No. 892,804. PATENTED JULY 7, 1908.

L. S. BURBANK.

ENGINE.

APPLICATION FILED APR. 22, 1902.

6 SHEETS—SHEET 1.

Fig. 1.

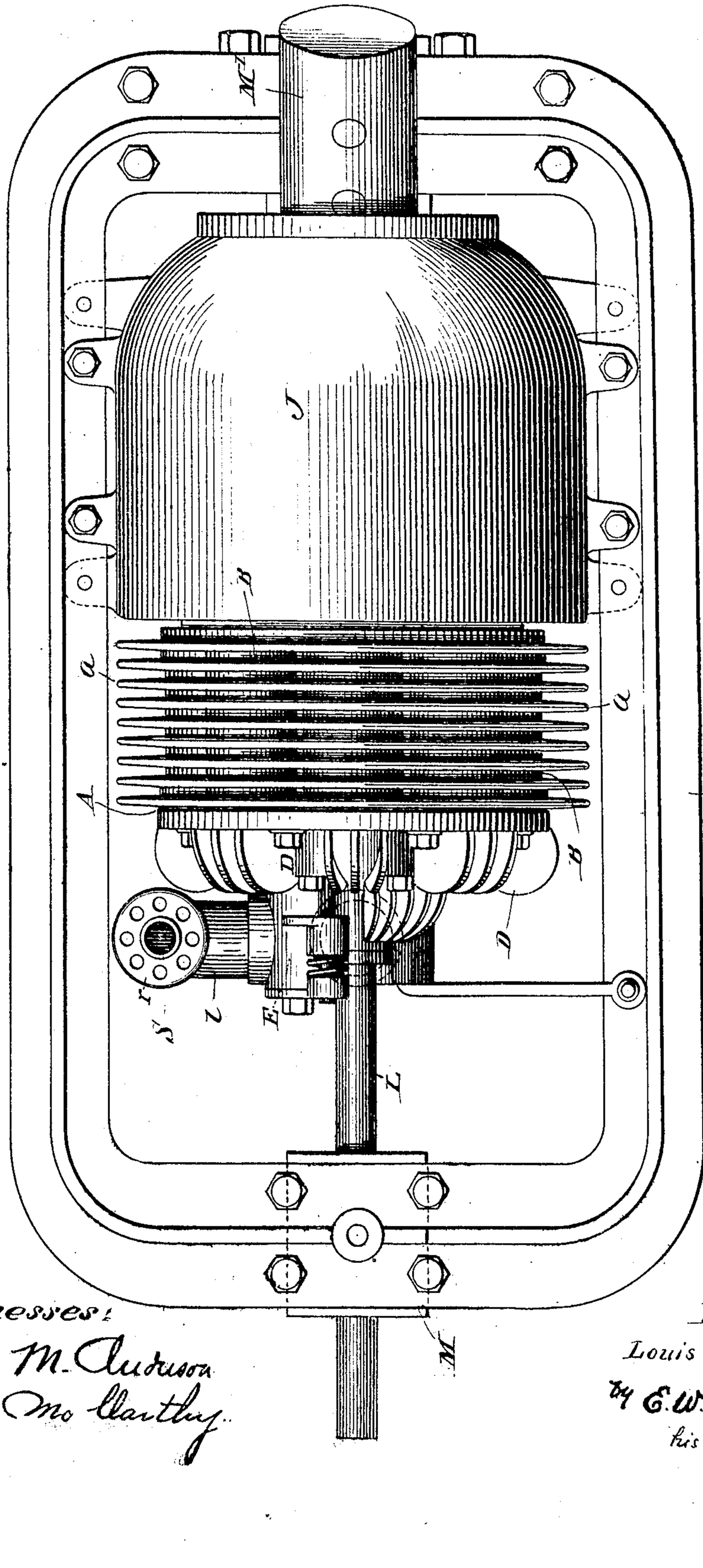

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Fig. 2.

