O. W. WILLIAMS & W. H. GARDNER.

ROTARY EXPLOSIVE ENGINE.

APPLICATION FILED NOV. 16, 1907.

947,008.

Patented Jan. 18, 1910.

3 SHEETS—SHEET 1.

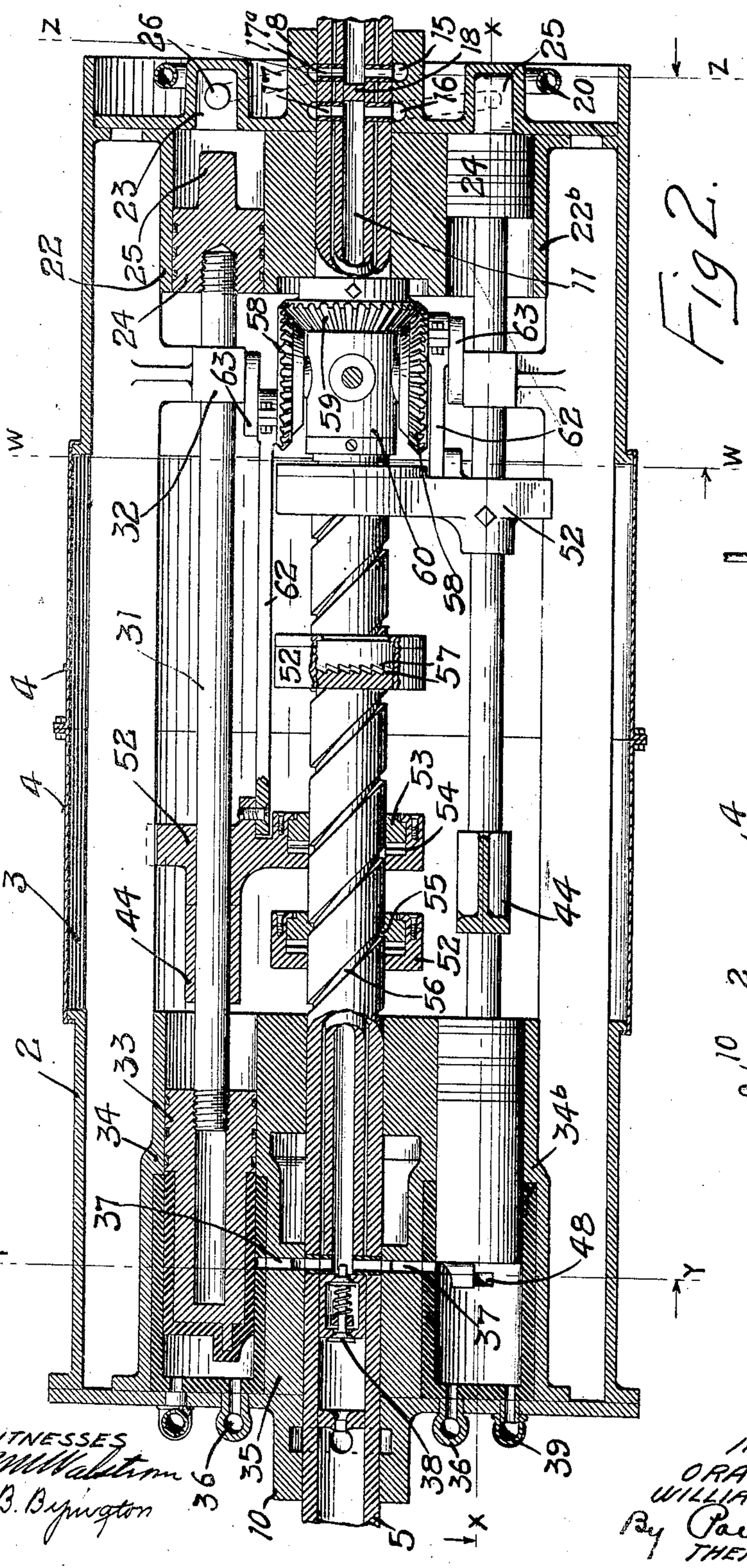

Fig 2.

