one of the pump pistons will be moved toward the drive shaft 26, while the other one will be forced outward. The piston which is forced outward will force a charge of air into the tubes leading to the combustion chambers, while the retracting piston will force air into the pipes 33 or 33^a as the case may be.

It will be seen that the cooling fluid will be alternately drawn into the casing and through the pipes 25 and 25^a by the pistons in the cylinders 30 and 29. When the air is introduced into the combustion chamber of each cylinder it will be forced in, in greater volume than is required for the proper mixture with the fuel gas. Therefore, all of the spent gases will be forced out and in addition to this the interior of the cylinder as well as the piston head end will be subjected to the influence of cool air and thus the tendency to over-heating of the interior of the cylinder and piston head will be avoided. Furthermore, a current of cool air will be forced through the piston and carry off any heated gases which may have accumulated, owing to the explosion of the fuel. It will be apparent that the system efficiently provides for the cooling of various affected parts of the motor and that the same is light, durable, compact and requires but little expenditure of energy from the motor in order to operate the same. A system similar to the one herein described is particularly applicable to motor vehicles in that it requires but little space and the necessity for pump gearing such as chains, belts, rods, etc., is avoided.

In the diagram designated as Fig. 1, I have lettered the cylinders as A, B, C, and D. By referring to said Fig. 1, a clear understanding of the coöperation of the correlated elements may be had. In this figure the piston in the cylinder A is about ready to receive its impulse from an exploded charge; the piston in the cylinder B has moved to the limit of its power stroke, and said cylinder B is exhausting so that air is passing through it to cool it; the piston in the cylinder C is compressing its charge; and the piston in the cylinder D has exploded its charge and is moving downward. Thus it will be seen that for each quarter of a revolution of the shaft 26 an explosion takes place in one of the cylinders 1.

In view of the fact that the cranks for the pump cylinders are set on a one-half (instead of the one-quarter circle as are the motor cranks) each pump is capable of taking care of two motor cylinders.

What I claim is:

1. The combination with a cylinder having an exhaust port, a piston, and an inlet port, of a valve closing said inlet port and adapted to be opened by pressure upon its outer side, a casing about said cylinder and provided with inlet and outlet ports, a pump including a reciprocatory piston, connection between said outlet port of said casing and both sides of said pump piston, inwardly opening check valves in said connection, connection between said pump and said outer side of said inlet valve to said cylinder, and an outwardly opening check valve in said latter mentioned connection; substantially as described.

2. In an explosion motor, the combination with a power cylinder having openings in its wall, a jacket around the same, and a piston in the power cylinder and having openings adapted to aline with said first mentioned openings, of means for causing air to pass through the jacket, through the

combustion chamber of the power cylinder, and through alining openings in the walls of the power cylinder and the piston; substantially as described.

3. In an explosion motor, the combination with a power cylinder having a combustion chamber, a ported piston in said power cylinder, and a cooling jacket surrounding said power cylinder, of means in virtue of which air is caused to pass through the jacket, through the combustion chamber, and through the ported piston; substantially as described.

4. In an explosion motor, the combination with a power cylinder, a ported piston in said power cylinder, and a cooling jacket surrounding said power cylinder, of means in virtue of which air is caused to pass through the jacket and over the power cylinder when the power cylinder is closed, and through the power cylinder and through the piston when the power cylinder is open; substantially as described.

5. The combination with a motor cylinder having a valved air inlet port and an exhaust port, a piston movable in said cylinder and controlling communication between said inlet and exhaust ports, said piston having a valved fuel inlet port, a cooling chamber in the piston surrounding said fuel inlet port, a jacket surrounding the cylinder, and a pump in communication with said jacket to cause air to pass over the exterior of the cylinder and to cause air to pass through the cooling chamber of the piston when the piston is in a position permitting communication between said inlet and exhaust ports, said valved air inlet port being effective to open at this time so as to admit air into the cylinder and permit it to pass out through the exhaust; substantially as described.

6. The combination with a motor cylinder having an air inlet at one end and an exhaust at the other, said cylinder having ports extending transversely through its walls and below the exhaust port, of a piston movable in said cylinder and having ports adapted to register with the transverse ports in the cylinder, and a casing surrounding the cylinder and provided with an inlet port at one end and an exhaust port at the opposite end; substantially as described.

In testimony whereof, I hereunto affix my signature, in the presence of two witnesses.

ALBERT F. ROCKWELL.

Witnesses:

JOSEPH D. BROWN,

CLARA H. VOORHEES.