No. 810,435 PATENTED JAN. 23, 1906.

F. REYNOLDS.

ROTARY EXPLOSIVE ENGINE.

APPLICATION FILED NOV. 2, 1903.

5 SHEETS—SHEET 1.

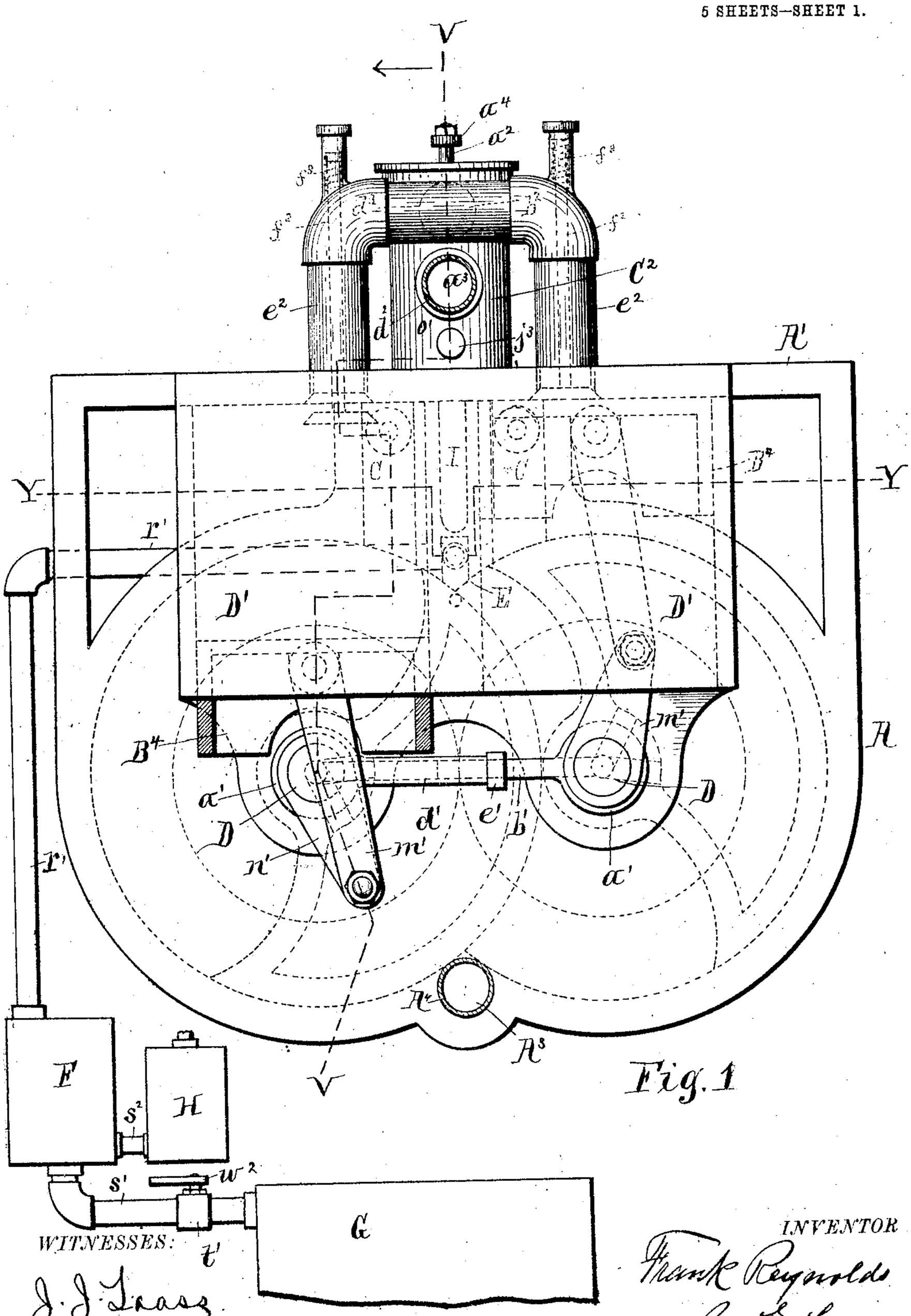

Fig. 1

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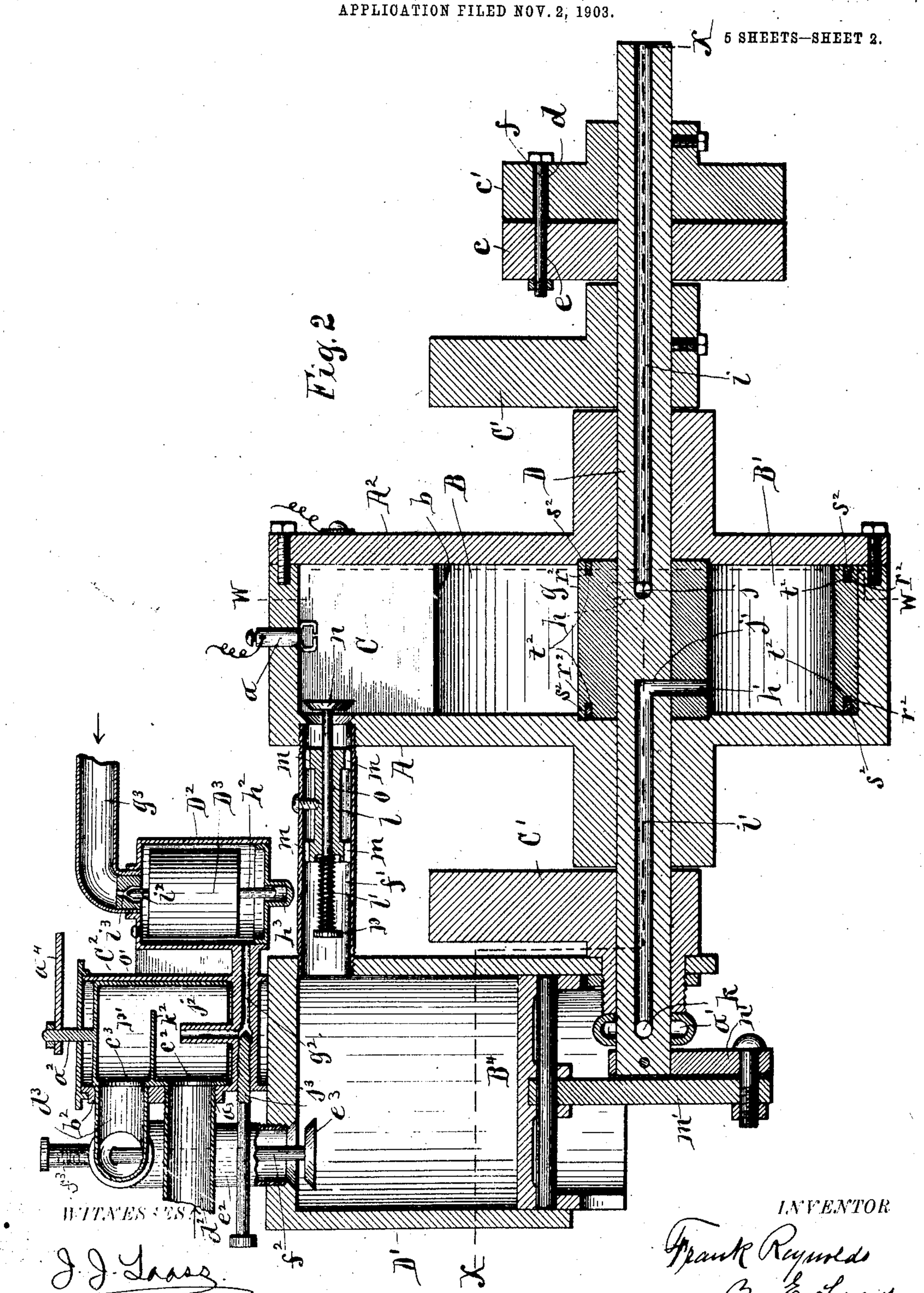
5 SHEETS—SHEET 2.

Fig. 2



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5 SHEETS—SHEET 3.