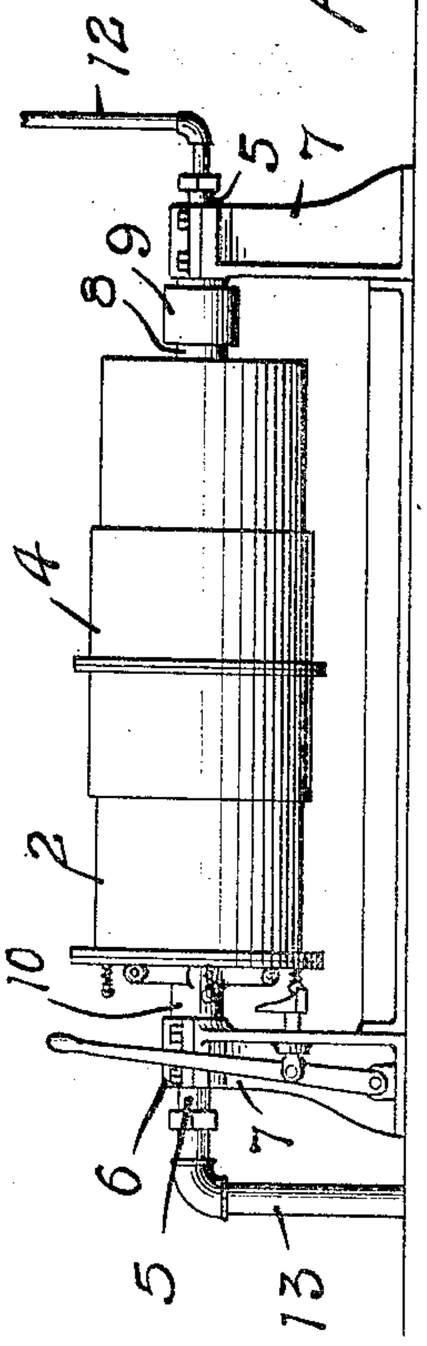

Fig 1.

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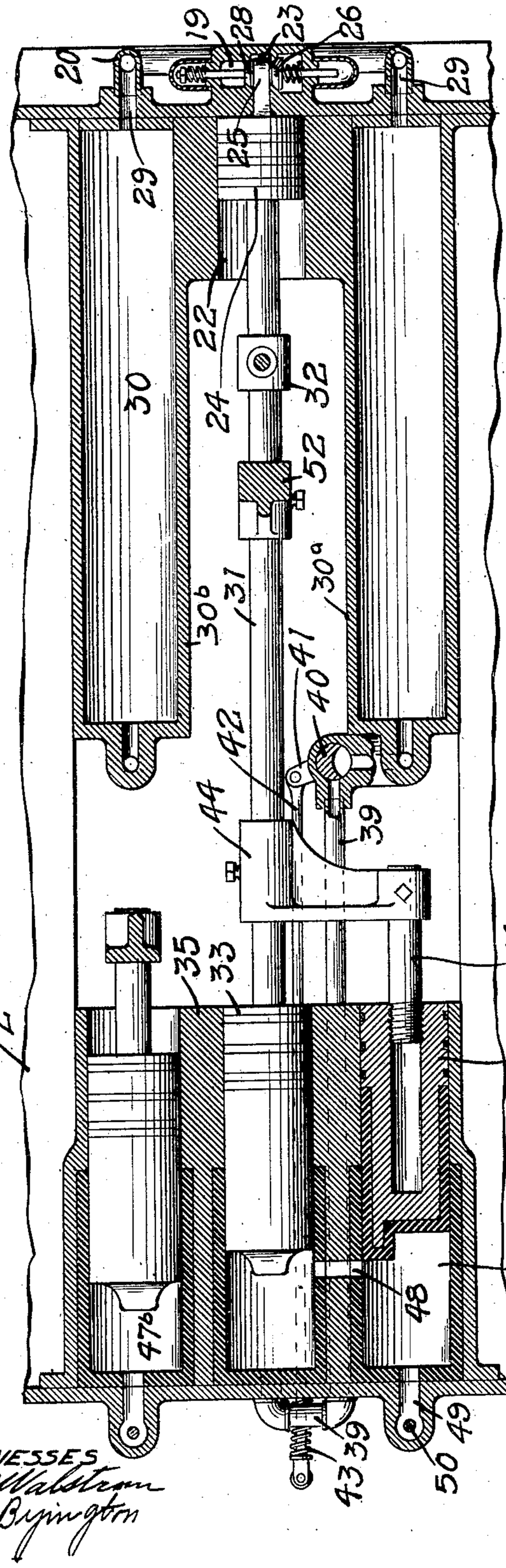

Fig 3. x-x.

