F. J. MINER.

EXPLOSIVE ENGINE.

APPLICATION FILED AUG. 23, 1909.

**991,631.**

Patented May 9, 1911.

3 SHEETS—SHEET 1.

Fig. 2.

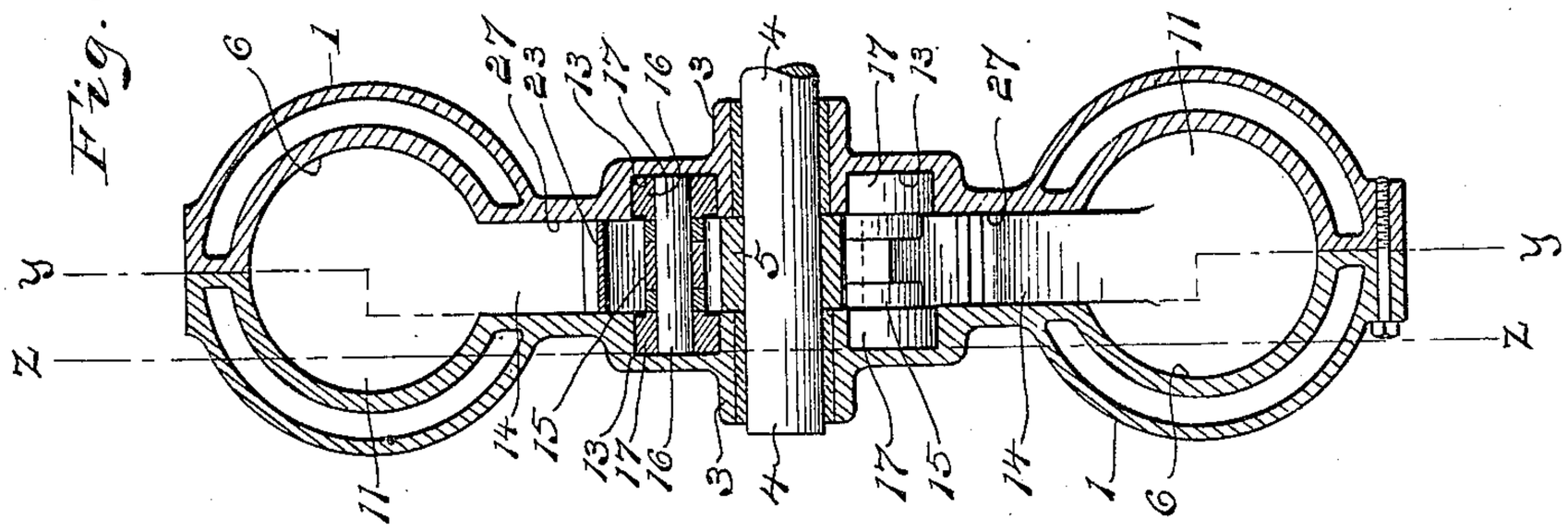
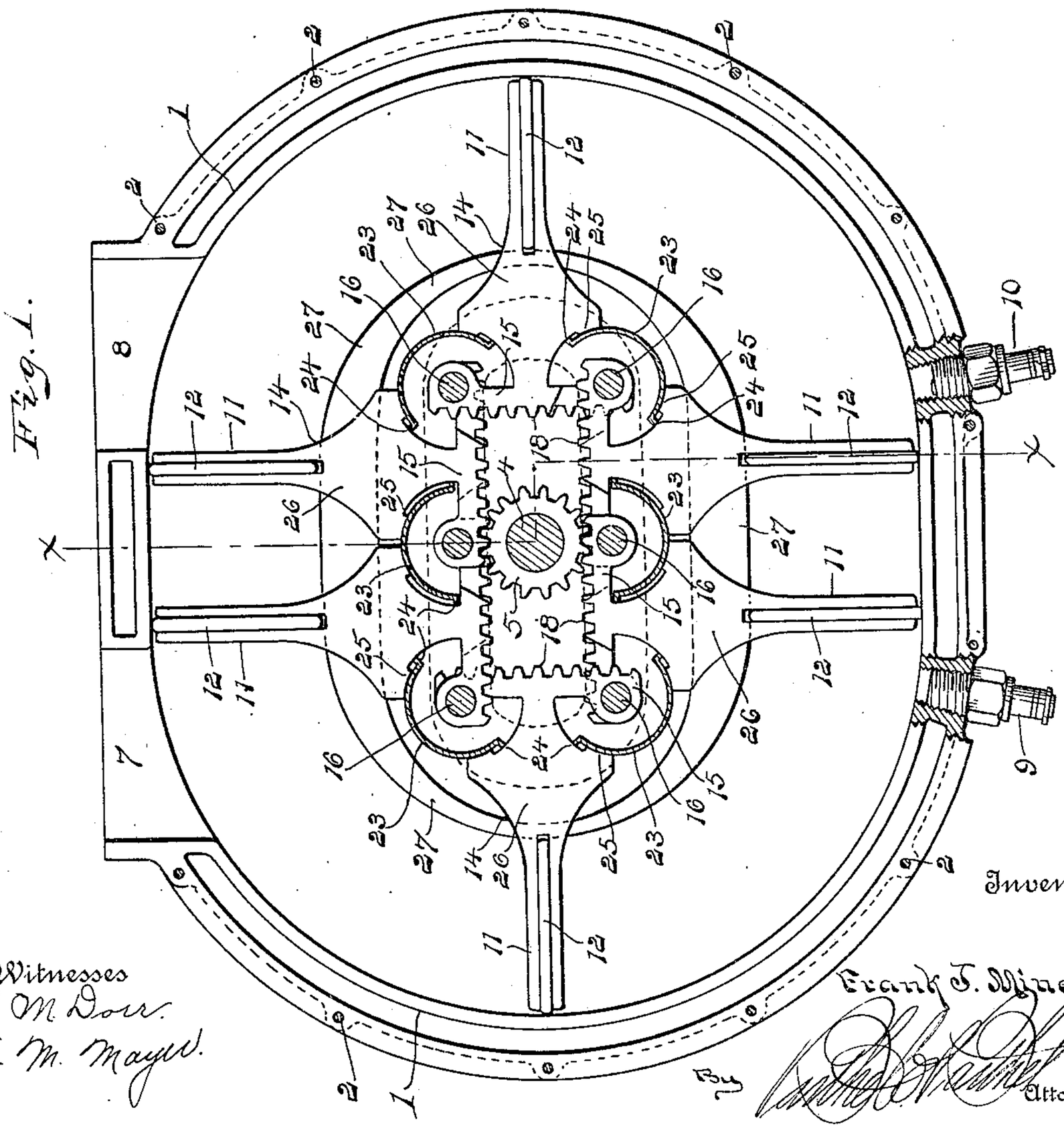



Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 4.

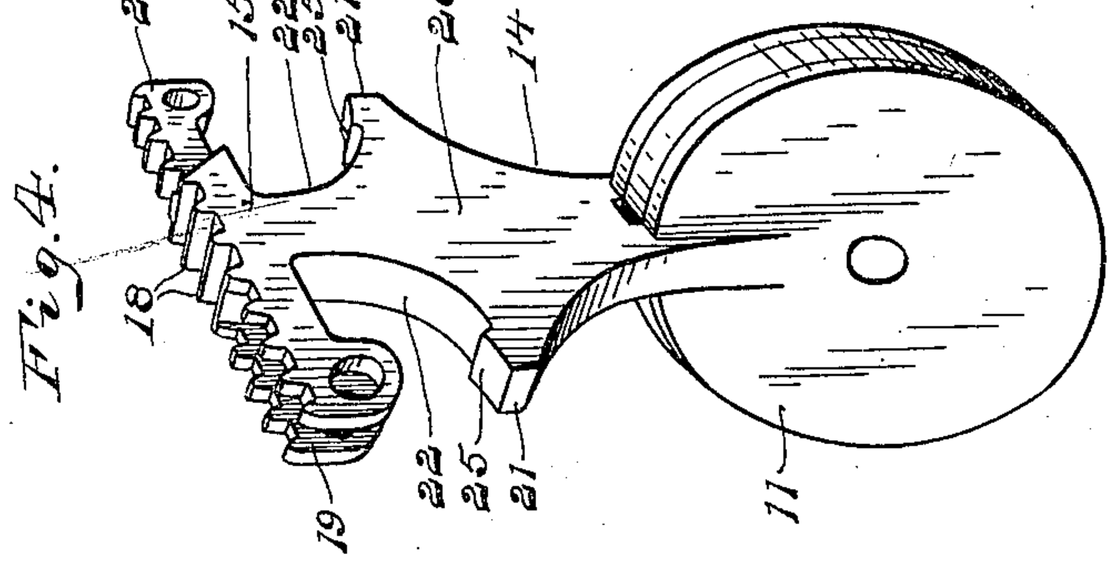
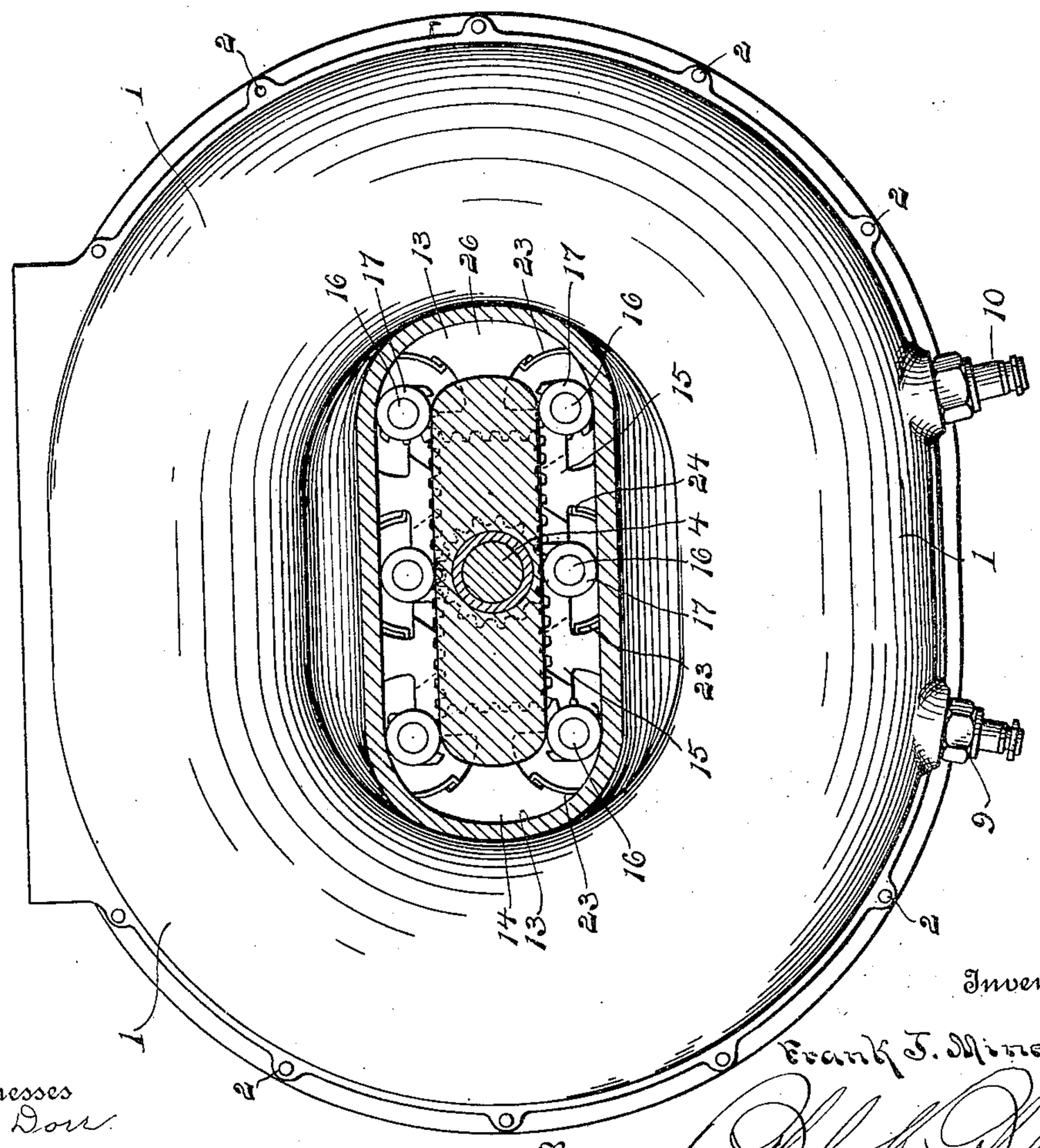



