No. 685,141. Patented Oct. 22, 1901.

C. A. HIRTH.

ROTARY EXPLOSIVE ENGINE.

(Application filed Apr. 24, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig: 1.

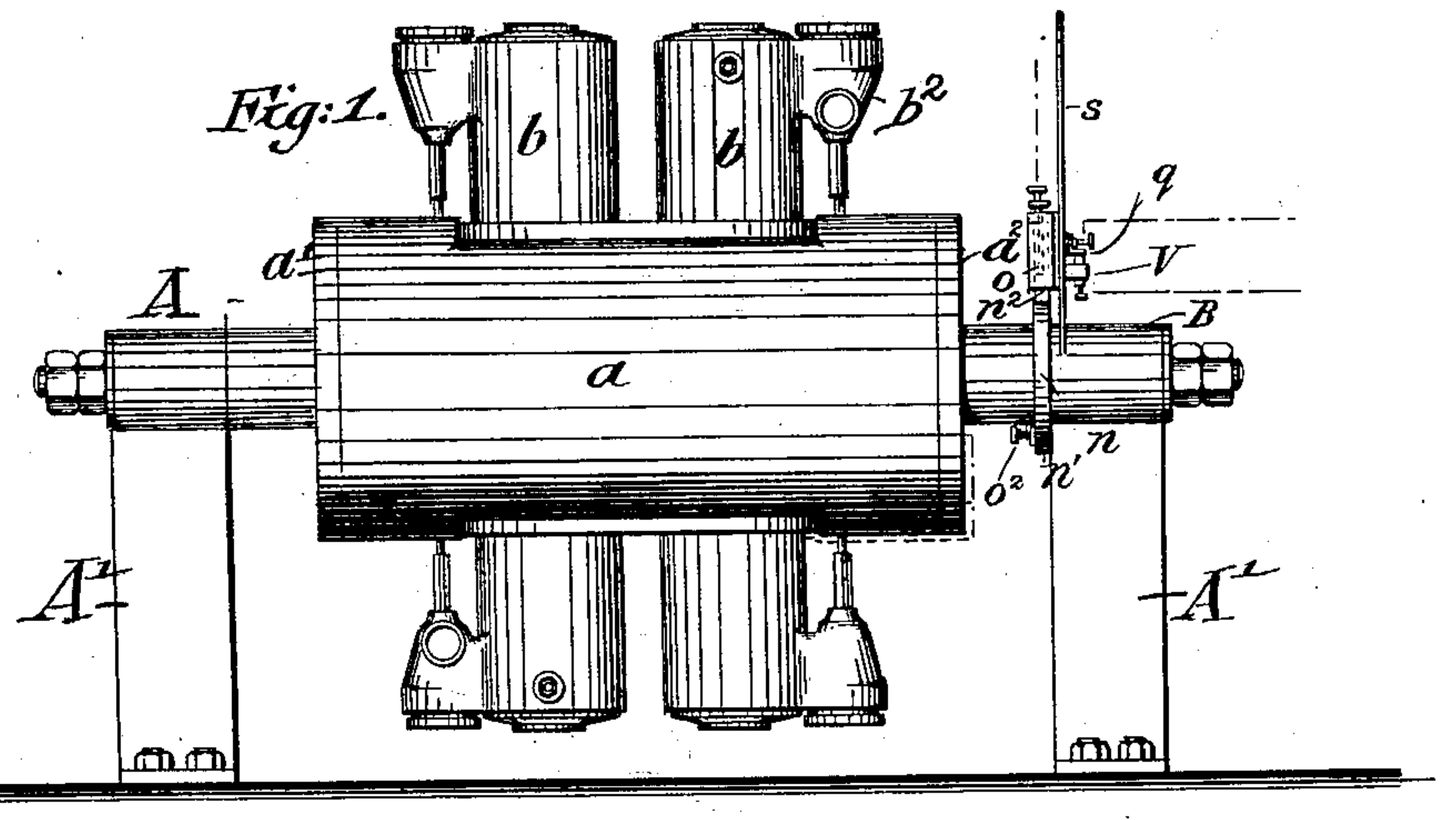

Fig: 2.