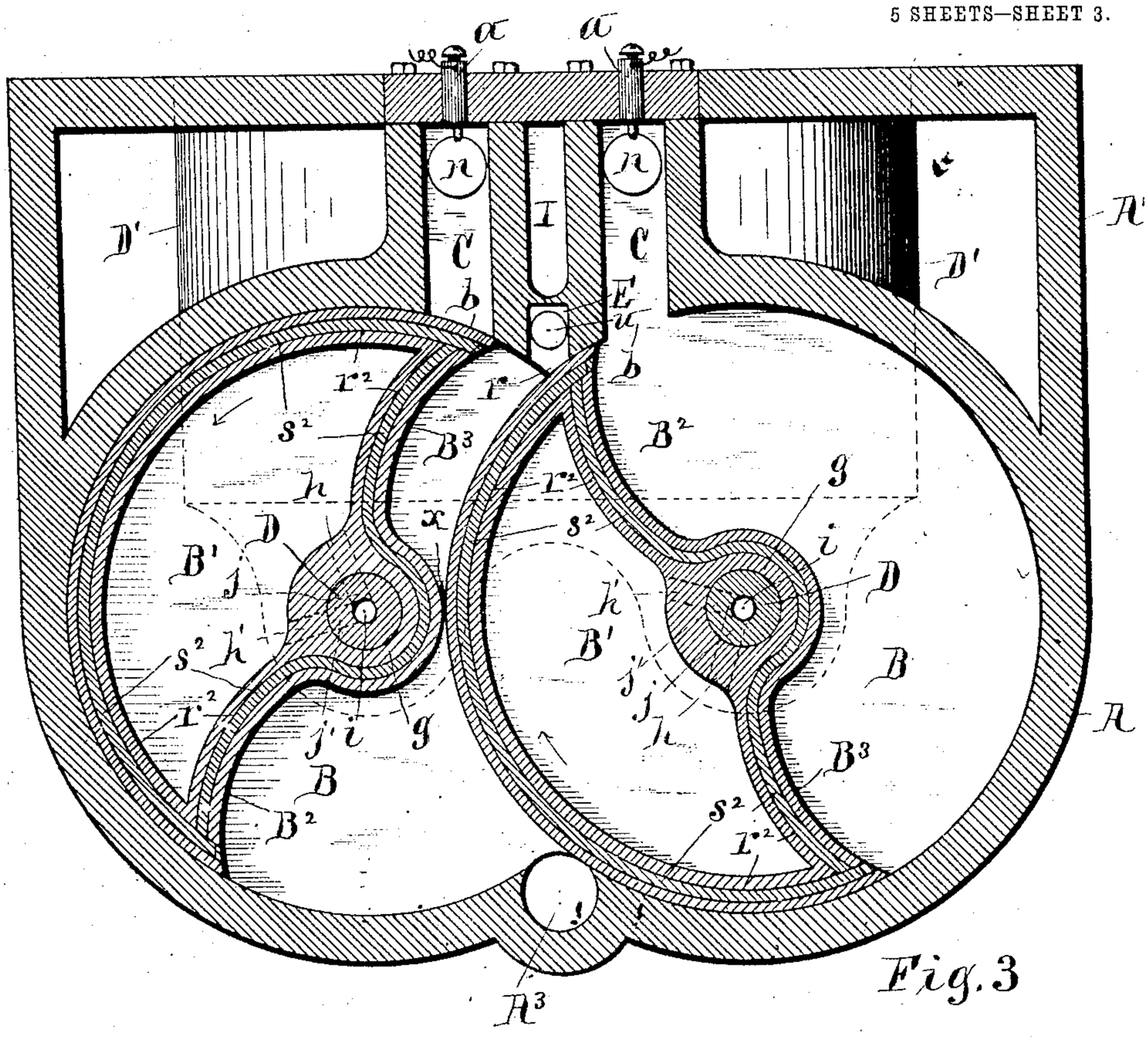

Fig. 3

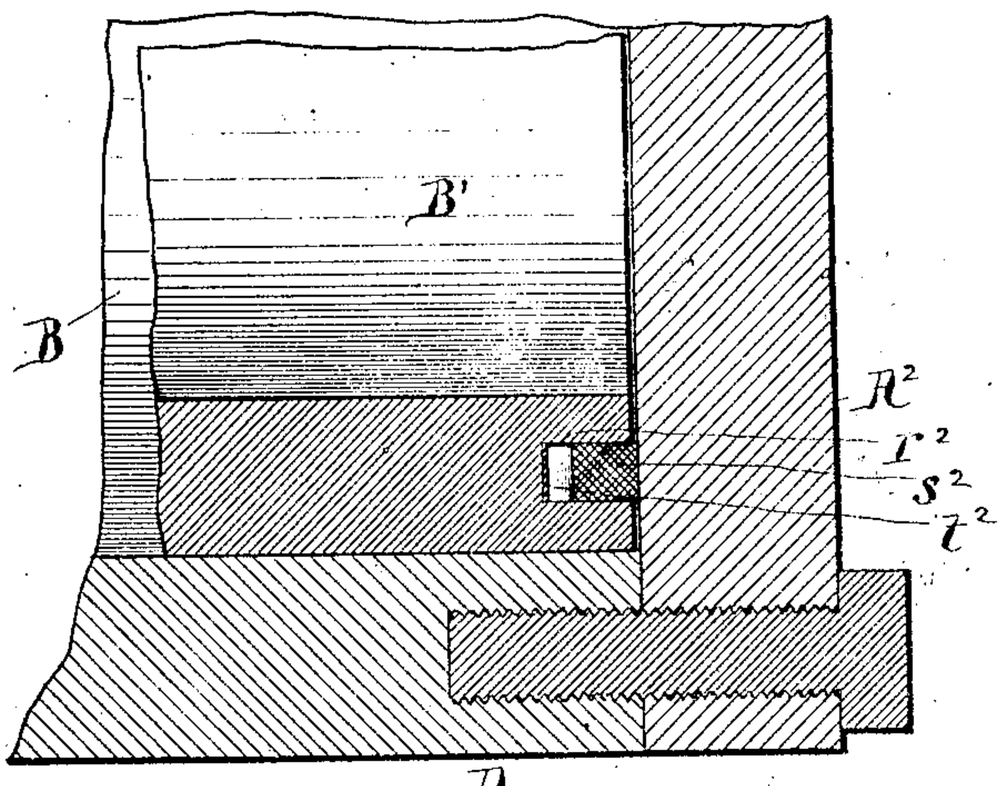

Fig. 7

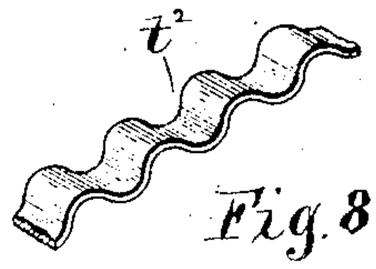

Fig. 8