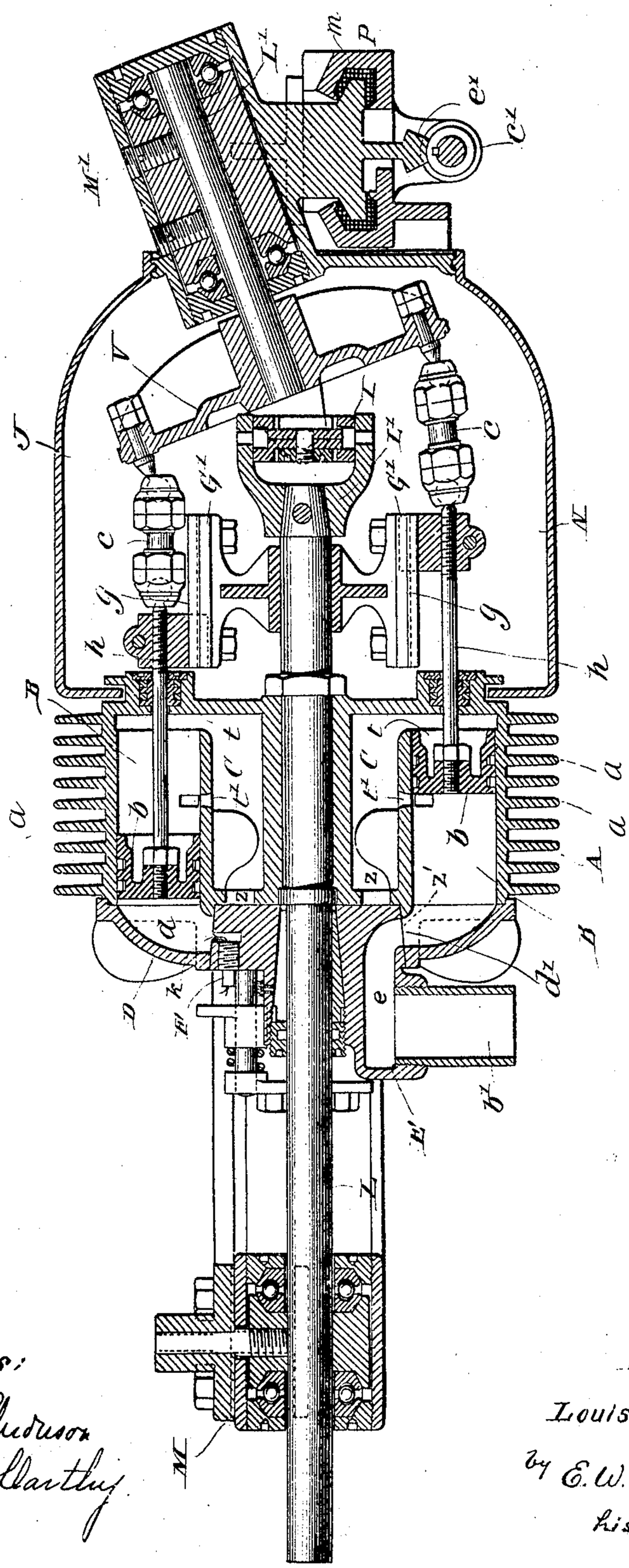

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Fig. 3.

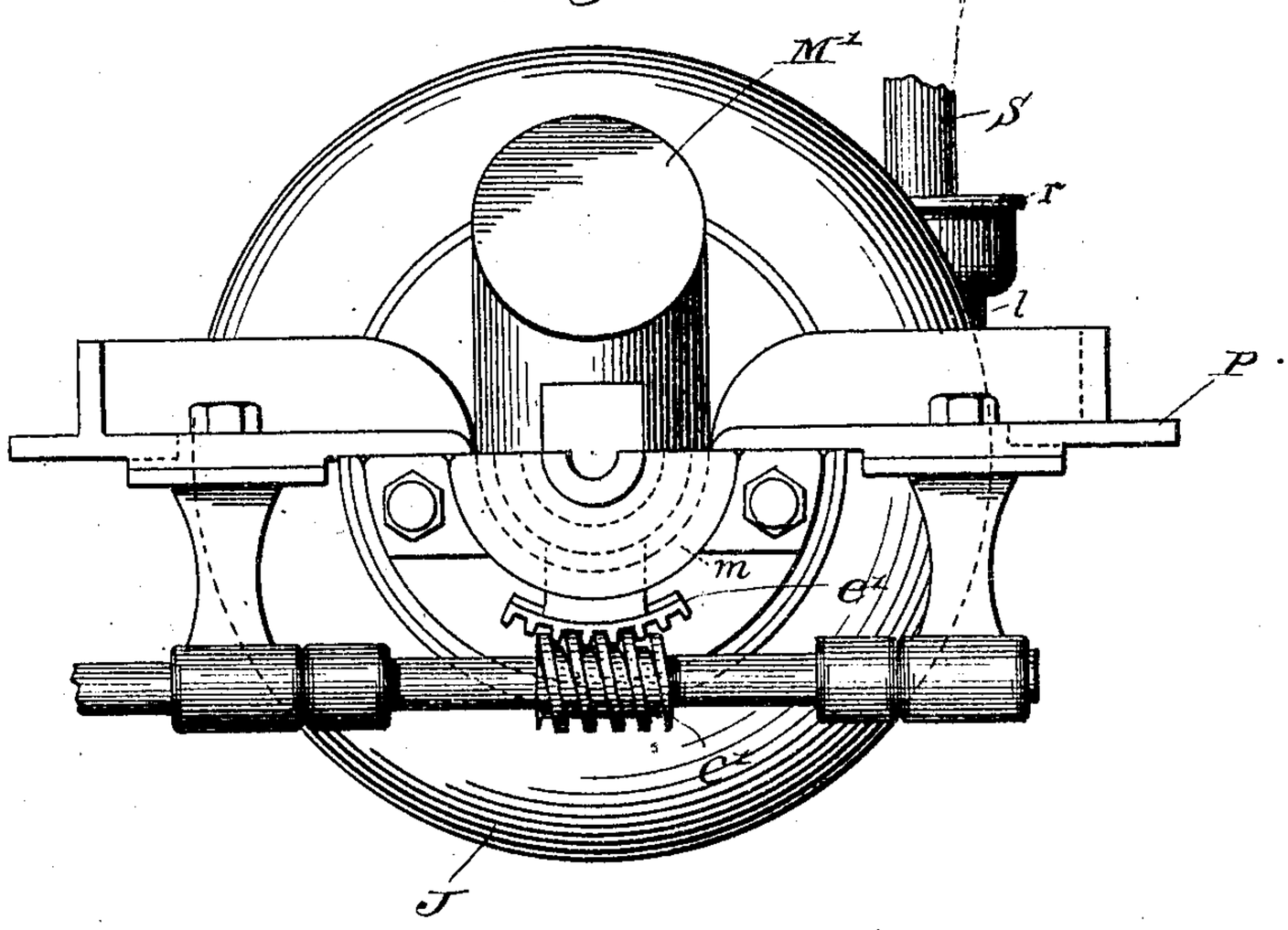

Fig. 4.