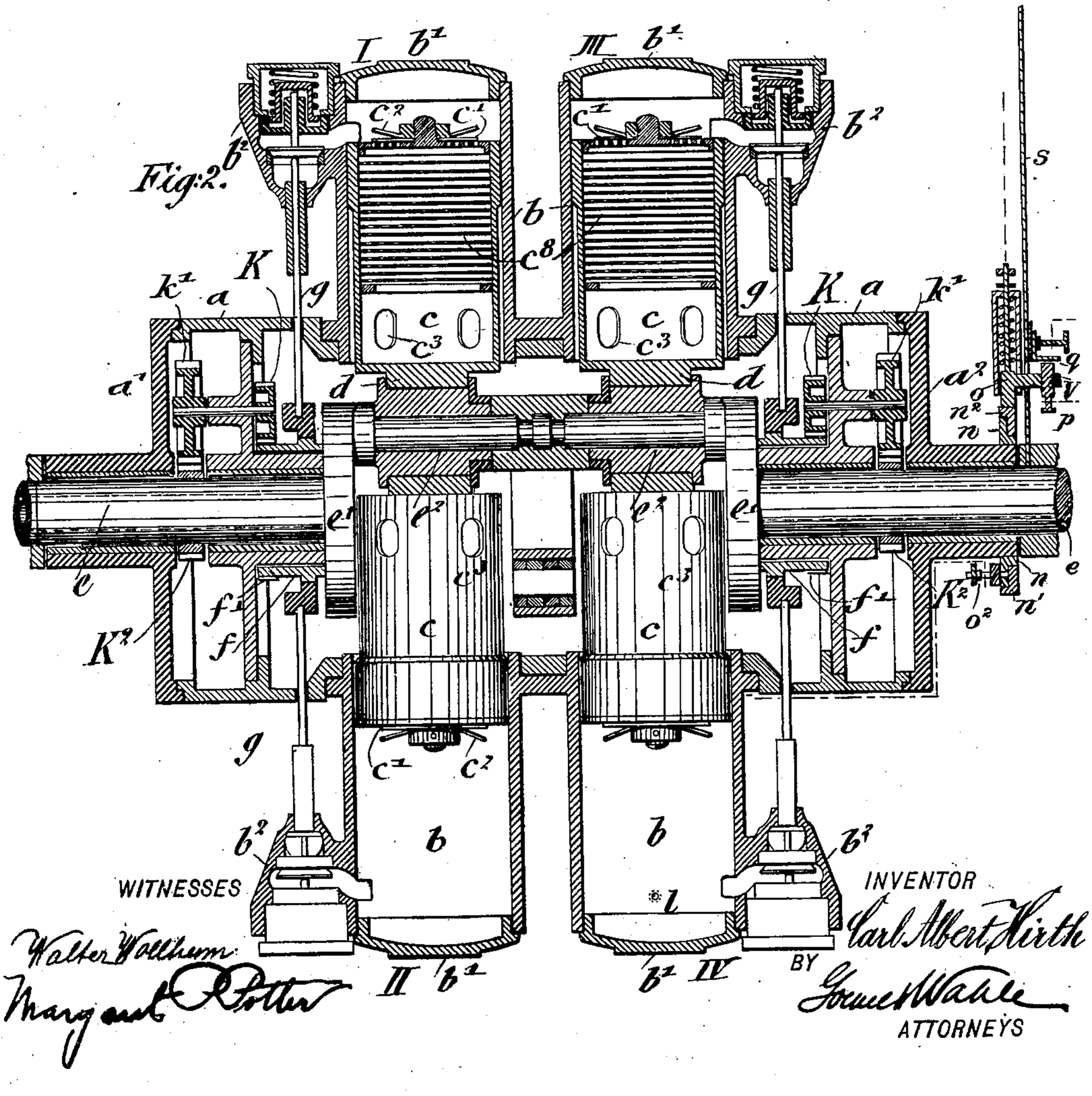

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Fig: 3.