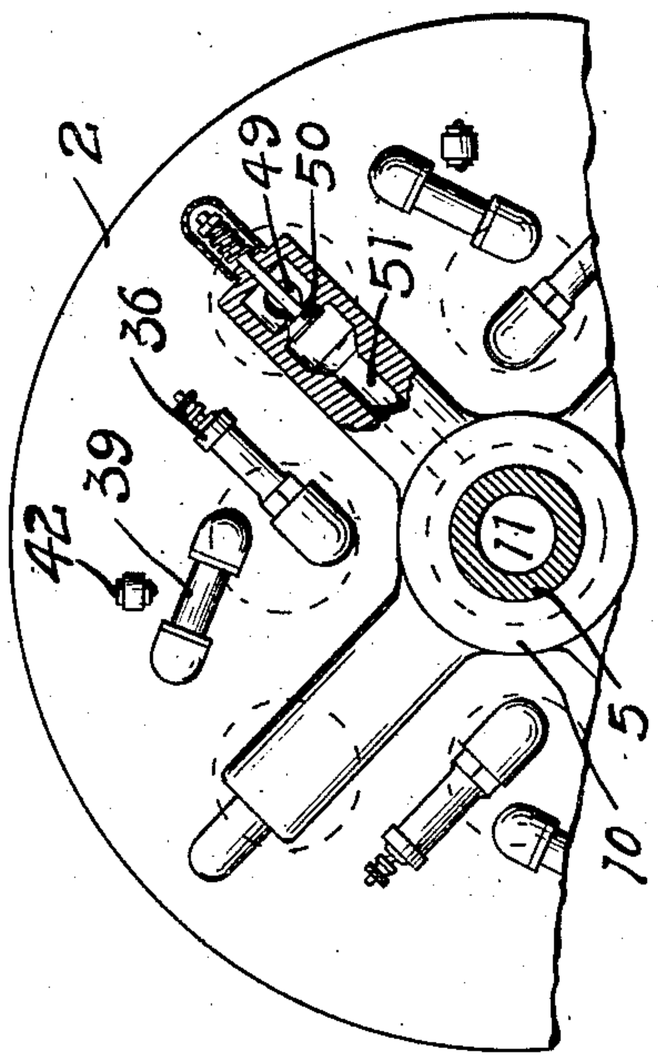

Fig 4.

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3 SHEETS—SHEET 3.