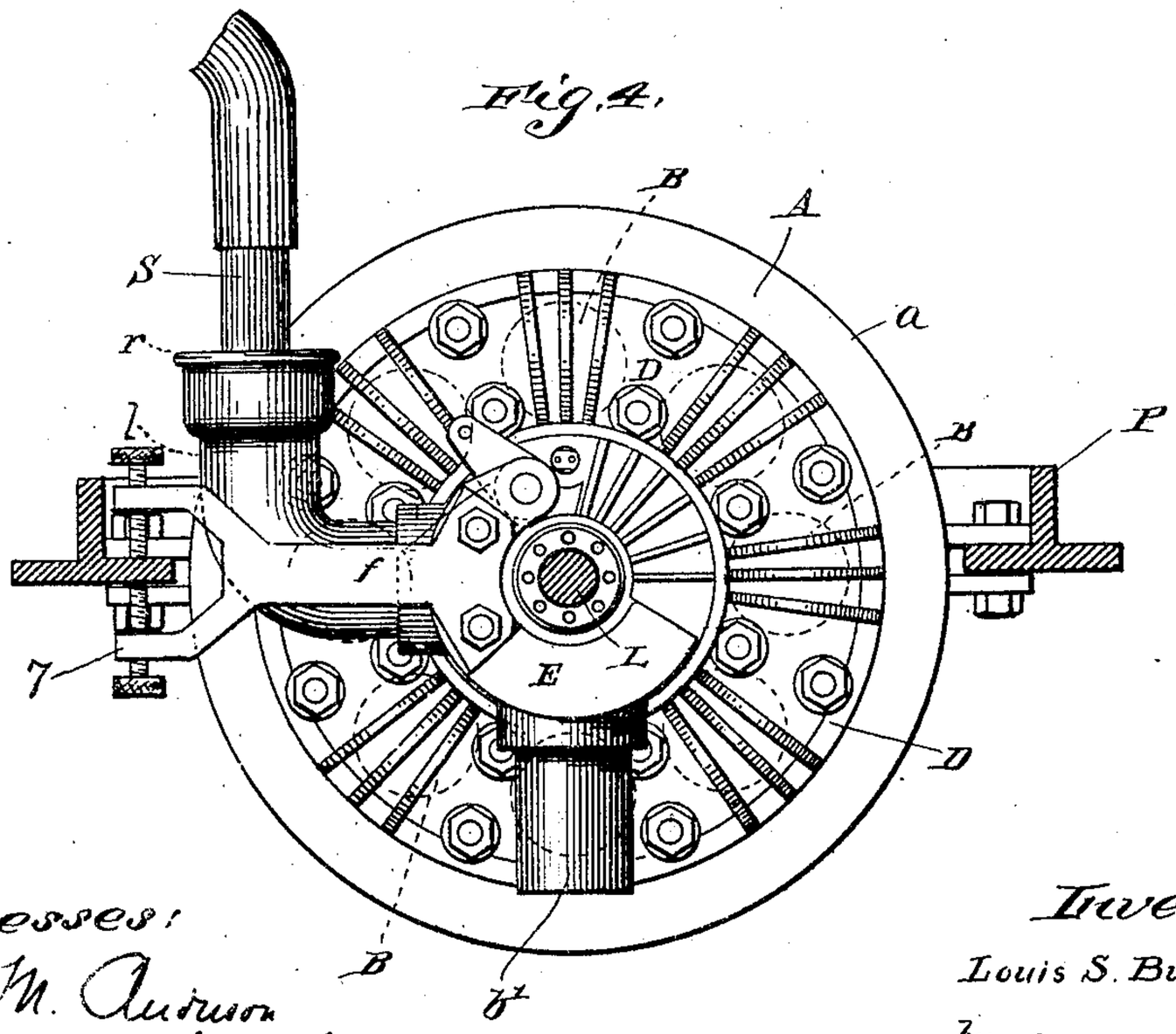

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Fig. 5.