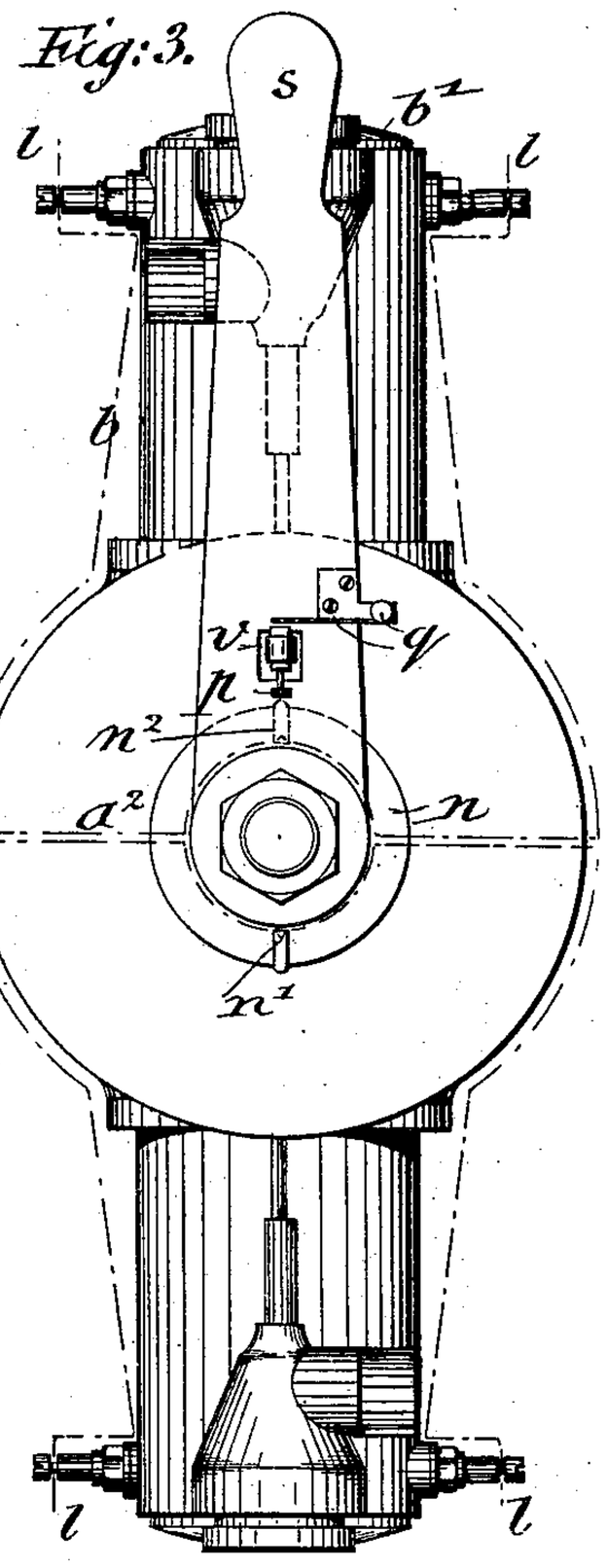


Fig: 4.