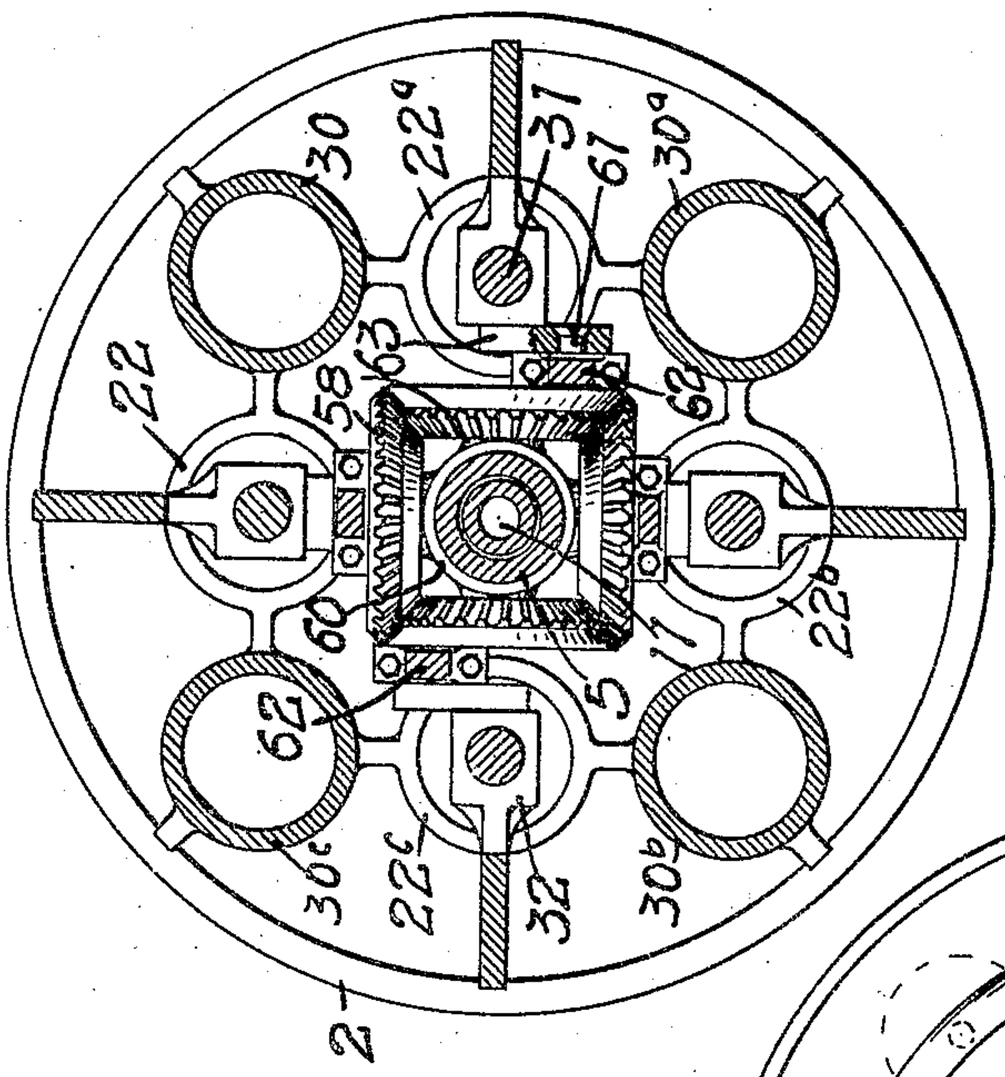
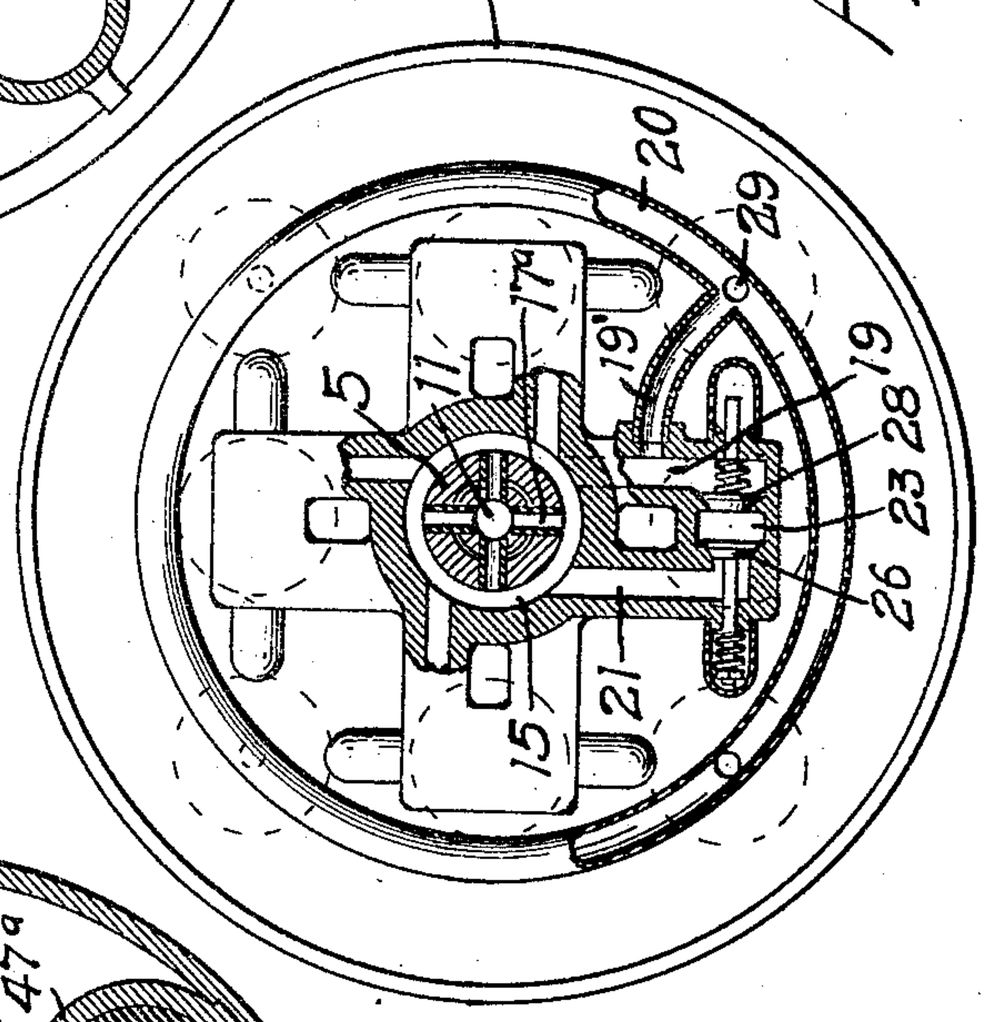