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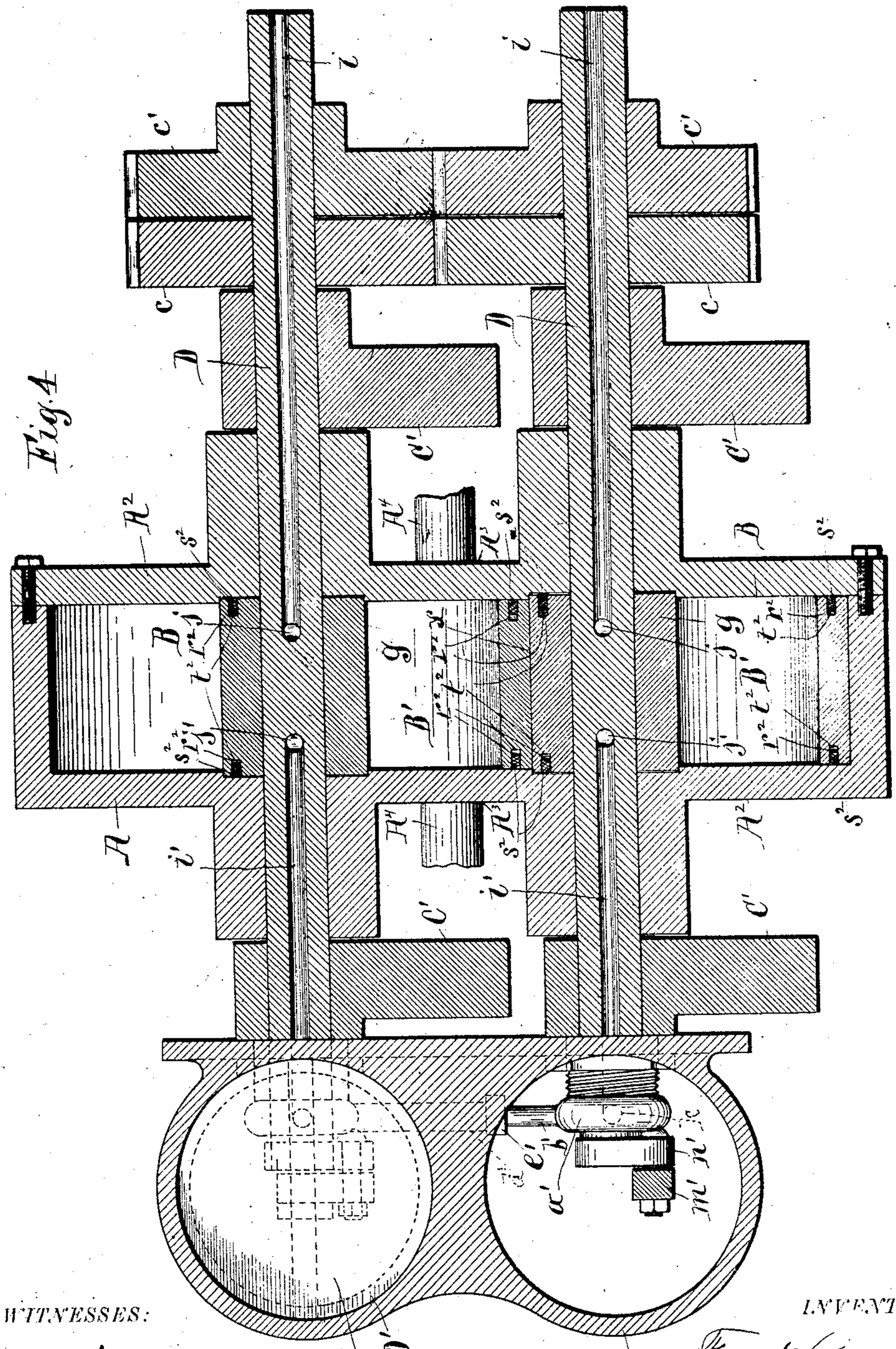
APPLICATION FILED NOV. 2, 1903.

5 SHEETS—SHEET 4.

Fig. 4



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ROTARY