G. T. GEER.

ROTARY ENGINE.

APPLICATION FILED NOV. 16, 1909.

953,328.

Patented Mar. 29, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

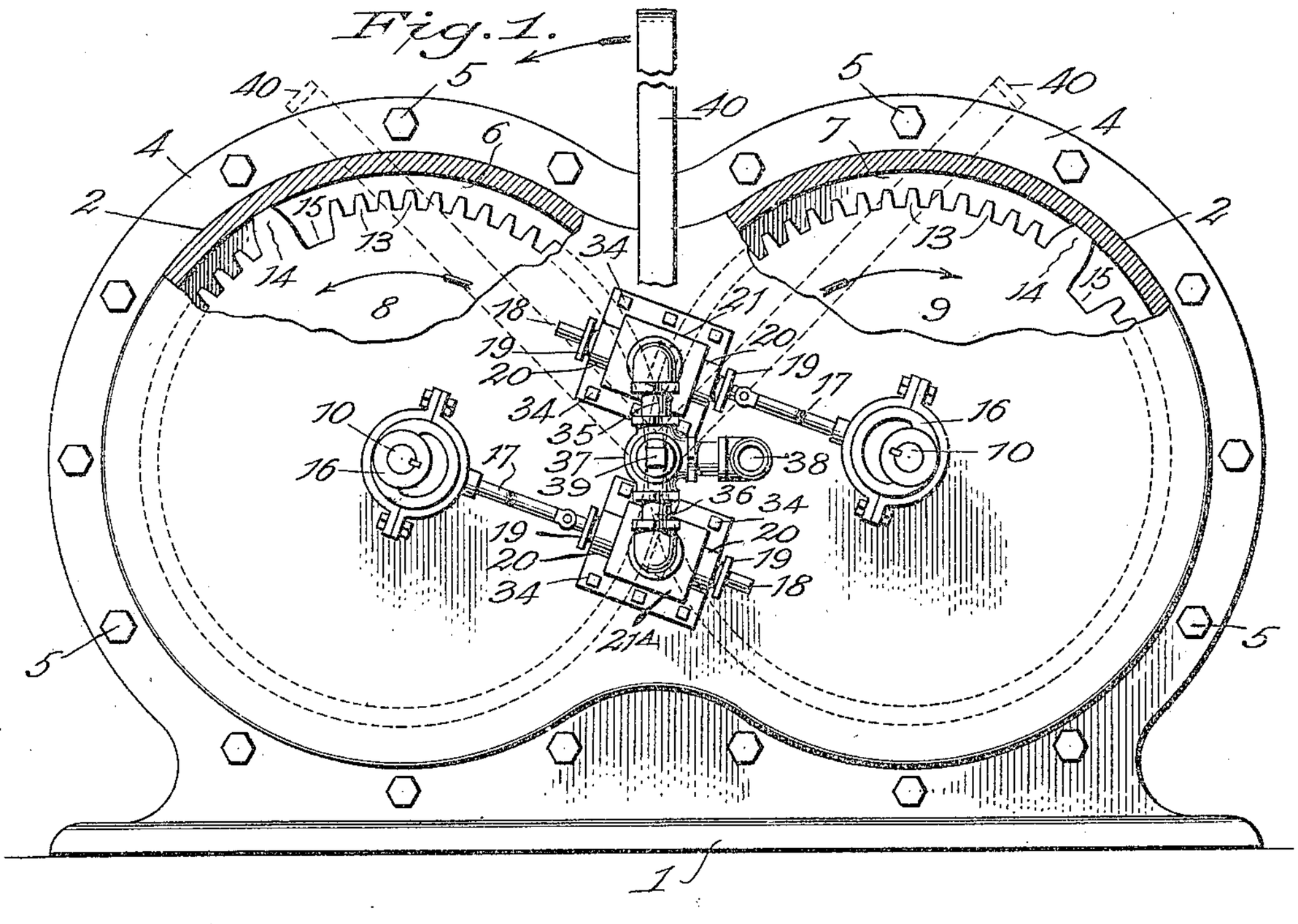
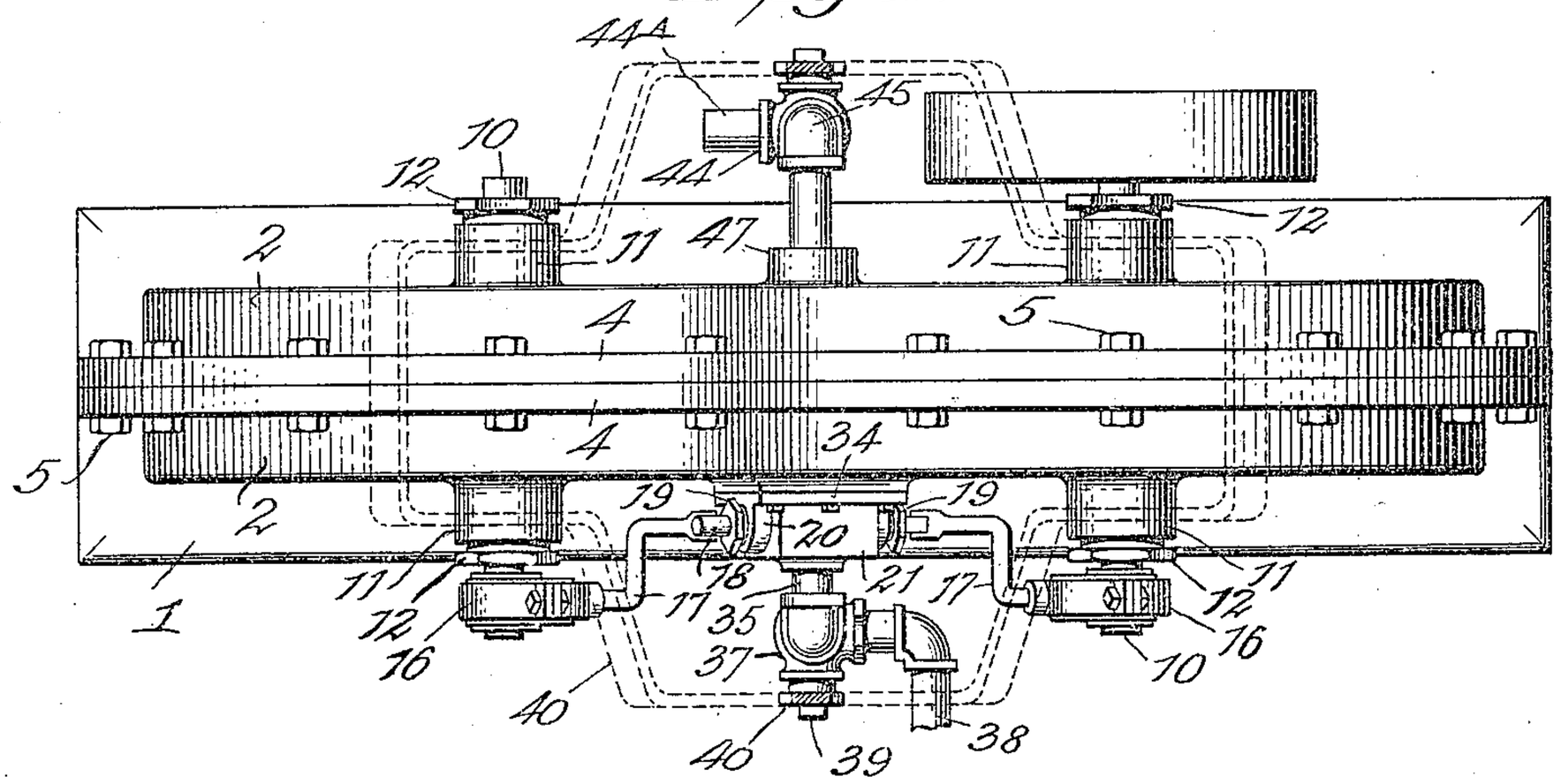