Fig 6. W-W

Fig 7. Z-Z



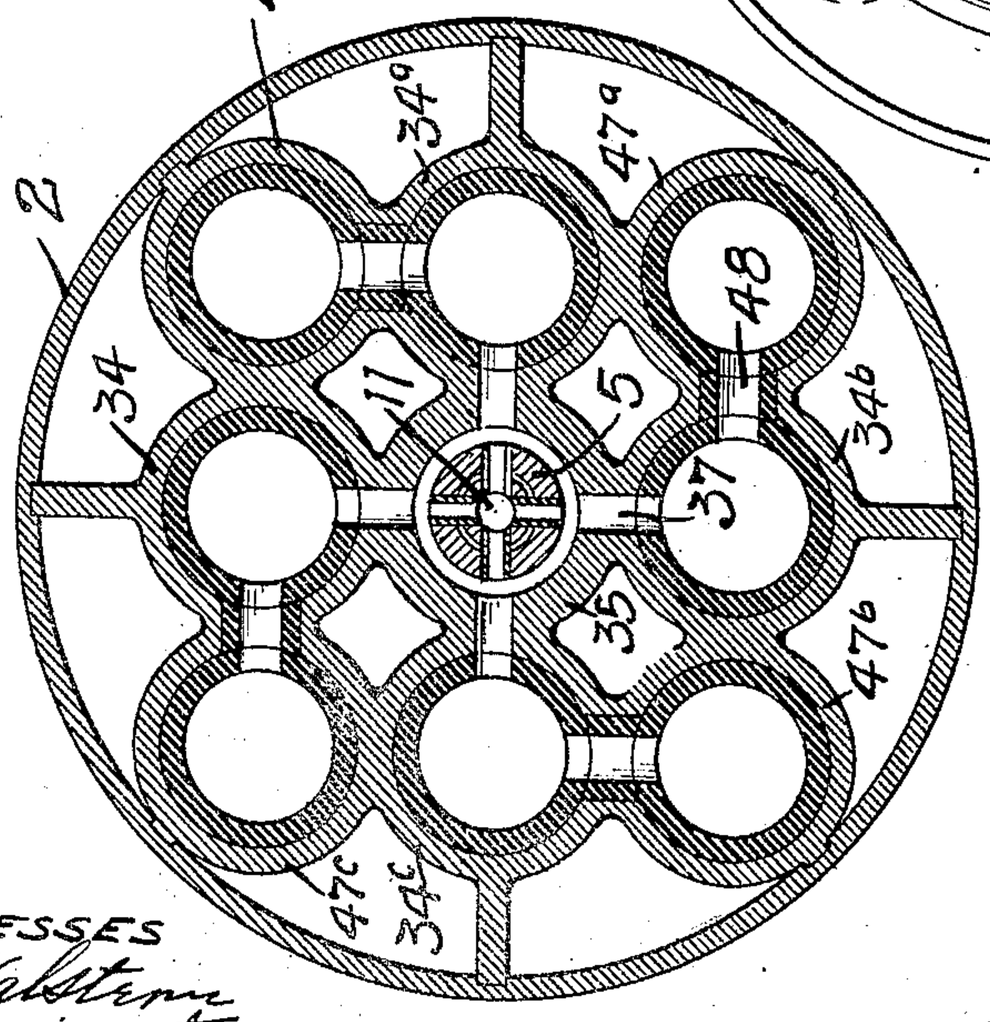


Fig 5. Y-Y

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UNITED STATES PATENT OFFICE.