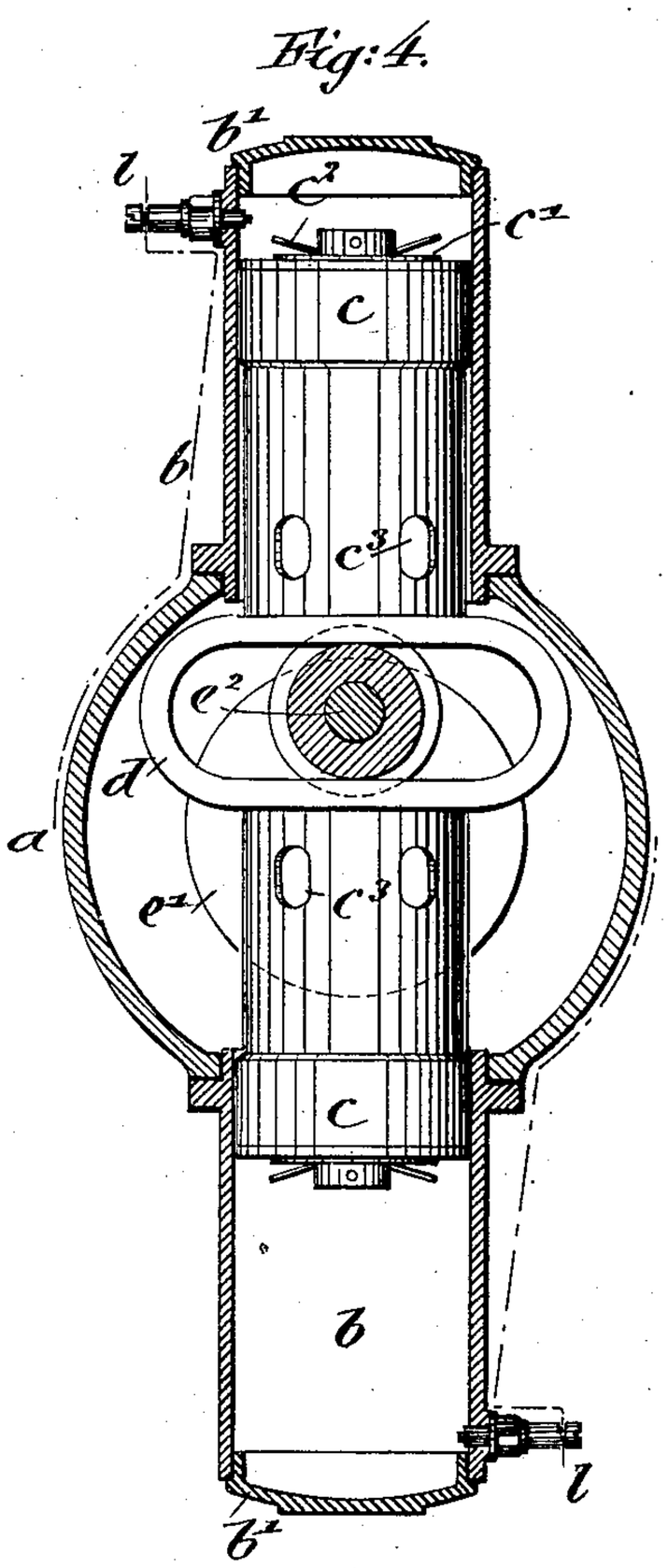


Fig: 5.

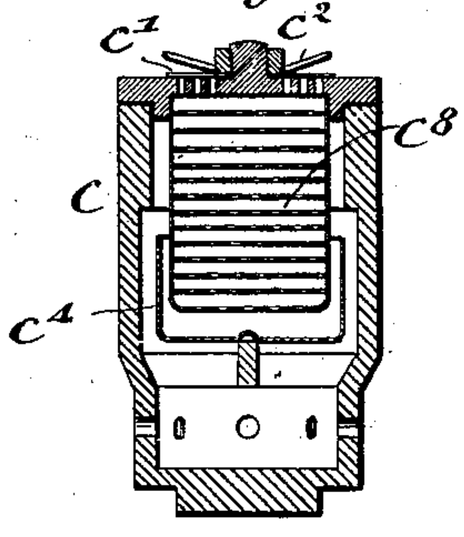
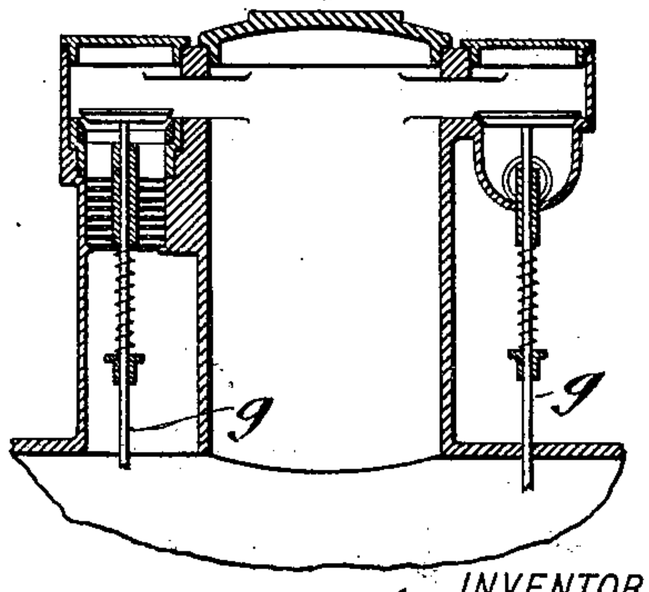


Fig: 6.