Fig. 2.



Witnesses:

J. Sargent Elliott

Adella M. Fowle

Inventor:

George T. Geer

By H. S. Bailey Attorney.

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2 SHEETS—SHEET 2.

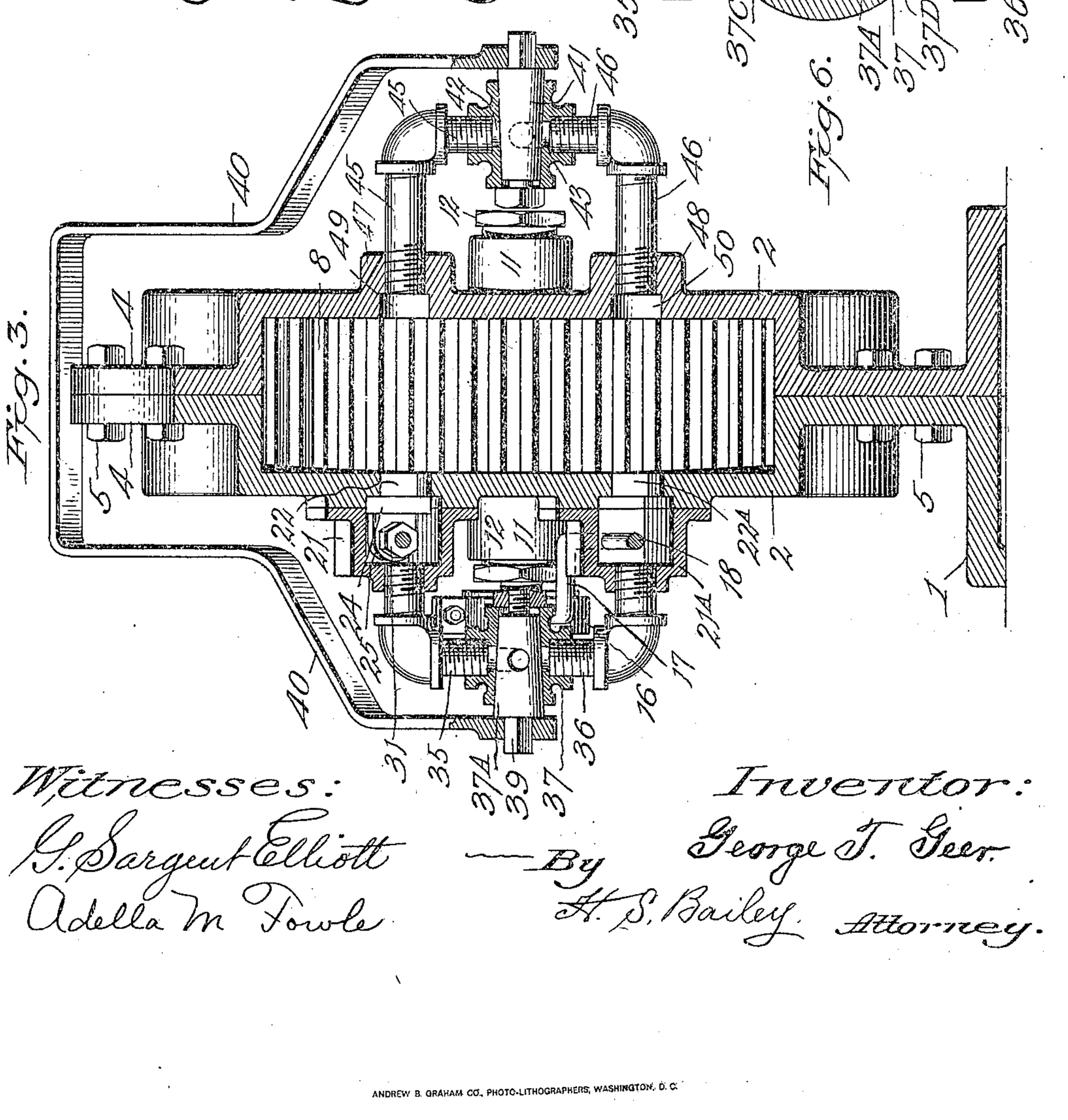

Fig. 3.

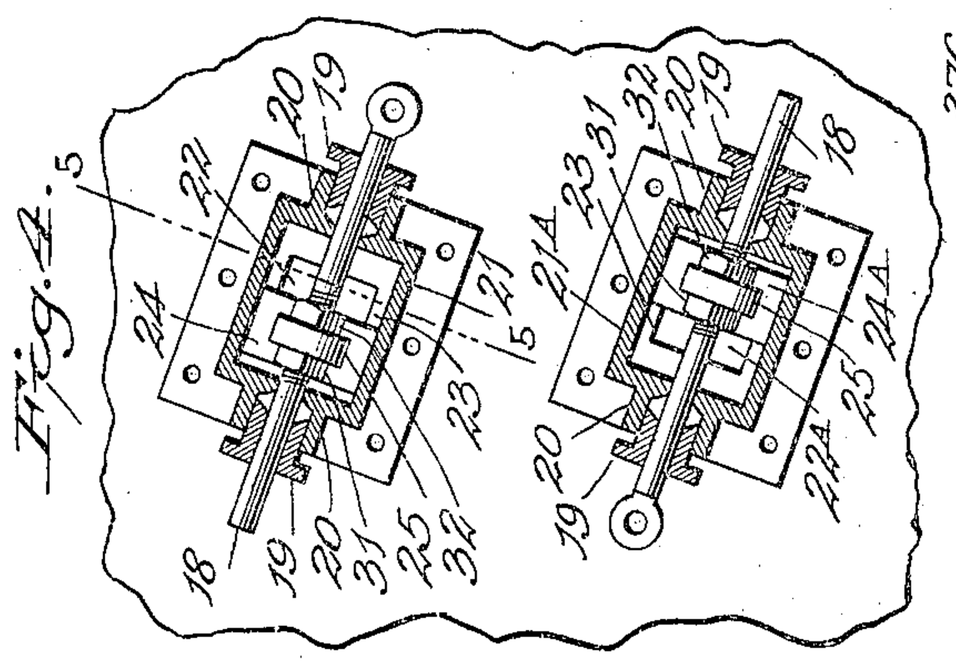

Fig. 4.