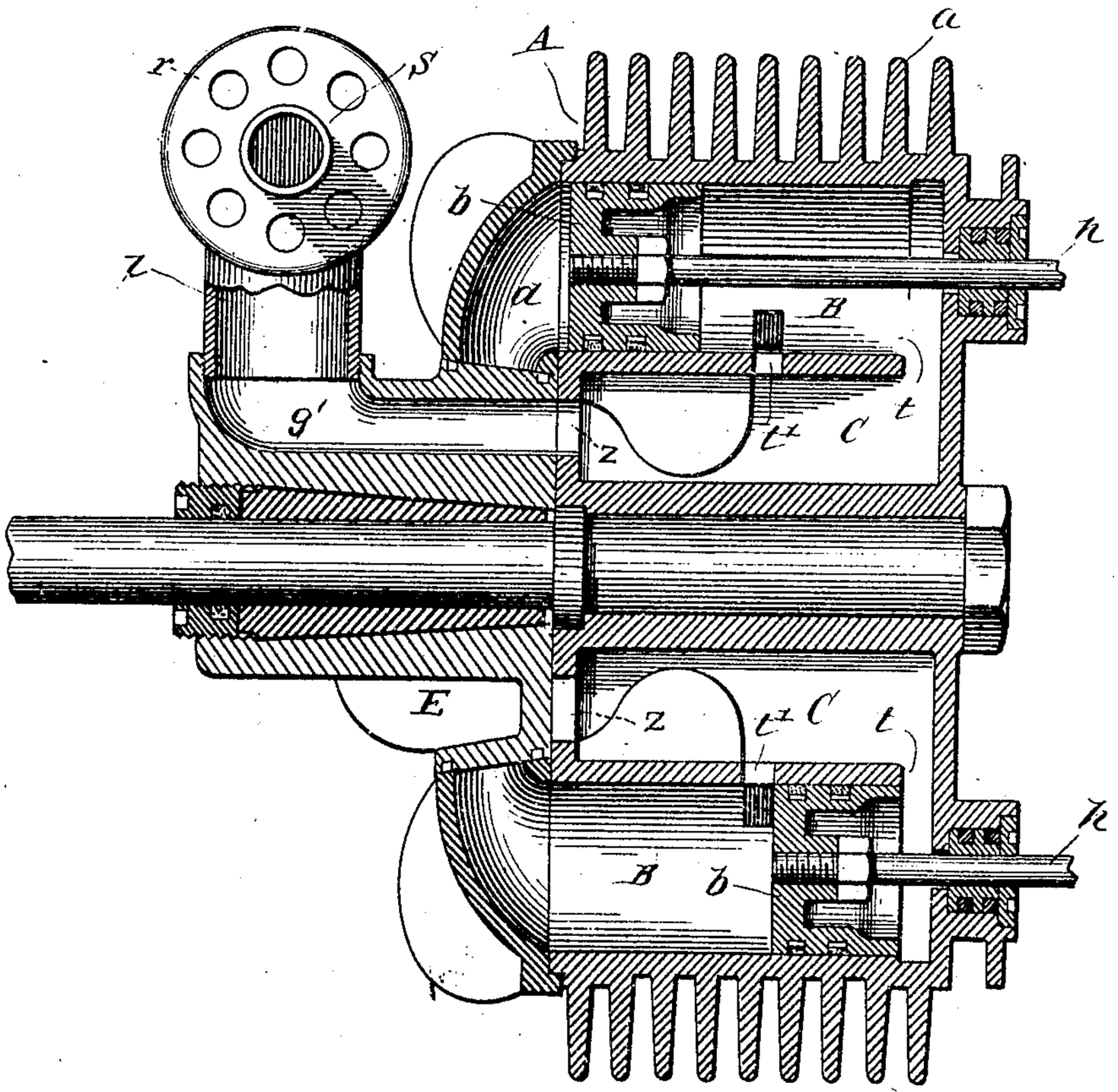
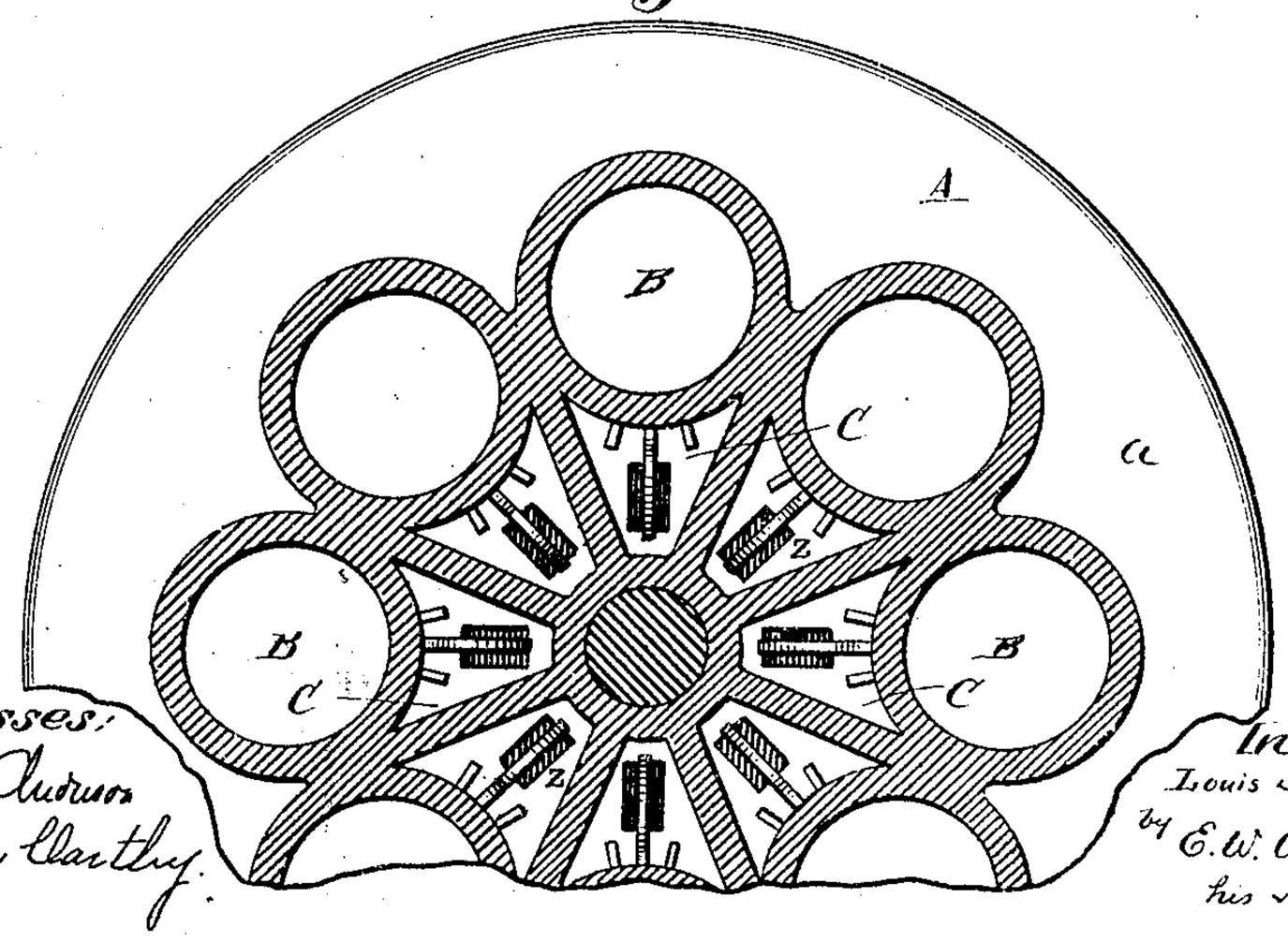


Fig. 6.



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6 SHEETS—SHEET 5.

Fig. 7.

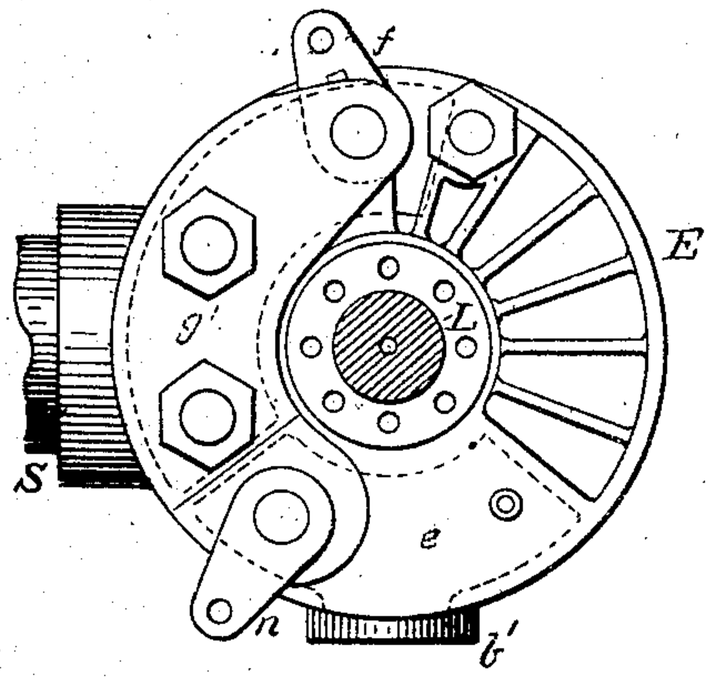


Fig. 8.