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ROTARY EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 685,141, dated October 22, 1901.

Application filed April 24, 1901. Serial No. 57,289. (No model.)

To all whom it may concern:

Be it known that I, CARL ALBERT HIRTH, a citizen of the Empire of Germany, residing in Stuttgart, in the Kingdom of Würtemberg, Germany, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

In gas and other engines in which the power is produced by the explosion of a suitable gas and air mixture the fly-wheel and the cooling liquid for the cylinders can be entirely dispensed with when the motor is so constructed that the cylinders, together with the plungers, are rotated around a stationary crank-axle, as then the weight of the cylinders and plungers replaces the weight of the fly-wheel, while the cylinders are subjected to a sufficient cooling action by their quick motion through the air. These advantages, however, were offset in the experiments heretofore made for obtaining such a motor by an almost unsurmountable obstacle, consisting in the difficulty of introducing the explosive gas and air mixture into the rapidly-rotating cylinders, inasmuch as the gas-tight connection between the gas-reservoir, located outside the motor, and the explosion-chambers of the rotating cylinders presented a very difficult problem, which has not been satisfactorily solved. Besides these difficulties there is another objectionable feature to be overcome—namely, the centrifugal force to which the explosive gas and air mixture is subjected on its way to the explosion-chambers and which impairs the uniform admixture of the gases, inasmuch as the air being heavier is forced quicker in outward direction than the lighter vapors. These objections and others connected therewith have therefore rendered the application of motors with rotating cylinders practically impossible. This invention is intended to overcome these difficulties and to furnish an improved construction of gas-engine with rotating cylinders, which has a large number of positive advantages; and for this purpose the invention consists of a gas-engine in which the cylinders are permanently connected with the crank-casing and rotated with the same and with the plunger-pistons around a stationary crank-shaft in such manner that the charging of the cylinders is produced directly from the casing of the crank-shaft, to which the explosive gas and air mixture is supplied through the stationary tubular crank-shaft itself.

The invention consists, further, in providing the plunger-pistons of such a gas-engine with metallic screens or other permeable conductors of heat, so as to produce an exchange of heat between the walls of the plunger-piston and the gas and air mixture drawn through the same and prevent also the back action of the explosion into the crank-casing; and the invention consists, lastly, of certain details of construction relating more specifically to the arrangement of the outlet-valves on the rotating cylinders and the gear by which the opening and closing of said valves are controlled at the proper time, as will be fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents an elevation of my improved gas-engine shown as arranged with four rotating cylinders. Fig. 2 is a vertical longitudinal section through the same. Fig. 3 is an end elevation. Fig. 4 is a vertical transverse section through two diametrical cylinders. Fig. 5 is a vertical transverse section through one of the plunger-pistons, showing a modified construction of the same; and Fig. 6 is a vertical transverse section showing a modified arrangement of the inlet and outlet valves.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, *a* represents a cylindrical casing which incloses tightly two stationary crank-shafts *e*, one of which is made tubular at one end, so as to conduct an explosive gas and air mixture from a suitable reservoir into the casing *a*. The stationary crank-shafts *e e* are supported in suitable sleeves A and B of supporting-standards A′ and retained firmly in position by nuts and jam-nuts applied to their threaded ends, as shown in Figs. 1 and 2. The casing *a* is provided with heads a' a^2, having sleeve-shaped bearings supported on brasses of the crank-shafts *e*, so as to rotate thereon. The cylindrical casing *a* incloses the stationary cranks e' at the ends of the crank-shafts *e* and serves as a reservoir for supplying the explosive gas and air mixture to the cylinders *b*, which are

preferably arranged in diametrical pairs on the casing *a*. The pairs of cylinders can be parallel to each other, as shown in Fig. 1, or one pair of cylinders may be located at right angles to the other, or any other arrangement of the cylinders may be used, provided that the weights of the cylinders are properly equalized during the running of the motor.