EXPLOSIVE ENGINE.

APPLICATION FILED NOV. 2, 1903.

5 SHEETS—SHEET 5.

Fig. 5

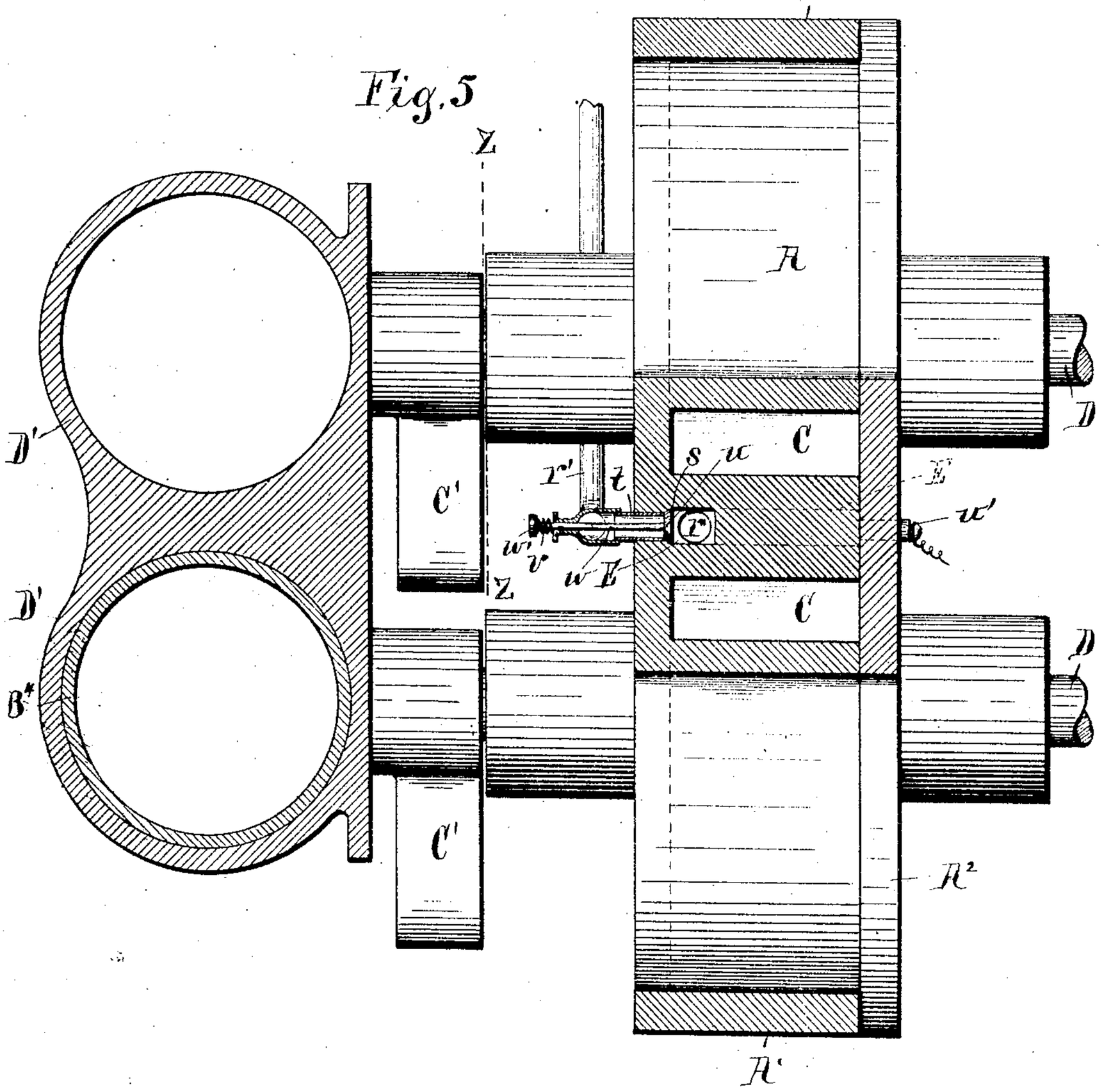
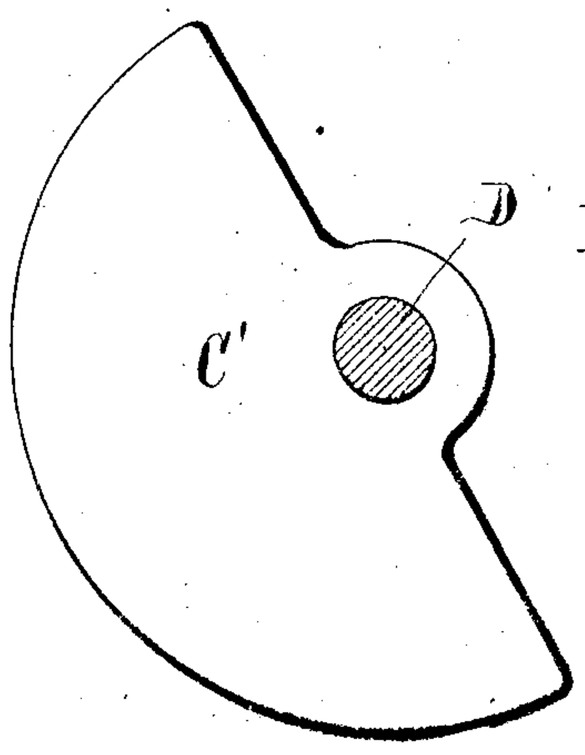