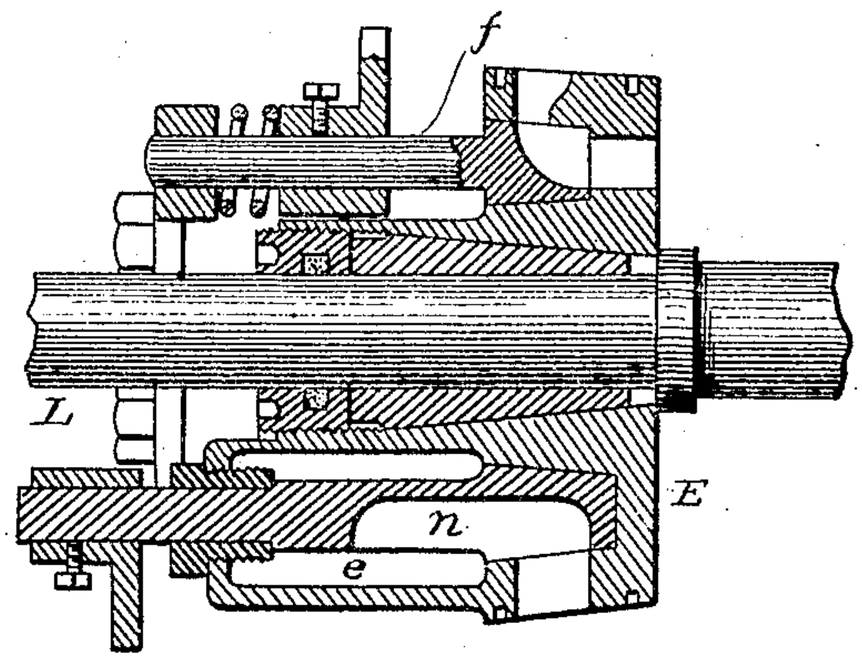


Fig. 9.

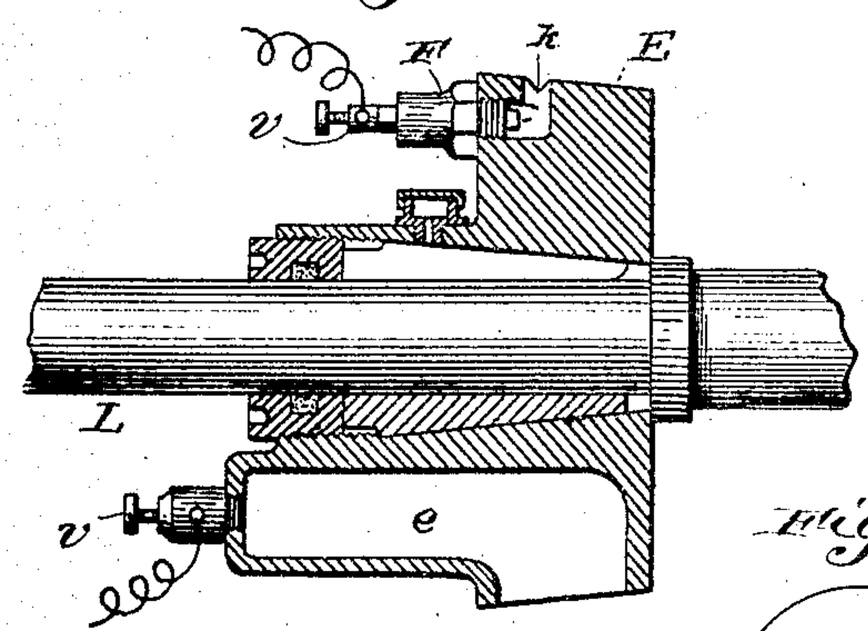


Fig. 10.