Fig. 3.

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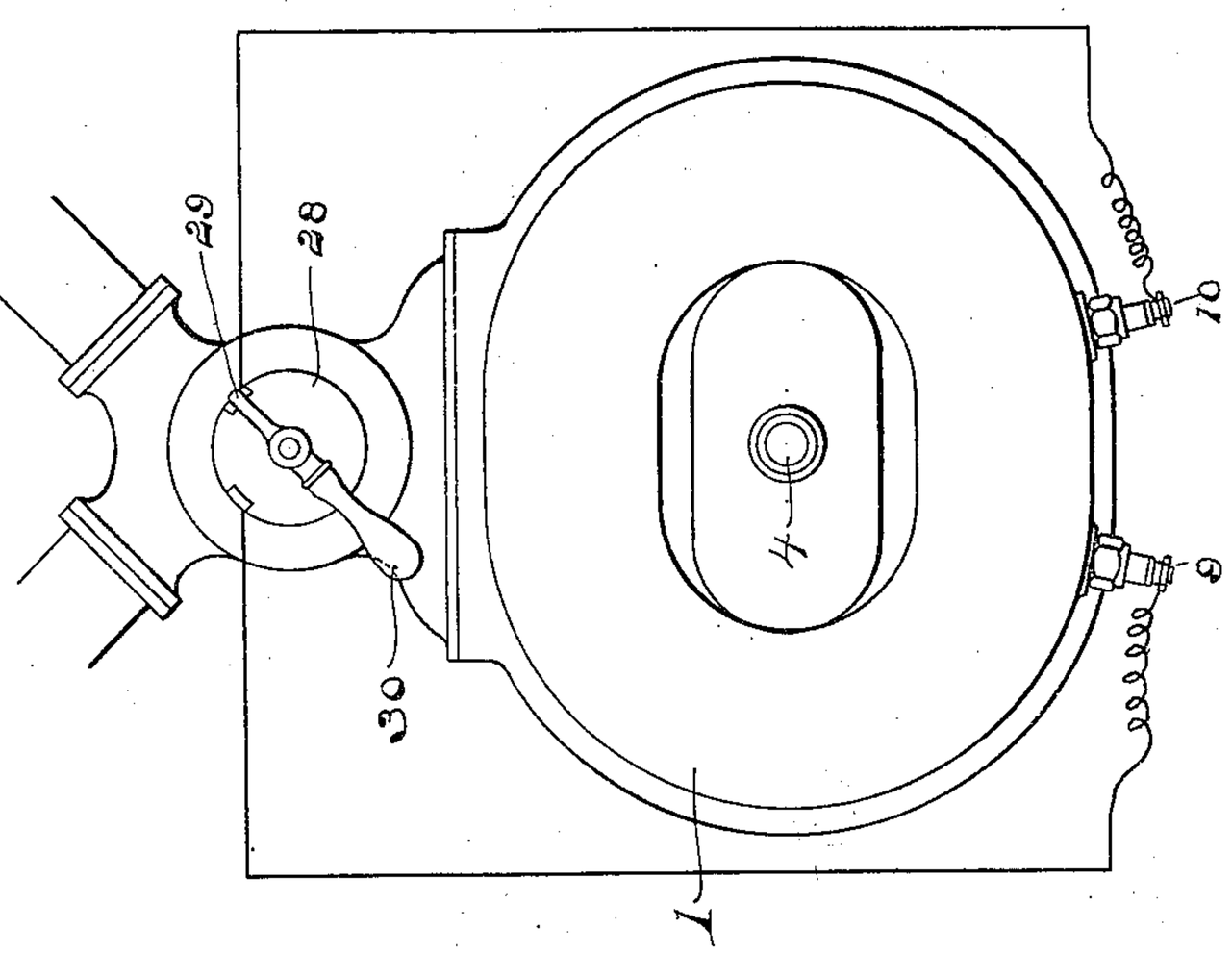
3 SHEETS—SHEET 3.

