I. M. KEPHART.

ROTARY ENGINE.

APPLICATION FILED JUNE 14, 1909.

983,257.

Patented Jan. 31, 1911.

4 SHEETS—SHEET 1.

Fig. 1.

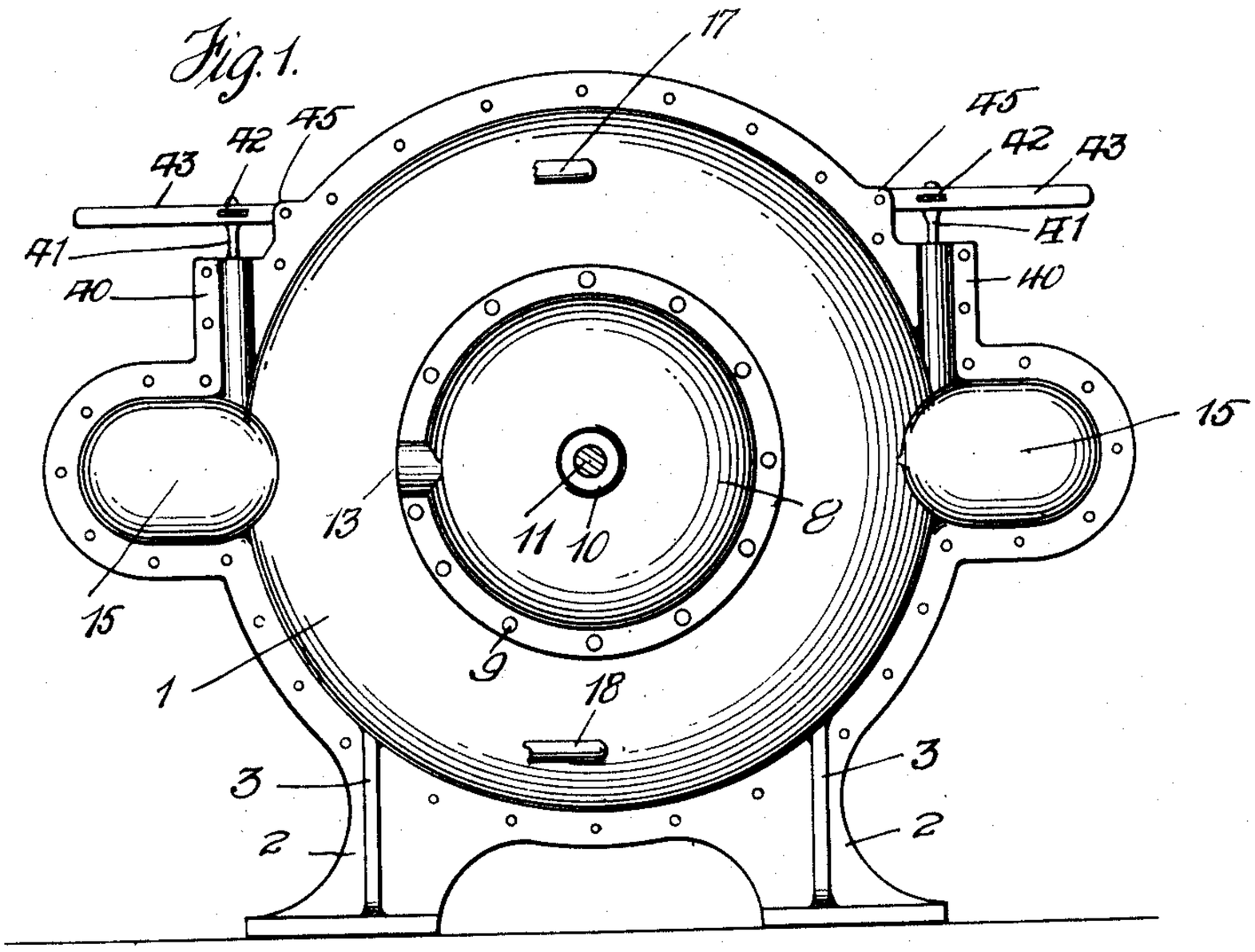