ORA W. WILLIAMS AND WILLIAM H. GARDNER, OF MINNEAPOLIS, MINNESOTA.

ROTARY EXPLOSIVE-ENGINE.

947,008. Specification of Letters Patent. Patented Jan. 18, 1910.

Application filed November 16, 1907. Serial No. 402,446.

To all whom it may concern:

Be it known that we, ORA W. WILLIAMS and WILLIAM H. GARDNER, of Minneapolis Hennepin county, Minnesota, have invented certain new and useful Improvements in Rotary Explosive-Engines, of which the following is a specification.

The object of our invention is to provide a very compact, durable engine and one that is capable of operating at a high speed.

A further object is to provide an engine which will have great power in proportion to the space it occupies and the diameter of its cylinders, and be comparatively economical in its consumption of oil.

The invention consists generally in various constructions and combinations, all as hereinafter described and particularly pointed out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a front elevation of an engine embodying our invention. Fig. 2 is a longitudinal sectional view of an engine embodying our invention. Fig. 3 is a longitudinal sectional view on the line *x—x* of Fig. 2. Fig. 4 is an end view partially broken away. Fig. 5 is a transverse sectional view on the line *y—y* of Fig. 2. Fig. 6 is a transverse sectional view on the line *w—w* of Fig. 2. Fig. 7 is a transverse sectional view on the line *z—z* of Fig. 2.

In the drawing, 2 represents a cylindrical shell or casing within which the operating parts of the engine are inclosed. The middle portion of the casing has an opening 3 covered by plates 4. These plates are separable as indicated in Fig. 2, to permit access to the interior of the casing and the working parts of the engine.

5 is a shaft rigidly mounted in bearings 6 on standards 7. This shaft is stationary, the engine and casing revolving around it. A hub 8 is loosely mounted on one end of said shaft and carries a driving pulley. A hub 10 is loosely mounted on the opposite end of the shaft and both of these hubs revolve with the casing 2. The shaft 5 has a passage 11 extending therethrough from end to end and communicating at one end with a gas intake pipe 12 leading from a carbureter (not shown), and at the opposite end with a discharge pipe 13. The hub 8 is provided with interiorly arranged annular grooves 15 and 16 extending around the shaft and communicating with the passage 11 through a series of ports 17 and 17ª, one series communicating with the passage 11 on one side of a plug 18 and the other series of ports communicating with said passage on the other side of the plug.

Ports 19 and 19′ lead from the annular groove 16 to a hollow ring 20 inclosing the hub 8, and passages 21 lead from the groove 15 to a series of pump cylinders which we will designate by numerals 22, 22ª, 22ᵇ, and 22ᶜ, there being preferably four of these cylinders within the casing. Each pump cylinder has a recess 23 in one end with which the passages 19 and 21 communicate and the pistons 24 of the cylinders have projections 25 to enter said recesses and thoroughly expel all the gas in the cylinders. Valves 26 are provided in the passages 21 and normally close the same but are arranged to open during the suction stroke of the pump pistons to draw the gas in through the passage 21. In the passages 19 valves 28 are provided working oppositely from the valves 26, the recess 23 in the pump cylinders being located between these valves. The suction stroke of the pump pistons will therefore open the valves 26 to draw the charge in through the passages 21, and on the compression stroke of the pump pistons the charge will be forced past the valves 28 and through the passages 19, grooves 16 and ports 17 into the passage 11 in the shaft 5. A portion of the charge will be delivered to the passages 19′ and from thence to the hollow ring 20 and through passages 29 into compression cylinders wherein the gas is stored for the purpose hereinafter explained. There are a series of these compression cylinders which we will designate by numerals 30, 30ª, 30ᵇ and 30ᶜ. The pump pistons are provided with rods 31 arranged to slide in guides 32, on the interior of the casing, and at the opposite end of said rods from the pump pistons we provide explosion cylinder pistons 33 operating within cylinders 34, 34ª, 34ᵇ and 34ᶜ, arranged within the head 35 of the casing. These explosion cylinders have the usual igniters 36 and intake ports 37 communicating with the shaft passage 11. The passage through the shaft is closed by a valve 38 which prevents the escape of gas to the atmosphere but will open and relieve the pressure in case there is any accidental ignition of the gas while passing through the shaft to the explosion cylinders. The ends of the explosion cylinders are connected by pipes 39 with the com-