Fig. 5.

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# UNITED STATES PATENT OFFICE.

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## EXPLOSIVE-ENGINE.

991,631. Specification of Letters Patent. Patented May 9, 1911.

Application filed August 23, 1909. Serial No. 514,129.

*To all whom it may concern:*

Be it known that I, FRANK J. MINER, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an internal combustion motor of a type wherein the driving members revolve continuously around a fixed center and wherein by suitable disposition of the ports and the ignition system, reversal of direction is obtainable at the will of the operator.

The invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

In general terms, the motor is formed of a series of members articulated in an endless chain, that are constrained to travel in a casing in such manner that a series of pockets are formed, each of which expands as it communicates with one port of the casing, and thereafter contracts. The contents is then fired by suitable means, and the pocket is expanded by the explosion resulting from the ignition and moved into register with another casing port where it is contracted to expel the exhausted charge, and returned to the first port. The members are propelled by this alternate expansion and contraction and operate a main shaft from which power is transmitted as desired.

Referring to the drawings, Figure 1 is a view partly in side elevation and partly in section, of a motor embodying features of the invention; Fig. 2 is a view in transverse section on line $x$—$x$ of Fig. 1, the section line $y$—$y$ indicating the plane of view of Fig. 1; Fig. 3 is a view in side elevation and in section on line $z$—$z$ of Fig. 2; Fig. 4 is a view in detail of one of the driving members; and Fig. 5 is a diagrammatic view of a reversing system for the motor.

As herein illustrated in preferred form, a casing 1 of two oppositely disposed sections secured by screws 2 or other suitable means has a central bearing 3 in which a main shaft 4 is journaled. A pinion 5 is secured on this shaft within the casing. A chamber 6, that is preferably circular in cross section, is formed in the casing substantially concentric with the main shaft 4. In contour the chamber is substantially a flattened ellipse with a pair of diametrically opposite straight sections. A pair of ports 7 and 8 open from this chamber in one side of the casing at either end of the adjacent straight section, and on the opposite side of the casing a pair of ignition plugs 9 and 10 are inserted, each at the end of the other intermediate straight section. A series of propeller blades or abutments 11 are articulated as an endless chain sweeping this chamber. Expansion rings 12 on the abutment peripheries form a tight joint with the chamber wall and the abutments are held perpendicularly to the wall regardless of their position therein by cam paths 13 that are formed in the opposite inner faces of the casing around the pinion 5. Each abutment has an inwardly extending stem 14 with a base 15 at right angles to the plane of the abutment. These bases are pivotally connected at their ends as by pins 16 in an endless chain, and as a convenient detail of construction, friction rolls 17 on the pin ends constitute the cam path engaging members. The disposition of the cam paths, friction rolls and abutment bases is such that the latter form continuous parallel rack bars on opposite sides of the pinion 5 when the abutments are traversing the straight sections of the chamber 6, and rack teeth 18 are formed on the bars that mesh with the gear 5 when the abutments are in such position. To insure rigidity one end of each base may have a longitudinal slot 19 that is engaged by a corresponding reduced portion or tongue 20 of the adjacent link, the abutting shoulders being adapted to hold the parts in alinement.