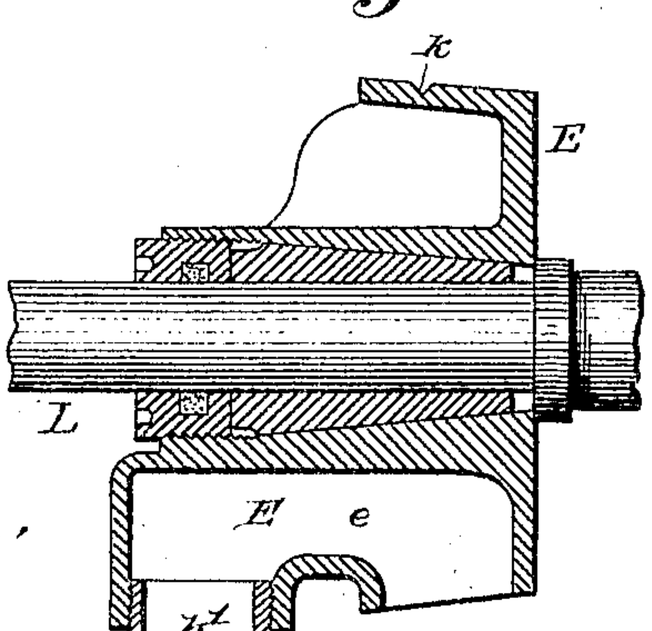
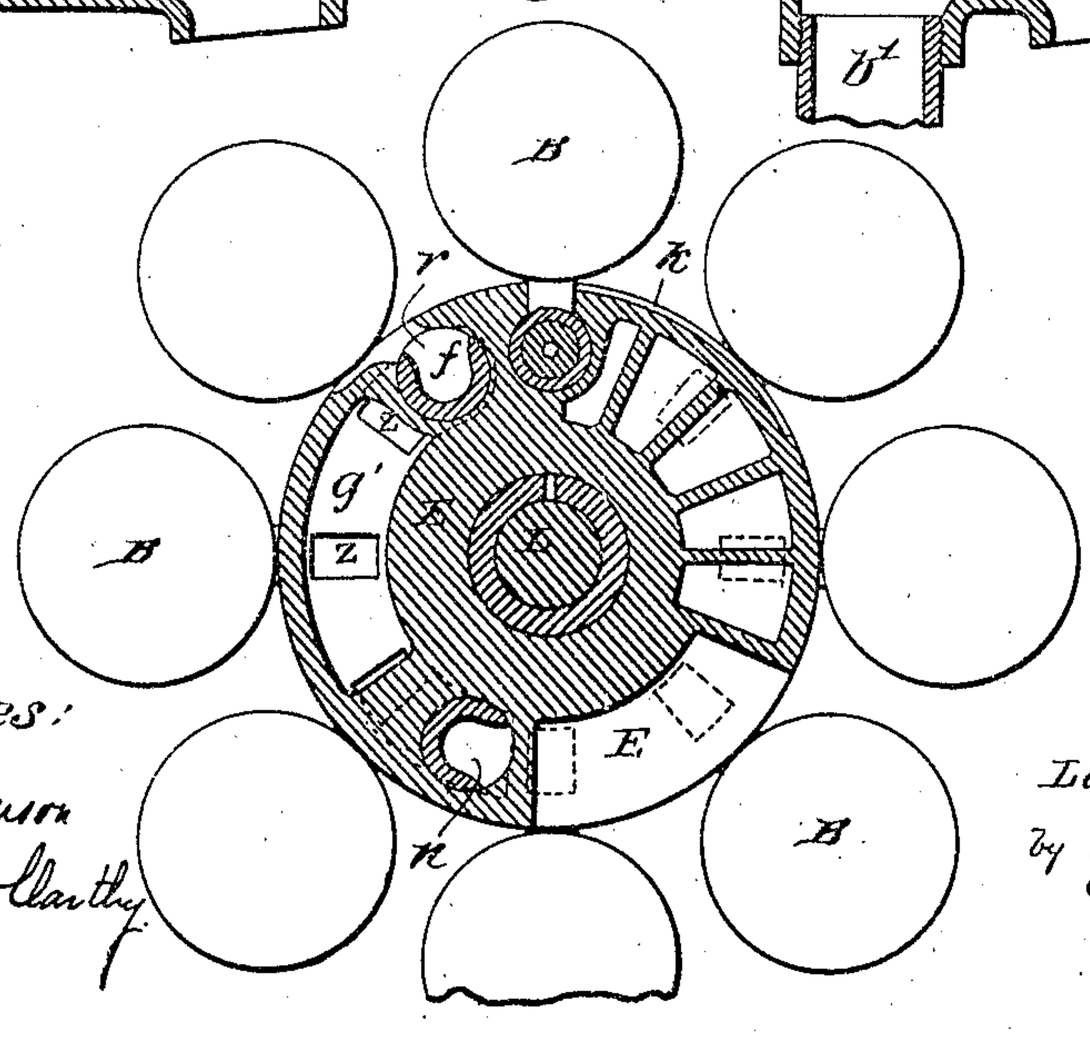


Fig. 11.



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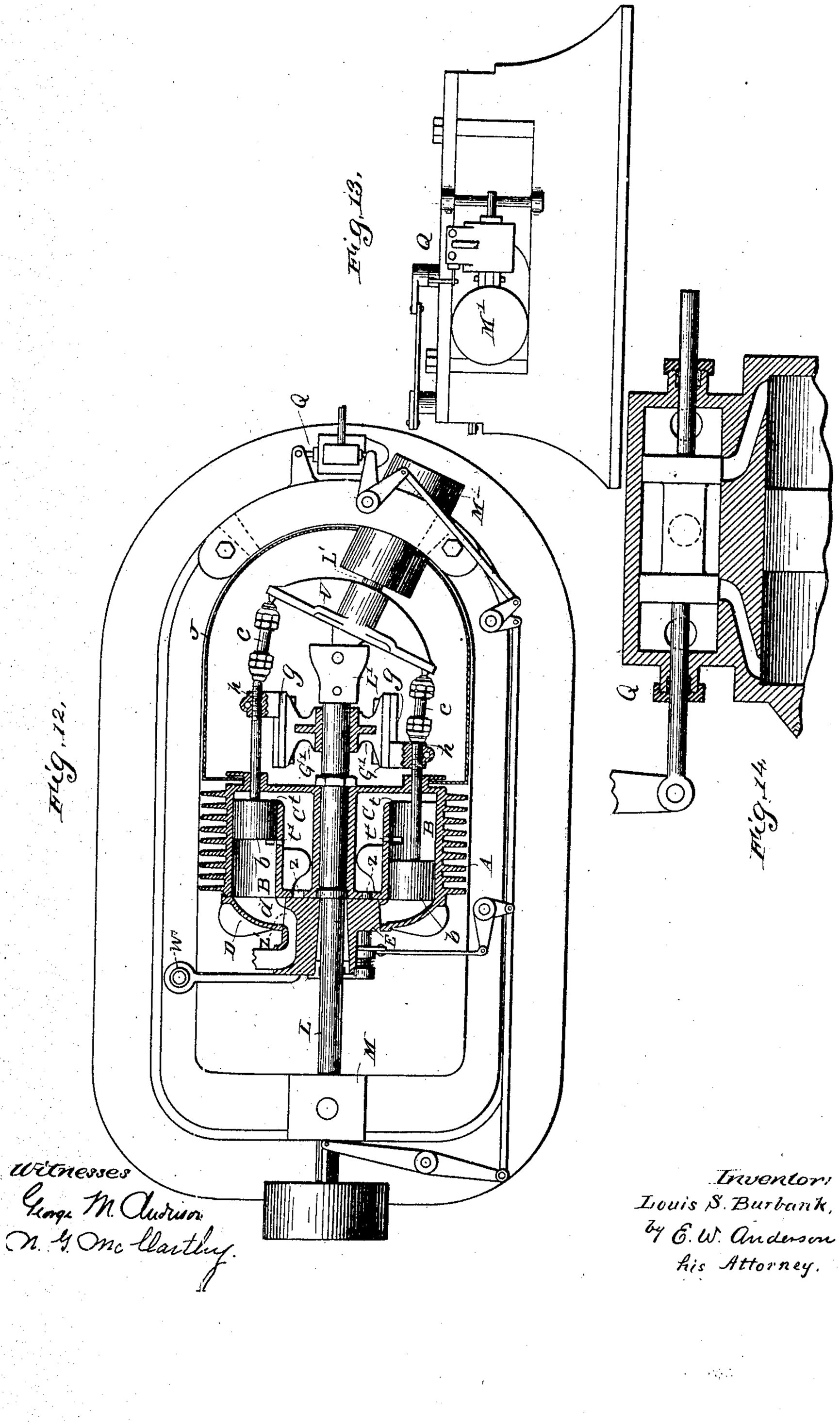
6 SHEETS—SHEET 6.