pressed gas-cylinders 30, 30ª, 30ᵇ and 30ᶜ, and each cylinder has a valve 40 operated by means of a lever 41 and a rod 42 to open the valve 40 against the tension of the spring 43 and allow the compressed gas to flow from a cylinder into its explosion cylinder, when for instance, it is desired to start the engine without drawing in the gas from the carbureter. The valves 40 are operable by the attendant whenever it is desired to introduce gas to the explosion cylinders. Upon the rods 31 brackets 44 are secured and connected to pistons 45 through rods 46, said pistons operating in exhaust chambers 47, 47ª, 47ᵇ and 47ᶜ. These chambers are connected by passages 48 with the explosion cylinders and the pistons operate simultaneously with the pistons in the explosion chambers. The passages 48 will be closed at the time of the explosion but will be uncovered at a predetermined point in the stroke of the pistons to allow the burned gases to be drawn into the exhaust chambers through the vacuum created by the movement of the pistons 45. On the return stroke of these pistons the burned gases will be forced out through the passages 49 through the valves 50 and passages 51 into the hollow shaft 5 and from thence into the discharge pipe 13.

The reciprocating movement of the pistons is converted into a rotary motion in the cylinder by the following mechanism:— 52 represents cross heads secured on the rods 31. 53 represents rings mounted within recesses 54 in said cross heads inclosing the shaft 5. The cross heads have openings through which the shaft 5 extends and said heads are free to move back and forth on said shaft. The rings 53 have ribs 55 adapted to enter spiral grooves 56 on the periphery of said shaft. A series of ratchet teeth 57 are provided on the cross heads 52 and the rings 53, said teeth being arranged to allow the free revolution of said ring when the cross head is moved in one direction but to lock said ring against revolution when the cross head is moved in the other direction. The result of locking the ring against revolution will be through its engagement with the spiral groove in the shaft to cause the revolution of the cylindrical casing and its driving pulley.

For the purpose of returning the explosion and exhaust pistons or performing the compression part of the stroke I provide a series of beveled gears 58 pivoted on a sleeve 60 that is loosely mounted on the shaft 5 and free to turn thereon. A gear 59 is secured on the shaft 5 at right angles to the gears 58 and meshes with each of them.

As indicated in Fig. 6 the gears 58 all mesh with the gear 59 but do not mesh with one another and are provided with wrist pins 61 having pitman rods 62 connecting them with the cross heads 52. The outer ends of the wrist pins 61 are mounted in cranks 63 journaled in the guides 32 upon the cylinder casing. It will be seen that the stroke of the cross heads is governed by the distance of the wrist pins from the centers of the gears 58 and the movement of the gears will be utilized to force the pistons into their cylinders and compress the charges of gas therein.

In the operation of the engine the gas will be drawn into the passage in the hollow shaft and forced by the action of the pump plungers into the compressed gas cylinders and through the hollow shaft toward the explosion cylinders. The withdrawal of the pistons in the explosion chambers will expose the ports leading thereinto and permit the gas to enter the cylinders in front of the pistons. On the return stroke the gas will be compressed and ignited. During the suction stroke the burned gases will be drawn into the exhaust cylinders and discharged from the engine.

The reciprocating motion will be converted into a rotary motion by means of the ratchet mechanism and spiral groove in the shaft and the cylinder casing will be revolved at a high speed with but little vibration and with the elimination of many of the undesirable features of an ordinary reciprocating engine. The parts are all accessible for cleaning and repairs and the engine will be economical to operate and will develop great power in proportion to the size of its cylinders.

We claim as our invention:

1. The combination, with a stationary shaft having a spiral formed thereon, of a cylinder having a reciprocating piston and means connecting said piston with said spiral whereby the reciprocation of the piston will impart a revolving movement to said cylinder.

2. The combination, with a stationary shaft having a spiral formed thereon, of a series of cylinders arranged at intervals around said shaft and having reciprocating pistons, means connecting said pistons with said spiral whereby the reciprocation of said pistons will impart a revolving movement to said cylinders.