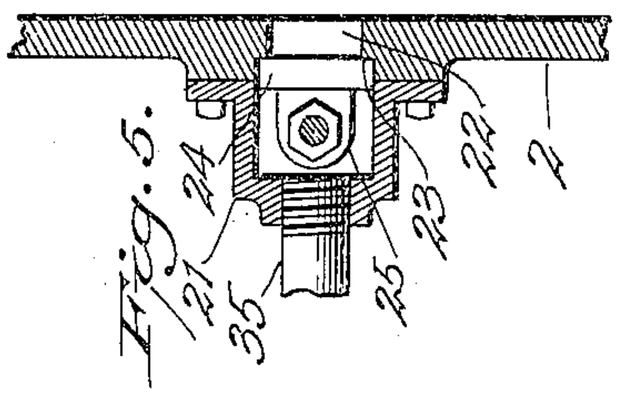

Fig. 5.

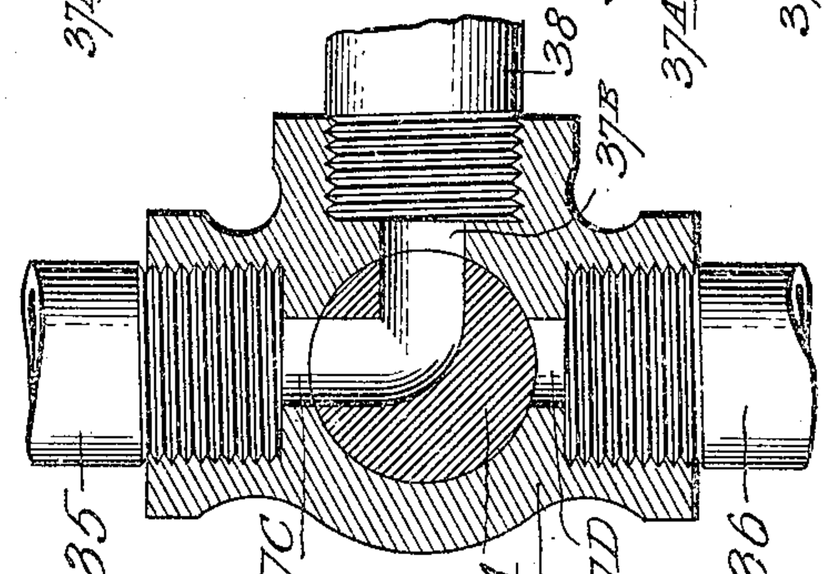

Fig. 6.

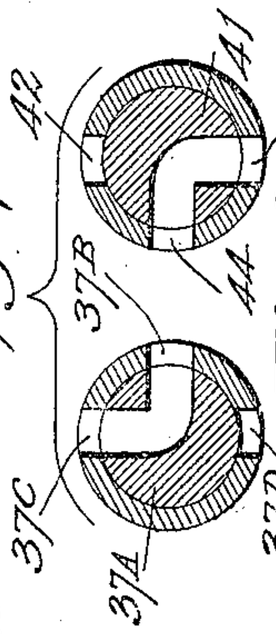

Fig. 7.

Fig. 8.

Fig. 9.

Witnesses:

G. Sargent Elliott

Adella M Fowle

Inventor:

George T. Geer.

By H. S. Bailey. Attorney.

UNITED STATES PATENT OFFICE

GEORGE T. GEER, OF DENVER, COLORADO.

ROTARY ENGINE.

953,328. Specification of Letters Patent. **Patented Mar. 29, 1910.**

Application filed November 16, 1909. Serial No. 528,303.

To all whom it may concern:

Be it known that I, GEORGE T. GEER, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented a new and useful Rotary Engine, of which the following is a specification.