To prevent leakage when the adjacent abutments are in angular relation, oppositely disposed ears 21 extend from the stem 14 with concave faces 22 whose centers coincide with the axes of the pins 16, and a semi-cylindrical filler plate 23 is inserted between each adjacent pair of stems with retaining flanges 24 adapted to abut corresponding lugs 25 on the faces 22 when the abutments are in extended relation. Incidentally the wide bearing faces 26 of the stems 14 have sliding relation with the walls 27 of the casing which are contracted between the cam paths 13 and the chamber 6, thereby steadying the abutments. Or the

connections may be otherwise designed to form a close joint and prevent leakage.

In operation one terminal or spark plug is active, the other "dead." Each abutment, as it leaves the straight section of the chamber adjacent the spark plugs exposes gas trapped between it and the following abutment to the active terminal so that it is fired. As the forward abutment is free to swing around the curved portion of the cam path or chamber, the explosion of the charge propels this blade forward at a greater angular velocity than the following blade. The latter in turn exposes a fresh charge behind it so that the movement forward is practically continuous. As an abutment passes the port adjacent the active ignition plug, it is retarded in its angular movement and moves with less velocity than the following blade which thereby forces the exhaust charge out through the port. Between the ports, each pair of abutments stand in parallel relation and in close proximity. As the forward abutment sweeps over the succeeding inlet port, it enlarges the space between it and the following abutment thereby drawing in a fresh charge behind it, the varying velocities of the blades thereafter compressing the charge and bringing it to the ignition terminal for firing as before. It is to be understood, of course, that the port thereto adjacent the active ignition terminal is connected to the exhaust port of the motor and the second port is connected with the fuel supply. Reversal of direction may obviously be obtained by cutting out the active plug and throwing in the other plug, with the corresponding change in the connection of the casing ports. This is accomplished in any preferred manner and is indicated diagrammatically in Fig. 5, wherein a valve 28 for shifting the port connections and a change-switch 29 arranged as shown are operated simultaneously by a member 30.

The main feature of the invention is the series of revoluble pockets which are expanded by explosion of their contents in such manner that the pocket-forming members are propelled around the casing, and any arrangement of parts which accomplishes this result may be used.

Obviously, changes in details of construction may be made without departing from the spirit of the invention and I do not limit myself to any particular form or arrangement of parts.

What I claim as my invention is:

1. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to form a plurality of pockets successively communicating with the ports and adapted to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

2. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to form a plurality of pockets successively communicating with the ports, means adapted to cause the members to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansions of the pockets resulting from the ignition of their contents.

3. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to form a plurality of pockets successively communicating with the ports, means constraining the members to move differentially to expand each pocket as it is in register with one port, to contract it before it reaches the succeeding port, and to also contract it when in register with said port, and means to ignite the contents of each pocket when contracted and closed to the ports, the members being propelled by the successive expansion of the pockets due to ignition of the contents.

4. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to form a plurality of pockets successively communicating with the ports and adapted to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, means adapted to ignite the contents of a contracted pocket, and means adapted to connect the ports severally with a source of fuel supply, the members being propelled by the successive expansion of the pockets due to the ignition of their contents.

5. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to form a plurality of pockets successively communicating with one of the ports and adapted to move differentially to expand each pocket as it is in register with said port, and to contract it before it reaches the succeeding port, and means adapted to ignite the contents of each contracted pocket at a point where the resultant explosion reëxpands it and propels the members toward said succeeding port.

6. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to form a plurality of pockets successively communicating with the ports and adapted to move differentially to expand each pocket as it is in register with one port and to contract it

before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being continuously propelled by the successive expansions of the pockets resulting from the ignition of their contents, the ignition means being adjustable to explode the contents of a contracted pocket at different points in the path of motion of the members.

7. In an explosive engine, a casing having ports, a series of revoluble members articulated together and arranged therein to move continuously and to form a plurality of pockets successively communicating with one of the ports and adapted to move differentially to expand each pocket as it is in register with said port, and to contract it before it reaches the succeeding port, means adapted to ignite the contents of each contracted pocket at a point where the resultant explosion reëxpands it and propels the members toward the next port, and means adapted to conduct fuel from a source of supply to the port adjacent which the pockets expand.