Fig. 6



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UNITED STATES PATENT OFFICE.

FRANK REYNOLDS, OF SYRACUSE, NEW YORK.

ROTARY EXPLOSIVE-ENGINE.

No. 810,435. Specification of Letters Patent. Patented Jan. 23, 1906.

Application filed November 2, 1903. Serial No 179,481.

To all whom it may concern:

Be it known that I, FRANK REYNOLDS, a citizen of the United States, and a resident of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Rotary Explosive-Engines, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to the class of gasolene-engines which are commonly known as the "rotary" type.

The present invention resides in an engine which is adapted for various uses, although it is more especially designed for propelling automobiles and launches.

The object of the present invention is to produce a gasolene-engine which shall be simple, strong, and durable in construction, safe, efficient, and reliable in its operation, and can be easily and conveniently controlled, and at the same time shall be inexpensive to manufacture.

Furthermore, the object of the invention is to provide simple and efficient means for starting the engine.

To this end the invention consists in the novel arrangement and construction of the component parts of the gasolene-engine, as hereinafter fully described, and set forth in the claims.

In the accompanying drawings, Figure 1 is an end view of the engine embodying my invention. Fig. 2 is a vertical longitudinal section on line V V in Fig. 1. Fig. 3 is a vertical transverse section on line W W in Fig. 2. Fig. 4 is a longitudinal section on line X X in Fig. 2. Fig. 5 is a horizontal transverse section on line Y Y in Fig. 1. Fig. 6 is a transverse section on line Z Z in Fig. 5. Fig. 7 is an enlarged detail sectional view of a portion of the case and one of the rotary pistons and illustrating more fully the air-tight packing of the piston, and Fig. 8 is a further enlarged detail view of a portion of the metallic strip disposed back of the packing.

Similar letters of reference indicate corresponding parts.

A represents a case, which may be of any suitable size and style and is formed with two intersecting cylindrical compartments B b. Said case is also formed with two compartments C C, disposed above the compartments B B and into which the explosive mixture received under compression. Between the compartments C C the case is formed with an air-space I for the purpose of cooling the said compartments. Said case A is preferably formed with a frame A′, which may be employed for supporting the case. One of the walls A^2 of the case is removable and is secured in place by means of bolts, thereby affording access to the interior of the case. In the lower portions of the walls A^2 A^2 of the case are provided ports A^3 A^3 for exhausting the exploded mixture, as hereinafter more fully described, from which project pipes A^4 A^4.

The explosion of the mixture is effected by the usual and well-known spark-plugs *a a*, the sparking of which may be produced by any suitably-controlled devices which are common to all explosive-engines. These explosion-compartments C C communicate with the respective cylindrical compartments B B by means of ports *b b*, as clearly shown in Fig. 3 of the drawings.

D D denote two parallel shafts which extend axially through the cylindrical compartments B B and are connected by two pairs of gears secured to the shafts, as indicated at *c c′ c′*. These gears are of equal sizes, whereby the said shafts rotate at the same speed and in opposite directions. One of the gears *c′* is provided with a segmental slot *d*, and the adjacent gear *c* is provided with a hole *e*, and through said slot and hole passes a bolt *f*. This arrangement permits the gears to be adjusted when they become worn, and thereby prevent chucking of the gears.

B′ B′ denote two sectoral pistons which are disposed in the aforesaid cylindrical compartments B B and are secured to the respective shafts D D, and thereby rotate in opposite directions. Said pistons are formed hollow for the reception of water, oil, or air for the purpose of cooling the same. Said pistons B′ B′ are provided with radial faces B^2 B^3, the latter being impinged by the exploded mixture and constituting the driving-faces. The said faces of each of the pistons are formed concave to prevent collision of the two pistons during their rotation and for the purpose of increasing the impingement of the mixture thereon incident to the explosion of the mixture.