My invention relates to improvements in rotary engines, and the objects of my invention are first—to provide an intermeshing gear toothed piston disk reversible rotary engine provided with a slide valve controlling mechanism; and second—to provide a simple, practical and efficient reversible rotary engine that can be constructed economically and that is adapted for use as a marine engine and for all other purposes for which a reversible engine can be used. I attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation of the improved rotary engine, the casing being broken away for clearer illustration. Fig. 2 is a plan view of the same. Fig. 3 is an enlarged vertical, transverse, sectional view taken on the line of the inlet and exhaust valves. Fig. 4 is a view of a portion of the engine casing, showing the two valve chests in section. Fig. 5 is a vertical, sectional view through one of the valve chests, on the line 5—5 of Fig. 4. Fig. 6 is an enlarged, vertical, sectional view through the inlet valve, the exhaust valve being similar in construction. Fig. 7 is a diagrammatic view, illustrating the relative positions of the inlet and exhaust valves when steam is admitted through the upper valve chest. Fig. 8 is a similar view showing the relative positions of the valves when the steam is cut off from both valve chests; and Fig. 9 is a similar view showing the valves in their relative positions when steam is admitted to the engine through the lower valve chest.

Similar characters of reference refer to similar parts throughout the several views.

Referring to the drawings, the numeral 1 designates the foundation base plate of my engine and 2 designates the casing. This casing comprises a pair of vertically arranged disk shaped cylinders which intersect each other at their edges and in horizontal alinement with each other so as to form an integral casting, which is divided into two equal halves longitudinally of its length, and each half is provided with bolt receiving flanges 4, which are formed on their edges to register opposite and against each other with steam tight joints between them, and are adapted to be bolted together by bolts 5, which extend through them. This casing may be formed independent of the base, if desired, and be bolted or otherwise secured to it, or it may be cast integral with it, as shown. This cylindrical casing contains two disk shaped cylinders, 6 and 7, which also overlappingly intersect each other at a small arc of their adjacent edges enough to permit the pistons 8 and 9, which are rotatably mounted in each cylinder, to intermesh with each other at the adjacent peripheral edges, as will be presently described.

The pistons 8 and 9 are disk shaped pistons, which are rotatively mounted on shafts 10, which extend through and beyond stuffing box hubs 11 and glands 12, which are secured to the hubs in any suitable manner on the opposite sides of the casing. These piston disks fit snugly but rotatably in the cylinder between the sides of the casing, and they are made enough smaller in diameter than the diameter of the cylinders to leave a clear space between the pistons, of area enough to form an ample steam port around the pistons to a projecting portion 14 formed on each piston, which are formed into gear teeth. These two projecting gear teeth project beyond the peripheral surfaces of the pistons and their peripheral edges are machined to fit closely but rotatively in the circumferential wall of the cylinders. These large gear teeth are cut to intermesh with each other as the pistons rotate and they form piston surfaces against which the steam pressure acts to rotate the pistons.

In order to cause the pistons to rotate positively together in such relation that these large piston acting teeth will always intermesh in operative rotative order, I provide the main peripheral surfaces of the pistons with intermeshing gear teeth 13, the circular pitch of which is also the circular pitch line of the larger gear teeth that act as the steam pressure actuating piston surfaces of the piston disks. Suitable tooth clearance spaces 15 are formed in each gear for the large piston teeth 14 to rotate in. And these tooth spaces are in the form of recesses and are formed adjacent to the surfaces of the tooth into which the steam flows from its inlet ports and these clearance spaces enable the steam to exert an expansive pressure

against the adjacent side surfaces of the tooth shaped pistons.

An eccentric 16 is mounted and secured on one of the projecting ends of each of the piston shafts and both of these eccentrics are positioned on the same side of the casing. These eccentrics are provided with rods 17, which extend to and are pivotally connected to valve stems 18, which project through glands 19 and stuffing box hubs 20, that form a part of a pair of steam or valve chests 21 and 21A, which are formed on or secured to the side of the casing. These steam or valve chests are positioned above and below the horizontal center of the casing in a vertical plane, and at equal distances above and below it. They are positioned, however, with their sides arranged in an oblique plane to the horizontal center so that their valve stems are in operative alinement with the rods of the eccentrics. These valve chests are formed around steam inlet ports 22 and 22A. These ports are formed within the valve chests and enter the piston cylinders at the intersecting central vertical plane of the two cylinders. These steam inlet ports 22 and 22A form the steam inlet ports that are opened or closed in alternate order to drive the rotary pistons in opposite directions, as will be fully described hereinafter. Around the ports in the bottoms of each of the valve chests valve seats 23 are formed, on which are seated valves 24 and 24A.

I preferably use for controlling the steam at its point of admission to the cylinder a flat form of slide valve. These valves are each provided with a projecting lug portion 25, in which an aperture is formed.