8. In an explosive engine ,a casing having ports, a series of revoluble members arranged therein to form a plurality of pockets successively communicating with one of the ports and adapted to move differentially to expand each pocket as it is in register with said port, and to contract it before it reaches the succeeding port, means adapted to ignite the contents of each contracted pocket at a point where the resultant explosion reëxpands it and propels the members toward said succeeding port, and means adapted to conduct fuel from a source of supply to the port where the pocket expansion occurs, the fuel supplying means being adjustable to deliver to either port, and the ignition means being correspondingly adjustable to change direction of motion of the members.

9. In an explosive engine, a casing having ports, a series of revoluble members arranged therein to form a plurality of pockets successively communicating with the ports and engaged by cam paths in the casing to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

10. In an explosive engine, a casing having ports, a series of revoluble members articulated therein and arranged to form a plurality of pockets successively communicating with the ports and engaged by cam paths in the casing to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

11. In an explosive engine a casing having ports, a main shaft journaled centrally therein, a series of revoluble members articulated together in the casing around the shaft to form a plurality of pockets successively communicating with the ports and adapted to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, a gear secured on the shaft that meshes with rack teeth on the members, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

12. In an explosive engine, a casing havings ports, a main shaft journaled centrally therein, a gear on the main shaft, a series of revoluble members adapted to mesh with the gear and articulated together in the casing around the gear to form a plurality of pockets successively communicating with the ports and engaged by cam paths in the casing to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port and constrained by the cam paths to mesh with the gear, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

13. In an explosive engine, a casing having ports, a gear rotatably secured therein, a series of revoluble members provided with gear teeth adapted to mesh with the gear, means articulating the members in an endless chain around the gear to form a plurality of pockets with the casing successively communicating with the ports, means adapted to constrain the members to form a continuous rack meshing with the gear and to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

14. In an explosive engine, a casing having ports, a gear centrally rotatable in the casing, a series of revoluble members articulated in the casing around the gear and provided with rack teeth, the casing coacting with the members to form a plurality of pockets successively communicating with the ports, and constraining the members to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, the members forming a continuous rack meshing with the gear, and means to ignite the

contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

15. In an explosive engine, a casing having ports, a gear journaled in the casing at substantially the transverse axial center of continuous cam paths formed in the casing wall and a chamber in the casing substantially concentric with the cam paths, a series of revoluble members articulated in an endless chain engaged by the cam paths to form a plurality of pockets in the chamber successively communicating with the ports and to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, the faces of the members adjacent the gear being provided with rack teeth that are constrained to mesh with the gear by the cam paths, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

16. In an explosive engine, a casing having ports, and continuous cam paths on the inner faces of its wall, a gear centrally journaled in the casing at substantially the transverse axial center of the cam paths and a chamber in the casing substantially concentric with the cam paths, a series of abutments arranged to form a plurality of pockets in the chamber successively communicating with the ports and provided with bases engaged by the cam paths, the bases and cam paths coacting to move the abutments differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, rack teeth on the bases, the bases forming a continuous rack, a driving gear, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

17. In an explosive engine, a casing having ports, a gear rotatable centrally in the casing, a series of revoluble members articulated together in an endless chain around the gear and arranged to form a plurality of pockets in a chamber that is substantially concentric with the gear, and provided with toothed bases that are engaged by continuous cam paths in the casing substantially concentric with the chamber to form oppositely disposed parallel rack bars in mesh with the gear, the cam paths constraining the members to move differentially to expand each pocket as it is in register with one port and to contract it before it reaches the succeeding port, and means to ignite the contents of a contracted pocket, the members being propelled by the successive expansion of the pockets resulting from the ignition of their contents.

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

FRANK J. MINER.

Witnesses:
OTTO F. BARTHEL,
C. R. STICKNEY.