The segmental portions of the pistons are of such radii that the peripheral portion of one is in contact with the hub *g* of the other during their rotation, thereby forming a cut-off at this point to prevent the escape of the exploded mixture, as indicated at *x* in Fig. 3

of the drawings. The hubs g of the said pistons are each provided with two radial passages h h', which communicate with the interiors of the pistons and respectively with bores i i', formed in the shaft D by means of ports j j'. The bores i i' extend through one end of the respective shafts and may be connected with any suitable tank or chamber containing the cooling agent. The bores i i' of the shafts each extend to within a short distance from the end of the shaft, and they communicate by means of transverse or radial ports k k with annular chambers a' a', loosely surrounding the shafts, which chambers are connected by pipes b' d', united by a suitable coupling e', thereby permitting a constant circulation of the cooling agent through the shafts and pistons, as clearly shown in Figs. 2 and 4 of the drawings.

When a liquid, as water or oil, is used as the cooling agent, the rotation of the piston causes the liquid to flow from the bore i through the radial passage h into the piston and out through the passage h' into the bore i'.

It will be understood that the cooling of the liquid or air may be effected by any suitable means, and a pump may be used for forcing the liquid or air through the described parts.

C' C' denote sectoral counterbalances, two of which are preferably secured to each shaft D and have a combined weight equal to that of the corresponding piston B'.

D' D' represent two vertically-disposed cylindrical chambers, preferably formed integral and having their lower ends open, and which may be supported in any suitable and convenient manner. In these chambers the explosive mixture is compressed, as hereinafter fully described. These chambers D' D' communicate with the respective explosion-compartments C C of the case A by means of tubes f' f'', connected to the upper portions of the chambers and compartments. In each of said tubes f' is secured a plug l, provided with passages m m for the mixture.

In each explosion-compartment C is a check-valve n, opening and closing the discharge end of the tube f'. Said valve is formed with a stem o passing through the aforesaid plug l and provided on its outer end with a collar or head p. Between said collar or head and the plug l and surrounding the said stem o is a spiral spring l', which serves to normally close the valve n. In each of said cylindrical chambers D' D' is disposed a reciprocating piston B', having its rod m' connected to a crank n', fastened to the shaft D, from which it receives its movement.

C^2 represents the main carbureter, which supplies the explosive mixture. This carbureter is composed of two vertically-disposed telescopic cylinders o' and p'. The outer cylinder o' is stationary and may be supported in any suitable manner and is provided with an air-inlet port a^3 and a mixture-outlet port b^2. The inner cylinder p' is adapted to be rotated and is provided with a stem a^2, projecting through the top of the cylinder o', to which stem is attached a hand-lever a^4 for imparting movement to said cylinder p'. The said cylinder p' is provided with ports c^2 c^3, which are disposed to register with the aforesaid ports a^3 b^2, respectively. In the air-inlet port a^3 is secured an air-supply pipe d^2, and in the outlet-port b^2 is secured a discharge-pipe d^3. Said discharge-pipe d^3 communicates with branch pipes e^2 e^2, which in turn communicate, respectively, with the upper portions of the cylindrical chambers D' D'. In each of said cylindrical chambers is a check-valve e^3, which opens and closes the end of the pipe e^2 and is provided with a stem f^2, extending upwardly and provided with a suitably-arranged spring f^3. (Shown in dotted lines.) Said spring serves to normally maintain the valve e^3 closed, which latter entraps the mixture in the chamber, as hereinafter explained.

D^2 represents a cylindrical chamber which contains the gasolene. Said gasolene-chamber communicates at its lower portion with the corresponding portion of the carbureter C^2 by means of a duct g^2 and has attached to its top a supply-pipe g^3, which leads from a suitable gasolene-reservoir. (Not necessary to be shown.) In said gasolene-chamber is a float D^3, provided on its bottom with a stem h^2, moving in a guide h^3, provided in the bottom of the chamber. On the upper end of the float D^3 is provided a similar stem i^2, preferably tapered at its outer end and constituting a valve. This valve is adapted to open and close a gasolene inlet-port i^3, formed in a plug secured in the end of the pipe g^3, and thereby control the supply of gasolene to the chamber D^2. The said gasolene feed-duct g^2 communicates with a stand-pipe j^2, extending into the inner cylinder p' of the carbureter, and in said duct is the so-called "needle-valve" j^3, which is adjustable to regulate the feed of gasolene to said carbureter. Above the stand-pipe j^2 is a diaphragm k^2, attached to the inner cylinder of the carbureter and serves to more effectually mix the air and gasolene. The aforesaid case A is formed with a supplemental explosion-compartment E, disposed between the main explosion-compartments C C and independent thereof. This compartment E is provided with a port r, by which it communicates alternately with the cylindrical compartments B B of the case. Said supplemental explosion-compartment E is also provided with an inlet-port s, in which is secured a pipe t, the discharge end of which is provided with a check-valve u. This valve is held normally closed by a spiral spring v, surrounding the stem w of the valve and exerting outward pressure

on a collar w', secured to said stem, as clearly shown in Fig. 5 of the drawings. The pipe t is connected to another pipe r', which leads from a carbureter F, and this carbureter is connected to a compressed-air tank or chamber G by means of a pipe s'. The pipe s' is provided with a suitable valve t', which controls the discharge of air from the tank or chamber G, and to the valve t' is attached a hand-lever w^2 for operating the same.