3. The combination, with a stationary shaft having a spiral formed thereon, of an explosion cylinder having a reciprocating piston, an exhaust cylinder also having a piston and a port communicating with said explosion cylinder and into which exhaust cylinder the burned gases are drawn by the movement of its piston, said explosion cylinder having a gas intake and mechanism connecting said pistons with said spiral, whereby the reciprocation of said pistons will impart a revolving movement to said cylinder.

4. The combination, with a stationary shaft having a spiral formed thereon, of an

explosion cylinder having a reciprocating piston, a pump cylinder connected with a source of gas supply and with said explosion cylinder and having a piston operating simultaneously with said explosion cylinder piston, and mechanism connecting said pistons with said spiral whereby the reciprocation of the pistons will revolve said cylinder.

5. The combination, with a stationary shaft having a spiral formed thereon, of a series of explosion cylinders arranged at intervals around said shaft and having reciprocating pistons, a series of pump cylinders also arranged at intervals around said shaft and having plungers and connected with a source of gas supply and with said explosion cylinders, said explosion cylinder pistons and said plungers being arranged to operate simultaneously, and mechanism connecting said pistons with said spiral, whereby the reciprocation of said pistons will impart a revolving movement to said cylinders.

6. The combination, with a stationary shaft having a spiral formed thereon, of an explosion cylinder having a piston, a pump cylinder also having a piston and connected with a source of gas supply and with said explosion cylinder, a compressed gas cylinder connected with said pump cylinders and also having a pipe connection leading to said explosion cylinders, and a regulating valve therefor normally closed, and mechanism connecting said pistons with said spiral whereby the reciprocation of said pistons will impart a revolving movement to said cylinder.

7. The combination, with a stationary shaft having a spiral formed thereon, of a cylinder having a reciprocating piston and a ratchet mechanism connecting said piston with said spiral whereby during the travel of said piston in one direction a revolving movement will be imparted to said cylinder.

8. The combination, with a stationary shaft having a spiral groove formed therein, of an explosion cylinder having a reciprocating piston, a ring inclosing said shaft and having a rib to enter said groove, means connecting said ring with said piston, means whereby said ring is allowed to revolve on said shaft when said piston is moved in one direction and locking said ring when said piston is moved in the opposite direction, whereby a revolving movement will be imparted to said cylinder.

9. The combination, with a stationary shaft having a spiral groove formed therein, of an explosion cylinder having a reciprocating piston operating in a direction parallel substantially with said shaft, mechanism connecting said piston with said shaft, a revoluble casing inclosing said shaft and a driving pulley secured to said casing.

10. The combination, with a stationary shaft having a spiral, of an explosion cylinder having a piston operatively connected with said spiral, a gear secured on said shaft, a sleeve on said shaft, a gear mounted on said sleeve and adapted to revolve therewith and meshing with the gear on said shaft, and means connecting said sleeve gear with said operative connections, for the purpose specified.

11. The combination, with a stationary shaft having a spiral, of a series of explosion cylinders arranged at intervals around said shaft and having a series of pistons, mechanism connecting said pistons with said spirals, a gear secured on said shaft at right angles substantially thereto, a sleeve loosely mounted on said shaft, a series of gears mounted on said sleeve and meshing with said first named gear, mechanism connecting said sleeve gears with said pistons and spiral-connecting mechanism, for the purpose specified.

12. The combination, in a rotary explosive engine, with a stationary shaft, a casing inclosing said shaft, a pulley secured to said casing a series of explosion cylinders arranged within said casing at intervals around said shaft, pistons for said cylinders operating in a direction parallel with said shaft, a series of pump cylinders connected with the source of gas supply and with said explosion cylinders, plungers in said pump cylinders connected with the pistons of said explosion cylinders and also operating in a direction parallel with said shaft and simultaneously with said pistons, and mechanism connecting said pistons with said shaft, whereby the reciprocation of said pistons and plungers will impart a revolving movement to said casing.

13. The combination, with a stationary shaft having a spiral formed thereon, of a cylinder having a reciprocating piston, a casing inclosing said shaft and wherein said cylinder is mounted, means connecting said piston with said spiral whereby the reciprocation of the piston will impart a revolving movement to said casing, and a driving pulley connected to said casing, substantially as described.

In witness whereof, we have hereunto set our hands this 11th day of November, 1907.

ORA W. WILLIAMS.
WILLIAM H. GARDNER.

Witnesses:
J. H. BALDWIN,
J. B. BYINGTON.