In the motor-cylinders *b* are arranged plunger-pistons *c*, which are connected at their inner ends by loop-shaped slide-links *d*, that are engaged by the wrist-pin e^2 on the stationary cranks *e'*, so that the plunger-pistons are reciprocated in the motor-cylinders while the same are rotated around the stationary crank-shafts *e*. The motor-cylinders *b* are open at their inner ends and connected with the casing *a*. The plunger-pistons *c* are also connected with the casing, preferably by means of openings c^3 in their cylinder-mantles, while the outer ends of the cylinders are closed by tightly-fitting heads *b'* and the outer ends of the plunger-pistons by valves *c'*, which are retained on the upper ends of the plunger-pistons by pins c^2, as shown in detail in Fig. 5. By the suction action of the plunger-pistons the explosive gas and air mixture is sucked into the explosion-chambers at the outer ends of the cylinders, the suction opening the valves *c'*, while during the period of compression of the gas and air mixture, during the period of exhaustion of the products of combustion, and during the explosion or working period the valves *c'* are closed by the pressure in the explosion-chambers of the cylinders *b*. The greater portions of the plunger-pistons are preferably filled with perforated screens c^8 of any approved construction, which serve to produce the more perfect intermingling of the gas and air sucked through the same and which also serve to heat the new and cold supply of explosive mixture in its passage through the screens, removing thereby the heat which is imparted to the screens and the walls of the plunger-pistons during the periods of compression and explosion. In this manner by the arrangement of the screens the cooling action which is imparted to the outer surface of the cylinder by the rapid passage of the same through the air is assisted by the interior cooling action exerted by the explosive mixture on the screens and inner surface of the cylinders. The screens, however, have another and very important advantage—namely, to prevent the ignition of the explosive gas and air mixture in the casing *a* by back action in case of the accidental opening of a valve during the explosion period.

Figs. 1 to 4 of the drawings show a four-stroke explosion-motor, the outlet-valves of which are only opened at every second rotation of the cylinders on their axis, so that it is consequently necessary to operate the double eccentric *f*, by which the spindles of the outlet-valves are actuated, from the stationary gear-wheel K^2 on the crank-shaft *e* by the transmitting gear-wheels *k'*, K, and *f'* in the proportion of one to two. These gears are located in extensions of the cylindrical casing *a*, as shown clearly in Fig. 2. Any approved construction of outlet-valves may be used, those shown in the drawings being located in separate valve-casings b^2, that are arranged alongside of the outer ends of the motor-cylinders *b*. The valve-spindles *g* are guided and spring-cushioned in the usual manner, as shown in Fig. 2, while the valve-casings are provided with outlet-tubes through which the products of combustion are conducted to the atmosphere. Each cylinder *b* is provided at its outer ends with a suitable ignition device *l*, that is actuated at the proper time, either electrically or otherwise, as shown in Figs. 3 and 4, in which they are connected by conducting-wires with suitable switching-in devices $n' n^2$, arranged on a disk *n*, rotating with the cylinders, and contacts *p v q*, arranged on a lever-handle *s*, applied to the stationary crank-shaft, as shown in Fig. 3. The disk *n* is made of insulating material and carries at diametrically opposite points the contacts $n' n^2$, which serve to press a slide-piece *o*, provided with a binding-post *p*, against a contact-spring *q* and to close thereby an electric circuit for an instant and then open the same again, whereby an electric spark is formed at the ignition devices *l* of the cylinders. The contacts $n' n^2$ are for this purpose connected by conducting-wires (shown in Figs. 3 and 4) with the ignition devices. The primary coil of an induction-coil (not shown) is connected with a binding-post of the contact-spring *q* and with the binding-post *p*, which is insulated from the projection *v* of the slide-piece *o*. The secondary coil of the induction-coil is connected with the binding-post o^2 and with the metallic framework of the motor. At the moment when one of the contacts $n' n^2$ is moved past the slide-piece *o* either n' or n^2 is pressed against the contact-spring *q*, and thereby the circuit of the primary coil closed. Simultaneously therewith a spark is produced by the secondary coil between the ignition devices of that cylinder in which the explosion is to take place, and so on in succession in the different cylinders. The plunger-pistons may also be constructed with an interior cup-shaped cylinder c^4, as shown in Fig. 5, said cylinder c^4 being arranged between the screens and the cylinder-mantle, so that the gas and air mixture is drawn in a circuitous course around the interior cylinder and then to the screens, so that a still more effective cooling action is exerted by the cold gas and air mixture on the screens and the interior surface of the walls of the plunger-piston. The gas and air mixture, however, can also be conducted directly into the explosion-chambers of the motor-cylinders *b* without passing through the plunger-pistons, in which case the inlet-valves are provided with exterior channels having interior screens, as shown in Fig. 6, through which the explosive mixture is drawn