The valve stems 18 preferably extend entirely through the apertures in the lugs of the valves, and also extend through the opposite ends of the steam or valve chest, and are supported in the packing chambers 20 and glands 19. These glands 19 are secured to hub portions 20, which are formed on the opposite end portions of the valve chest.

The valve stems are provided with a threaded portion which extends loosely through the aperture in the lug of the valves, and the valve stem is provided with two nuts 31 and 32 which are positioned on the valve stem on opposite sides of the lug, and are screwed up against it close enough to prevent any play of the valve lug between the nuts, but are positioned so as to permit the slide valves to seat firmly and slidably on its valve seat.

The steam or valve chests 21 and 21A are secured to the casing by any suitable means, preferably by screw bolts 34. These valve chests are connected together by steam inlet pipes 35 and 36, which are connected at one of their ends to the valve chests and are connected at their opposite ends to a three-way valve casing 37 having an inlet port 37B and outlet ports 37C and 37D. One end of a steam inlet pipe 38 is connected to the plug valves' casing, the opposite end of which is adapted to be extended by piping to a supply of steam. This steam inlet valve may be of any suitable type, but I preferably use the common form of plug valve 37A, which is provided with a square or other form of wrench receiving hub portion 39, to which one end of a yoke lever 40, which I term the controlling or reversing lever is secured. The opposite end of this controlling lever 40 extends over the top of the casing of the engine and is connected to an exhaust valve 41. This steam inlet plug valve is provided with two ports, which are arranged at about a quarter angle and are adapted to register with the steam supply pipe and with either one or the other of the steam pipes that extend to the valve chests, depending on which way the plug valve is turned by the controlling lever, as will be fully explained hereinafter.

The exhaust valve to which the controlling lever is connected may also be of any suitable type, but I preferably use an ordinary form of plug valve, the same as in the inlet steam pipes. This exhaust controlling valve 41 is positioned in horizontal axial alinement with the steam controlling plug valve that admits steam to the cylinders in the direction it is desired to have the pistons rotate in. This exhaust controlling valve comprises a three-way valve casing, which is provided with entrance ports 42 and 43, and with an outlet port 44, to which an exhaust pipe 44A is connected that is open to the atmosphere, and its plug valve is provided with two ports, which are arranged to control either one or the other of the two entrance ports 42 and 43 and the outlet port 44 of the plug valves' casing at the same time.

The entrance ports 42 and 43 are connected to one end of two pipes 45 and 46, the opposite ends of which are threaded to two hubs 47 and 48, which are formed on the opposite sides of the engine casing from the valve chests and in horizontal alinement with them, and form exhaust steam chests. The interiors of these exhaust steam chests are provided with apertures which form exhaust ports 49 and 50 and which connect with the pipes 45 and 46 and also extend into the intersecting zone of the two cylinders and are positioned in a vertical plane above and below the intermeshing arcs of the disk piston and across from but in horizontal alinement with the steam inlet ports 22 and 22A. These exhaust ports 49 and 50 are always open to the entrance of exhaust steam into them from the cylinders, but they are opened and closed to the atmosphere by the exhaust controlling valve 41, which is provided with two ports which are

placed at about a quarter angle to each other and are so arranged relatively to each other and to the ports 42 and 43 that a movement of the controlling lever across the top of the casing of the engine will open one set of steam inlet and exhaust ports and close the other set.