UNITED STATES PATENT OFFICE.

LOUIS S. BURBANK, OF NIAGARA FALLS, NEW YORK.

ENGINE.

No. 892,804. Specification of Letters Patent. Patented July 7, 1908.

Application filed April 22, 1902. Serial No. 104,180.

To all whom it may concern:

Be it known that I, LOUIS S. BURBANK, a citizen of the United States, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Engines; and I do 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 appertains to make and use the same.

The invention relates to engines, and is particularly applicable to engines of the explosive type for gas.

The object in view is to provide a light balanced high speed engine of adjustable character, economical in use and easily controlled.

In the accompanying drawings, the invention is illustrated mainly in its application to gas engines.

Figure 1 is a plan view. Fig. 2 is a vertical longitudinal section. Fig. 3 is a rear end view. Fig. 4 is a partial transverse section. Fig. 5 is a transverse sectional view, showing the valve. Fig. 6, is a cross section of the rotary cylinder. Fig. 7, is a face view of the clearance way head plate. Figs. 8, 9 and 10 are different sections of the main valve. Fig. 11 is a cross section of said valve. Figs. 12, 13 and 14 show a modification of means for controlling the skew disk.

The engine is mounted in a frame P, provided with a horizontal bearing M, in its forward portion for the main shaft L, and an inclined bearing M′, in rear for the journal L′, of the skew disk, or inclined journal device V. The frame also carries the stationary main supply and cut-off valve E, and its connecting supply pipe S and *l*, and exhaust pipe *b*′. The valve E is connected to the frame by means of an adjustable arm 7. To the frame is also secured the casing J, within which the inclined journal device V, and piston connections move, said casing being adapted to contain oil in the lower portion N, for the constant lubrication of these rapidly moving parts. The circular periphery of the main valve E, is beveled to fit neatly its seat *d*′ in the front of the rotary cylinder casting A, which is provided with a number of piston cylinders B, usually eight, arranged in an equidistant manner around the outer portion of said casting, and communicating with their respective compression chambers C, which are located nearer the main shaft. In rear of this casting, the main shaft is provided with a spider G′, having guide bearings *g*, for the rods *h*, of the pistons *b*, said rods being connected, usually by ball-joint links *c*, to the inclined journal device, whereof the journal L′ is connected to the rear end of the main shaft by means of a strong universal or double axis gimbal joint I. At the rear portion of the frame, the inclined bearing M′, for the inclined journal device is made adjustable by means of the circular bearing *m*, which is engaged thereby, said bearing being concentric with the axis of the main shaft. The adjustment is governed by means of a worm *c*′, and sector gear *e*′, as shown. By means of this adjustment, the position of the disk is controlled in such wise that the point equivalent to a dead center can readily be brought into proper relative position to the ignition plug F, in the main valve to control the sparking.

The exposed portion of the cylinder casting is usually formed with ribs, flanges or radiator projections *a*, in order that, when in rapid rotation in the air, it will be kept sufficiently cool, it being designed in this manner usually to dispense with a water jacket. Radiator flanges or projections may also be provided in the compression chambers.

The front end or head D, of the rotary casting is provided for each cylinder with a clearance way *d*, which communicates with the forward end of such cylinders. This clearance way also communicates intermittently during rotation with the exhaust way *e* in the main valve. The ignition plug F, is in the main valve and projects into the combustion chamber, and about one-third of the valvular body between the ingition plug and the exhaust as shown in dotted lines Fig. 7, is chambered as indicated at *g*′ for expansion. The ignition groove *k*, extends sufficiently along the valve periphery to include at least two cylinders. A valve *f*, is provided on the periphery of the main valve in connection with the intake to enable the operator to control the charge. The air is taken in at *l*. The compression chambers communicate with the piston cylinders through the openings *t*, *t*′, in their inside walls, and with the intake chamber in the main valve through their forward end openings *z*. The opening *t*, is at the rear end of the cylinder, and the opening *t*′, is in the intermediate portion between its ends.

The supply pipe S, for the gas or explosive

material is shown centrally arranged within the air pipe *l*, which is of larger diameter, and forms with the chamber in the main valve, to which it is connected, a mixing chamber for the gas and air. The air pipe is provided with a regulating valve *r*, of ordinary register character. The exhaust way of the main valve is also provided with a controlling valve *n*. This valve is designed to provide means for shortening the time of exhaust in case the fresh vapors should have a tendency to escape through the exhaust port *e*, (Fig. 2) after having forced out all of the products of combustion.

The main shaft turns in a bearing of the main valve, which is held in position by the frame-work, and this bearing is usually arranged with a tapering journal device, having an adjustment nut. Binding posts for the electric wires of the circuit of the ignition device are indicated at *v*, *v*. The main valve is made slightly adjustable, circularly, as a means of controlling the point of ignition. The arm of said main valve may engage a screw at *w*, connected to the main frame for this purpose, as indicated in Fig. 12.

In the operation of this engine, the mixture of gas and air is drawn, by the suction of each piston moving backward or toward the valve end, from the mixing chamber in the stationary valve into the compression chamber, through the port *z*, of the latter, which passes by the mixing chamber during the rotation of the cylinder casting. This port is open toward the top of the valve where the termination of the mixing chamber cuts it off. At the top of the valve, the piston starts forward again, when the front end of the same compresses the gases in the compression chamber. At a point near the end of this forward stroke, and just after the previous charge in the cylinder has exhausted, the piston passes over the port *t'*, connecting the compression chamber with its cylinder, and the compressed gases rush into the cylinder, and force out the products of combustion of the previous charge. The piston having now reached the limit of its forward movement at the bottom of the valve, starts back, and after it has traveled past the port *t'*, cuts off communication with the compression chamber, and compresses the charge into the clearance chamber, ready for igniting at the top of the valve. On its way near the top of the valve, the exhaust port in the clearance chamber passes a valve *f*, the amount of whose opening, or whose closing, determines the amount of compression, and consequently the control of the engine. That is to say, the gases which pass through this valve reduce the amount in the clearance chamber by just that much, they passing back into the mixing chamber in the valve ready to be used by the succeeding charges. The charge having reached its full compression is exploded when the piston is at or near the dead point or top of the engine, the exact point forward or back being determined, in practice, by operator, according to the conditions of speed, etc., required, and being controlled by the position of the inclined journal boxing, the adjustment of which changes the position of the dead point with relation to the valve.