H denotes a chamber which contains gasolene and is connected to the carbureter F by means of a pipe S^2. The said carbureter F and gasolene-chamber H may be of any suitable or well-known construction. The aforesaid supplemental explosion-compartment E is provided with an electric spark-plug a', similar to the spark-plugs a a in the main explosion-compartments, which plug is disposed slightly below the plane of the upper point of intersection of the compartments B B and secured to the rear wall of the case, as shown in Figs. 1 and 5 of the drawings.

The sparking may be effected by any suitable means. (Not necessary to be shown.)

The air may be compressed in the tank or chamber G in any convenient manner—as, for example, an automatic pump may be arranged to communicate with said tank and be operated by one of the engine-shafts D or other movable part of the engine.

Having described the construction of my improved gasolene-engine, I will now proceed to explain the operation of the same, as follows, to wit: To start the engine, the person in charge turns the hand-lever w^2 to open the valve t' in the pipe s', whereby the air under compression is discharged from the chamber or tank G and passes through the carbureter F, in which it becomes mixed with the gasolene fed to the carbureter from the chamber H, it being understood that the supply of gasolene is controlled by a valve or valves common to all engines. The mixture effected in the carbureter being under pressure derived from the tank G is forced through the pipe r'. This pressure opens the check-valve u and admits the mixture into the aforesaid supplemental explosion-compartment E in the case A. When proper amount of the mixture is supplied to the compartment, the valve t' is closed, whereby pressure is relieved back of the valve u to allow the spring v to close the latter, and thus entrap the mixture in said compartment. Immediately after the valve u is closed the usual and well-known properly-timed electric devices (not shown) are actuated to cause a sparking at the plug a', thereby producing the explosion of the mixture in said compartment E. By reason of the said compartment communicating alternately with the aforesaid cylindrical compartments C C through the port r the resultant force of the said explosion causes the mixture to impinge the concave face B^2 of one of the pistons B′, exposed to the port, which impingement imparts rotary motion to said piston. The rotation of the piston allows the exploded mixture to escape through the exhaust-ports A^3 A^3. The shaft D of the driven piston being geared to the other shaft D, as aforesaid, rotates the companion piston in opposite direction. The engine being under motion and the needle-valve adjusted to feed the gasolene to the carbureter C^2 the hand-lever a^4 is operated to rotate the inner cylinder p' of the said carbureter to cause the ports c^2 and c^3 to register with the ports a^3 and b^2, respectively, of the outer stationary cylinder o'. This operation of the inner cylinder admits the air through the ports a^3 c^2 and permits the discharge of the mixture of air and gasolene through the ports b^2 c^3. The rotating shafts D D impart reciprocating movement to the respective pistons B^4 B^4, disposed in the cylindrical chambers D′ D′ and which are so arranged that one moves outward during the inward movement of the other. The outward stroke of a piston B^4 creates a suction in the corresponding cylindrical chamber D′. This suction opens the check-valve e^3 and permits the explosive mixture to be drawn from the carbureter C^2 into said chamber. During this movement of the piston B^4 the aforesaid valve n in the explosion-compartment C is maintained closed by its spring. When the piston B^4 reaches the end of its outward stroke, the spring f^3 automatically closes the check-valve e^3, and thus entraps the mixture in the said chamber D′. By the inward stroke of said piston the mixture becomes compressed between the top of the piston and head of the chamber and subsequently forced out through the tube f'. This force is sufficient to open the valve n, and thereby admit the compressed mixture in the explosion-compartment C. The succeeding outward stroke of the said piston B^4 relieves the pressure back of the valve n, whereby the spring k' automatically closes said valve and entraps the compressed mixture in said compartment, in which it is exploded. This explosion is produced by the usual electric spark-plug a. The sparking of said plug may be effected and controlled by any suitable and well-known devices which operate automatically. Inasmuch as these devices are common to all engines of this character, an illustration and a description of the same are unnecessary.

It will be understood that the mixture is admitted into a compartment C while the port b thereof is closed by the peripheral portion of the rotary piston B′ and that the electric devices controlling the sparking are timed so as to ignite the mixture as the port is opened. The reciprocating pistons B^4 B^4 being arranged and operating as described, the mixture is alternately compressed in the chambers D′ D′ and likewise supplied to the corresponding explosion-compartments C C.

The resultant force of the exploded mixture causes the mixture to impinge the concave faces B^2 B^2 of the pistons B′ B′ and impart rotary motion to the same in the manner hereinbefore described and allow the mixture to escape through the exhaust-ports A^3 A^3.

I do not limit myself to the specific construction and arrangement of the component parts of my improved engine, inasmuch as these may be greatly modified without departing from the spirit of my invention.

The end faces of the pistons B′ B′ are formed with grooves r^2 in which a suitable packing s^2 is provided, and back of said packing in the grooves are disposed spring-metal strips t^2, which press the packing outward to produce an air-tight joint between the pistons and walls of the case A, as clearly shown in Figs. 3 and 7 of the drawings.

What I claim is—

1. In a rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments and formed with two separate explosion-compartments each provided with a port affording communication with its respective cylindrical compartment, suitable igniters in the explosion-compartments, parallel rotary shafts extending axially through the said cylindrical compartments and geared to rotate in opposite directions, sectoral pistons in the latter compartments and secured to the respective shafts and opening and closing said ports alternately, compression-chambers communicating directly with the respective explosion-compartments, a carbureter communicating with each of said chambers alternately, means supplying the carbureter with air and gasolene, reciprocating pistons in the chambers and operated by the aforesaid shafts, and compressing the mixture in said chambers and forcing the compressed mixture into the explosion-compartments, check-valves in said chambers and explosion-compartments and opened by the suction and compression respectively of the mixture, means automatically closing said valves, and exhaust-ports in the said case, substantially as described.