The operation is as follows: Assuming that the controlling or reversing lever is moved in one direction, say in the direction of the arrow, the steam inlet plug valve 37A is then moved to admit steam to the steam chest 21 through the pipe 35, and the steam inlet valve 24 is moved to open its steam inlet port 22, and the other steam inlet valve 24A is moved to close its port 22A, though the chest 21A is cut off from the supply of steam when the valve 37A is in this position, as shown by Fig. 6. The exhaust plug is moved at the same time to open its two ports to register with the exhaust ports 43 and 44, which connect with the port 50 and the pipes 46 and 44A to the atmosphere and to close the exhaust passage 42 connecting with the exhaust port 49 through the pipe 45. And if the controlling lever is moved in the opposite direction, the steam inlet plug valve 37A is moved to close the port 37C connecting with the steam inlet valve 24 and its port 22 and open the port 37D connecting with the steam inlet valve 24A and its inlet port 22A, and the exhaust plug valve 41 is moved to close the port 43 connecting with the inlet port 50, and to open communication between ports 49, 42 and 44 to the atmosphere. Steam entering the steam port 22 exerts its expansive pressure against the side faces of the large piston teeth and drives the disks in the direction of the arrows shown in Fig. 1, and as the disks rotate the eccentrics 16 are rotated by the shafts of the pistons and the eccentric rods, and valve stems and the slide valves are reciprocated and the slide valve 24 is adjustably set to cut off the steam at a predetermined part of the rotative stroke of the piston that will give the best results from the use of the expansive force of the steam, the adjustment of these slide valves being arranged to give variable degrees of cut-off relative to the operative rotative movement of the toothed pistons, this adjustment being effected by the nuts 31 and 32 on the valve stem that clamp the lug of the valve between them, which can be changed to set the valve relative to the throw of the eccentrics and of its throw on its seat to give a greater or less opening of steam inlet area to the port 22, and a larger or shorter cut-off relative to the operative rotary movement of the piston teeth under the expansive force of the steam. The slide valve 24A is also set in a similar cut-off position to the valve 24, but when the slide valve 24 is receiving steam through the steam inlet's plug valve ports the steam supply to the slide valve 24A is cut off by the steam inlet valve. When, however, it is desired to reverse the direction of the rotary movement of the engines the controlling lever is grasped by the operator and moved to the opposite end of its throw and the steam inlet and also the exhaust plug valves are rotated to close the steam inlet to the valve 24 and the exhaust port 50 and moved to admit steam to the slide valve 24A and to open the exhaust ports connecting the exhaust port 49 to the atmosphere, and to cut off the flow of steam to the slide valve 24 and the flow of the exhaust steam through the exhaust port 50, which causes the piston teeth and the disks to reverse their rotary movement and rotate in the opposite direction.

My invention provides a simple, inexpensive and practical variable cut-off slide valve rotary engine that is positive in its action and that is arranged to practically prevent the leakage of steam between the two piston disks, and while I have illustrated the preferred construction and arrangement of my improved rotary engine I do not wish to be limited to the construction and arrangement shown, as many changes might be made without departing from the spirit of my invention.

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

1. In a rotary engine, the combination with a suitable supporting base and casing of a pair of disk shaped cylindrical spaces arranged within said casing to intersect each other at a small arc portion of adjacent edges, a pair of disks of smaller diameter having their peripheral edges provided with intermeshing gear teeth and of enough smaller diameter than said cylindrical spaces to rotatively intermesh with each other, a large gear tooth shaped piston member on each disk extending to the inner peripheral wall of said cylinders and intermeshing with each other rotatively, and suitable actuating valves and reversing mechanism operatively arranged to drive said disks and pistons in either direction, and eccentrics connected with said disks for operating said valves.

2. In a rotary engine, the combination of a pair of longitudinally arranged intersecting cylinders provided with steam and exhaust ports and formed in two parts and adapted to be secured together, power transmitting shafts journaled in the center of each cylinder, a pair of intermeshing gear disks secured on said shafts and of smaller diameter than said cylinders, a large gear tooth piston portion on the peripheral edges of said gears extending to but in rotative relation with the inner peripheral wall of said cylinders and arranged and adapted to rotatively intermesh with each other,

an eccentric mounted on each shaft, steam chests on said casing adjacent to said eccentric and surrounding said steam inlet and exhaust ports, a slide valve operatively seated in each of said steam inlet chests, said steam inlet ports, exhaust ports and slide valves being positioned to operatively drive said pistons in either rotative direction, a steam inlet system of piping connecting said steam inlet and steam exhaust chests, a valve arranged in said pipes for controlling the flow of steam to rotate said pistons in either direction and a controlling or reversing lever connected to both the steam inlet and exhaust controlling valves and arranged to open or close either set of steam and exhaust ports to drive said pistons in the rotative direction desired.

3. In a rotary engine, the combination of the intersecting cylinders and intermeshing gear toothed pistons, said intermeshing pistons being of smaller diameter than the diameter of said cylinders and provided with small intermeshing gear teeth throughout all but a small portion of their peripheral surfaces, a large projecting gear tooth on that portion of the surface of each of said disks not occupied by said small gear teeth, said large projecting teeth being arranged to rotatively intermesh with each other and to extend to and fit closely but rotatively in the inner peripheral wall of said cylinders, and means including a slide valve controlled reversible steam inlet and exhaust mechanism for reversing the rotary motion of and for driving said gear toothed disk pistons in either rotary direction, as desired.