in and delivered to the explosion-chambers, while the outlet-valves are arranged at opposite sides of the cylinders. Both the inlet and outlet valves, however, require with this arrangement a positive motion from suitable eccentrics on the stationary crank-shaft.

The operation of my improved gas-engine is as follows: By the explosion in cylinder II the plunger-piston is moved inwardly, so that a compression motion of the plunger-piston in cylinder I takes place. At the end of this motion the outlet-valve of cylinder II is actuated by one cam portion of the double eccentric *f*, so that during the following rotation of the cylinder through an angle of one hundred and eighty degrees (the second stroke) the plunger-piston in the cylinder II expels the products of combustion, while simultaneously in cylinder I the explosion of the compressed gas and air mixture takes place, so that the return stroke of the plunger-piston is produced. At the third stroke the plunger-piston of cylinder II draws in a new quantity of the explosive mixture, while the products of combustion in cylinder I are expelled, for the reason that the opposite cam portion of the eccentric *f* has in the meantime lifted the outlet-valve of this cylinder, while during the fourth stroke the plunger-piston in cylinder II compresses the gases drawn in, while in cylinder I a new supply of explosive gas and air mixture is sucked in. This is continually repeated during the rotation of the cylinders, as the four-stroke cycle takes place during every two full rotations of the cylinders.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a gas-engine with rotating cylinders, the combination, with a rotary crank-casing, provided with pairs of diametrically-arranged motor-cylinders, of plunger-pistons in said cylinders, screens located in said plunger-pistons in the path of the explosive mixture, stationary crank-shafts and slide-links connecting said plunger-pistons and crank-shafts for reciprocating the plunger-pistons, said plunger-pistons being provided with openings at their inner ends and valves at the outer ends for supplying the explosive mixture from the casing to the explosion-chambers of the cylinders, substantially as set forth.

2. In a gas-engine with rotating cylinders, the combination, with a rotary crank-casing provided with pairs of diametrically-arranged motor-cylinders, of plunger-pistons in said cylinders, the interior of said plunger-pistons being in open communication with said casing, and screens located in said plunger-pistons through which the explosive mixture is drawn from the crank-casing into the explosion-chambers of the cylinders, so as to produce an exchange of heat from the plunger-handle to the explosive mixture, substantially as set forth.

3. In a gas-engine with rotating cylinders, the combination of a crank-casing provided with pairs of diametrically-arranged motor-cylinders, plunger-pistons in said cylinders, screens located in said plunger-pistons in the path of the explosive mixture, the interior of said plunger-pistons being in open communication with said casing, stationary crank-shafts engaging the inner connected ends of said plunger-pistons, one of said crank-shafts being tubular for supplying the explosive mixture to the interior of the crank-casing, and valves at the outer ends of the plunger-pistons for supplying the explosive mixture from the casing through the plunger-pistons to the explosion-chambers of the cylinders, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

CARL ALBERT HIRTH.

Witnesses:
KONRAD ZEISIG,
WM. HAHN.