2. In a rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments and explosion-compartments each communicating with the upper portions of its respective cylindrical compartment, parallel shafts extending axially through the latter compartments and geared to rotate in opposite directions, sectoral pistons in the cylindrical compartments and secured to said shafts, suitably-controlled igniters in the explosion-compartments, a pair of upright chambers communicating at their upper portions directly with the respective explosion-compartments, a carbureter communicating with the upper portions of each of the chambers alternately, reciprocating pistons in said chambers operated by the aforesaid shafts and drawing the explosive mixture from the carbureter alternately into said chambers and compressing the mixture therein and subsequently forcing the compressed mixture from the chambers into the corresponding explosion-compartments, automatic check-valves between the latter compartments and compression-chambers and between the said chambers and carbureter, and exhaust-ports in the said case, substantially as described.

3. In a rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments and explosion-compartments each communicating with its respective cylindrical compartment, parallel shafts extending axially through the latter compartments and geared to rotate in opposite directions, sectoral pistons in said cylindrical compartments and secured to said shafts, suitably-controlled electric sparking devices in said explosion-compartments, a pair of vertically-disposed cylindrical chambers communicating at their upper portions with the respective explosion-compartments, a carbureter communicating with the tops of said chambers, reciprocating pistons in said chambers, and operated by said shafts and alternately drawing the explosive mixture from the carbureter into the chambers and compressing the same therein and forcing the compressed mixture into the corresponding explosion-compartments, horizontally-movable check-valves in said compression-chambers opened by the suction-strokes of the latter pistons, and like valves in the explosion-compartments opened by the compression-strokes of the pistons, springs closing said valves, and means for exhausting the exploded mixture from the aforesaid cylindrical compartments substantially as described.

4. In a rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments and explosion-compartments each communicating with its respective cylindrical compartment, parallel shafts extending axially through the latter compartments and geared to rotate in opposite directions, sectoral pistons in said cylindrical compartments and secured to said shafts, sectoral counterbalances secured to said shafts, igniters in the explosion-compartments, means for alternately supplying the latter compartments with explosive mixture under compression, and suitable check-valves and exhaust-ports arranged substantially as and for the purpose set forth.

5. In a rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments and explosion-compartments each communicating with its respective cylindrical compartment, parallel rotary shafts extending through said cylindrical compartments and geared to rotate in

opposite directions, sectoral pistons secured to the respective shafts, igniters in the explosion-compartments, a pair of cylindrical chambers communicating at their upper ends with the respective explosion-compartments, a carbureter communicating with said chambers, a gasolene-chamber communicating with the carbureter, an air-inlet port and a mixture-discharge port in the carbureter, means for simultaneously opening and closing said ports, means controlling the feed of the gasolene to the carbureter, suitably-operated reciprocating pistons in the aforesaid cylindrical chambers, and drawing the explosive mixture from the carbureter alternately into said chambers and compressing the same therein and forcing the compressed mixture into said explosion-compartments, cranks and rods imparting movement from the aforesaid shafts to the latter pistons, check-valves in said explosion-compartments and compression-chambers, and exhaust-ports in said case substantially as described and shown.

6. In a rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments and explosion-compartments each communicating with its respective cylindrical compartments, igniters in the explosion-compartment, parallel shafts extending axially through the cylindrical compartments and geared to rotate in opposite directions, sectoral pistons in said latter compartments and secured to said shafts, exhaust-ports in said case, a pair of cylindrical compression-chambers, pipes conducting the compressed mixture from the chambers to the respective explosion-compartments, check-valves opening and closing said pipes, a carbureter, an inlet-port and a mixture-outlet port in the carbureter, a gasolene-chamber communicating with the carbureter, a supply-pipe connected to the gasolene-chamber, means for simultaneously opening and closing the aforesaid ports in the carbureter, a pipe connected to the carbureter, branch pipes leading from the latter pipe to the tops of the respective compression-chambers, reciprocating pistons in the latter chambers and actuated by the aforesaid shafts, said pistons alternately drawing the explosive mixture from the carbureter into the respective chambers and compressing the mixture therein and forcing the compressed mixture into the said explosion-compartments, and check-valves in said latter compression-chambers opening and closing the aforesaid branch pipes, substantially as described.

7. In the herein-described rotary explosive-engine the combination of a case comprising two intersecting cylindrical compartments, parallel shafts extending axially through said compartments and geared to rotate in opposite directions, said shafts each being provided with a longitudinal bore and at one end with a transverse port, chambers surrounding the respective shafts at said ends and communicating with said bores, a pipe affording communication between the chambers, hollow sectoral pistons in said compartments and formed with hubs by which they are secured to said shafts, transverse ports in the shaft extending from the aforesaid bores, and the said hubs formed with radial passages communicating with said ports and affording communication between the bores of said shafts and interiors of the pistons, as and for the purposes set forth.

8. In the herein-described rotary explosive-engine, the combination with a case formed with two cylindrical compartments, suitably-journaled sectoral pistons in said compartments, grooves formed in the end faces of said pistons, packing in said grooves, and corrugated spring-metal strips disposed back of the packing and pressing the same outward for the purpose set forth.

9. In the herein-described rotary explosive-engine, the combination of a case comprising two intersecting cylindrical compartments main explosion-compartments each communicating with its respective cylindrical compartment and a supplemental explosion-compartment communicating alternately with said cylindrical compartments, oppositely-rotating sectoral pistons journaled in the latter compartments, exhaust-ports in the case, igniters in said explosion-compartments, a main carbureter supplying the main explosion-compartments with mixture, another carbureter supplying the supplemental explosion-compartment with mixture, and a compressed-air tank or chamber communicating with the latter carbureter substantially as and for the purpose set forth.

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