In starting, the first charge is ignited by means of an electric sparking device, as indicated in Fig. 9 whose circuit is provided with a switch near the operator, and whose sparking terminals in the ignition plug have their air gap in a recess of the main valve, at the normal dead point or just where the exhaust ports travel over it. Each charge ignites the following one through the action of its inflamed gases, which kick back through the ignition groove along the face of the valve, in the path of the travel of the exhaust ports. The electric lighting device is intended to be used principally in starting, but can be thrown on at any time. After the charge has been ignited, it explodes and expands, pushing the piston before it and performing the work of the engine, the other end of the piston at the same time, compressing the succeeding charge. When the charge has been expanded, and has done its work, the exhaust port *z'* travels over the exhaust chamber in the valve, and allows the products of combustion to escape. The succeeding charge follows this right up, and fills the cylinder for the next impact. The explosions take place successively, and, owing to the multiple cylinder arrangement, at rapid intervals. The pistons act through their rods and connections on corresponding portions of the inclined journal device, which, responding to the rapidly succeeding pressures, is caused to rotate, carrying in rotation with it, the main shaft, and the multiple cylinder barrel or casting.

The parts are all well balanced in order to provide for high speed with ease of motion. The exhausts being small and very rapid, some thousands per minute, there will be no disagreeable puffing noise. It is designed to operate these engines without a water jacket, and with this object in view, the large moving air surface is provided, chiefly, by means of the flanges or projections of the rotary cylinder barrel or casting.

As the charge controlling valve is designed to allow the surplus charge to return to the mixing chamber, the speed of the engine can be regulated without interfering with economy in the use of the explosive mixture. Economy is further provided for in the means for regulating the exhaust for proper scavenging.

The running parts being within an oil containing casing, but little attention is required in the case of the mechanism.

Having thus described this invention, what I claim as new, and desire to secure by Letters Patent, is:—

1. The combination with a main shaft and its multiple cylinders rigidly attached thereto, of the stationary main valve, the adjustable inclined journal device connected to the main shaft, the pistons and devices connecting said pistons to the inclined journal device, and means for igniting the charge substantially as specified.

2. The combination with a main shaft, and an inclined journal device connected thereto, of multiple piston cylinders attached to the main shaft, an adjustable stationary main valve, means for igniting the charge pistons, and piston connections, and adjustable boxing for said inclined journal device, substantially as specified.

3. The combination with a main shaft, its multiple piston cylinders, and corresponding compression chambers, of the pistons, the main valve, the igniting devices the inclined journal device, its double axis pivot joint to the end of the main shaft connections from the said journal device to said pistons, substantially as specified.

4. The combination with a main shaft, and an inclined journal device, of a stationary main valve, igniting devices multiple revolving piston cylinders connected to said main shaft, corresponding pistons and their connections to said inclined journal device, and the gimbal joint connection of the latter to the main shaft, substantially as specified.

5. The combination with the main frame, and the main shaft, of the multiple cylinder casting attached to said main shaft, the stationary main valve, means for igniting the charge the inclined journal device, pivoted to the end of the main shaft its adjustable boxing, the pistons and piston connections to said inclined journal device, substantially as specified.

6. The combination with the rotary main shaft, and its multiple cylinder casting of the main valve, its sparking device, and its peripheral ignition groove, substantially as specified.

7. The rotary multiple piston cylinder casting, having in connection with each cylinder, a compression chamber, and a partition having openings for communication of said chamber with such cylinder at its end, and intermediately of its ends, substantially as specified.

8. An engine having multiple piston cylinders on a main shaft double pivoted at its end to an inclined journal device connected to pistons in said cylinders, a stationary main valve around said shaft, and a valve in said main valve for controlling the charge, substantially as specified.

9. An engine having multiple piston cylinders attached to a main shaft cross pivoted to an inclined journal device pivoted to pistons in said cylinders, compression chambers in communication with said cylinders, a stationary main valve, and a valve in said main valve for controlling the charge, and a valve for controlling the exhaust, substantially as specified.

10. An engine having multiple piston cylinders attached to a main shaft cross-pivoted to an inclined journal device connected to pistons in said cylinders, a stationary main valve, a valve in said main valve for controlling the charge, and a valve for controlling the exhaust, means for igniting the charge, and means for communicating the inflammation from one cylinder to another, substantially as specified.

11. An engine having multiple piston cylinders attached to a main shaft, connected by a universal joint at its end to an inclined journal device, connected to the pistons of said cylinders, a stationary main valve around said shaft, a valve in said main valve for controlling the charge, and a valve, in said main valve for controlling the exhaust, substantially as specified.

12. In an engine, the combination with a revolving shaft and piston cylinders attached thereto, of a stationary main valve around said shaft, of pistons, an inclined journal device connected to said pistons, and pivot jointed to the end of said main shaft, a valve in said main valve for controlling the charge, means for controlling the exhaust, and means for adjusting the inclined journal device, substantially as specified.

13. The combination with a main shaft, its attached piston cylinders compression chambers, and common clearance chamber, of the stationary main valve, the inclined journal device, the pistons connected thereto, the double pivot joint to the main shaft the charge controlling valve, the exhaust controlling valve and the exhaust, substantially as specified.

14. An engine having a stationary supply and cut-off valve around a rotary main shaft carrying multiple piston cylinders, and pistons connected to an inclined journal device, double pivot jointed to the end of said shaft whereby said shaft is turned through the operation of the expansive material in said cylinders, means for igniting and means for controlling the charge, substantially as specified.

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

LOUIS S. BURBANK.

Witnesses:
AUGUSTUS THIBAUDEAU,
R. M. OLSON.