4. In a rotary engine, the combination of the casing provided with a suitable supporting base, said casing being provided with a pair of longitudinally arranged disk shaped cylinder spaces arranged to intersect each other at a small arc of their adjacent edges, with a pair of intermeshing gear toothed disks of smaller diameter than said cylinders journaled in said cylinders upon suitably journaled power transmission shafts, an enlarged gear tooth shaped portion on each of the peripheries of said gear toothed disks extending rotatively to the circumferential wall of said cylinders and arranged to intermeshingly rotate, toothed clearance and intermeshing spaces at the sides of said tooth shaped pistons, a pair of valve controlled steam inlet ports on one side of said casing and pistons arranged to admit steam to drive said pistons in either direction, and a pair of valve controlled exhaust ports on the opposite sides of said pistons in said casing, and means including a reversing lever for operating said valve controlled ports to drive said pistons rotatively in either direction and to reverse their direction of rotary movement when desired.

5. In a rotary engine, the combination of the supporting base, the casing provided with intersecting cylinders and rotating pistons, said casing being provided with steam chests and steam inlet and exhaust ports arranged to admit steam to operate said pistons in either rotary direction, the toothed piston disks and the power transmitting shafts, with slide valves operatively arranged in said steam inlet chests to control said steam inlet ports, valve stems adjustably secured to said valves and reciprocally mounted in said steam inlet chest, steam inlet pipes and steam exhaust pipes connecting said steam inlet and exhaust ports, a plug valve operatively connected in each inlet and exhaust system of steam ports provided with a pair of ports adapted to register with either one set or the other of steam inlet and exhaust ports and a controlling or reversing lever secured to said plug valves and arranged to operate both plug valves simultaneously to open either one of the systems and close the other, as desired, to run said piston disks in either direction.

6. In a rotary engine, the combination of the casing provided with steam ports and with steam chests thereon, the intermeshing gear toothed disk pistons and the driving shafts with the slide valves and valve stems operatively and adjustably mounted in said steam chests and the eccentrics mounted on said shafts and operatively connected to said slide valves' valve stems and the inlet and outlet valves, and means including a lever for moving them to reverse said pistons.

7. In a rotary engine, the combination of the casing, the geared piston disks provided with a pair of intermeshing tooth shaped pistons, the driving shafts and the eccentrics secured thereto, said casing being provided with two independent sets of steam inlet and exhaust ports arranged to introduce a supply of steam into said cylinders in such a manner as to drive said pistons rotatively in opposite directions in alternate order at any predetermined time, and means including a reversing lever and a controlling valve mechanism connected to said steam chests and ports and to said eccentrics for reversibly operating said engine.

8. In a rotary engine, the combination of the casing provided with two sets of valve controlled steam inlet and exhaust ports, the rotary geared pistons, the driving shaft and the eccentrics secured to said driving shafts, with a slide valve arranged to control each steam inlet port, a valve stem adjustably connected to each valve stem at one end and operatively connected to said eccentrics at its opposite end and arranged to be reciprocated thereby as said shafts and pistons rotate, steam pipes connected at one of their ends to said steam inlet and valve

chests and also to said exhaust steam chests, a three-way plug valve casing connected at its opposite ends to the ends of both sets of steam inlet and exhaust pipes, a plug valve in each of said casings provided with two ports arranged and adapted to connect alternately with either one or the other sets of ports of both the steam inlet and exhaust system of ports, and a controlling or reversing yoke shaped lever extending over said engine's casing and connected at its two ends to said steam inlet and exhaust steam controlling plug valves and arranged and adapted to operate said plug valves simultaneously to operatively open either one or the other of steam inlet and exhaust ports, as desired.

9. In a rotary engine, a pair of intersecting cylinders, intermeshing pistons in said cylinders of less diameter than said cylinders and projections on said disks which contact with the radial surface of said cylinders, shafts extending through the cylinders upon which the pistons are mounted, valve chests on the sides of the cylinders inclosing inlet ports, slide valves in said chests for controlling said ports, eccentrics on the ends of the shafts connected with said slide valves, a three-way inlet valve connected with said valve chests, a three-way exhaust valve connected with exhaust ports opposite to said inlet ports, and means for turning said valves simultaneously.

10. In a rotary engine, the combination of a pair of intersecting cylinders, shafts extending axially through said cylinders, intermeshing pistons on said shafts of less diameter than the cylinders having projections which engage the radial surface of the cylinders, duplicate valve chests on the cylinders, one above and the other below the line of the shafts and midway between their axial centers, slide valves in said chests adapted to control inlet ports extending into the cylinders, eccentrics on the shafts connected with the slide valves, a three-way valve connected with said valve chests and with a supply of steam, a three-way exhaust valve connected with exhaust ports diametrically opposite the inlet ports and with the atmosphere, and a lever for turning said valves simultaneously.

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

GEORGE T. GEER.

Witnesses:

G. SARGENT ELLIOTT,

ADELLA M. FOWLE.