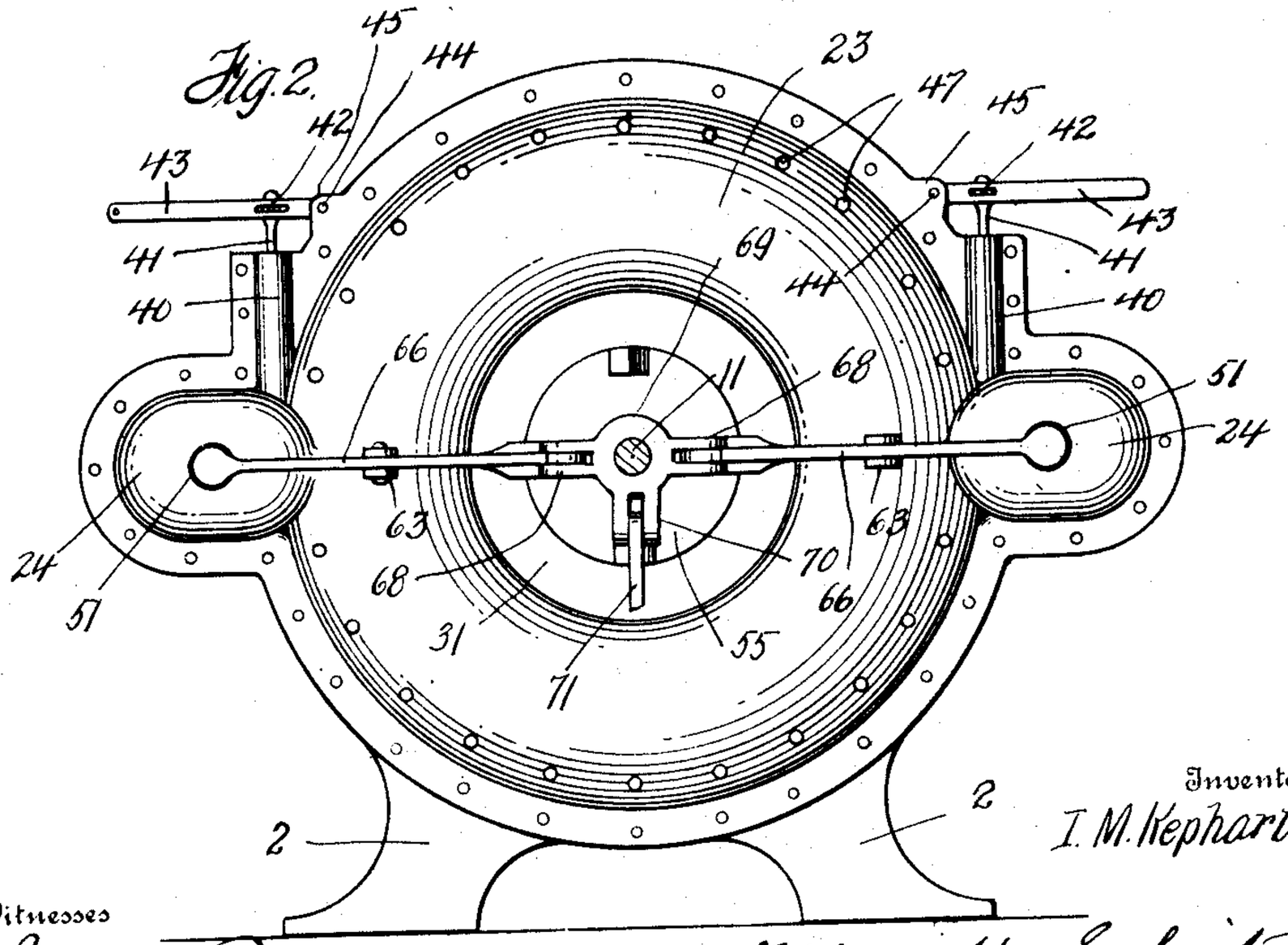


Fig. 2.



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4 SHEETS—SHEET 2.

Fig. 3.

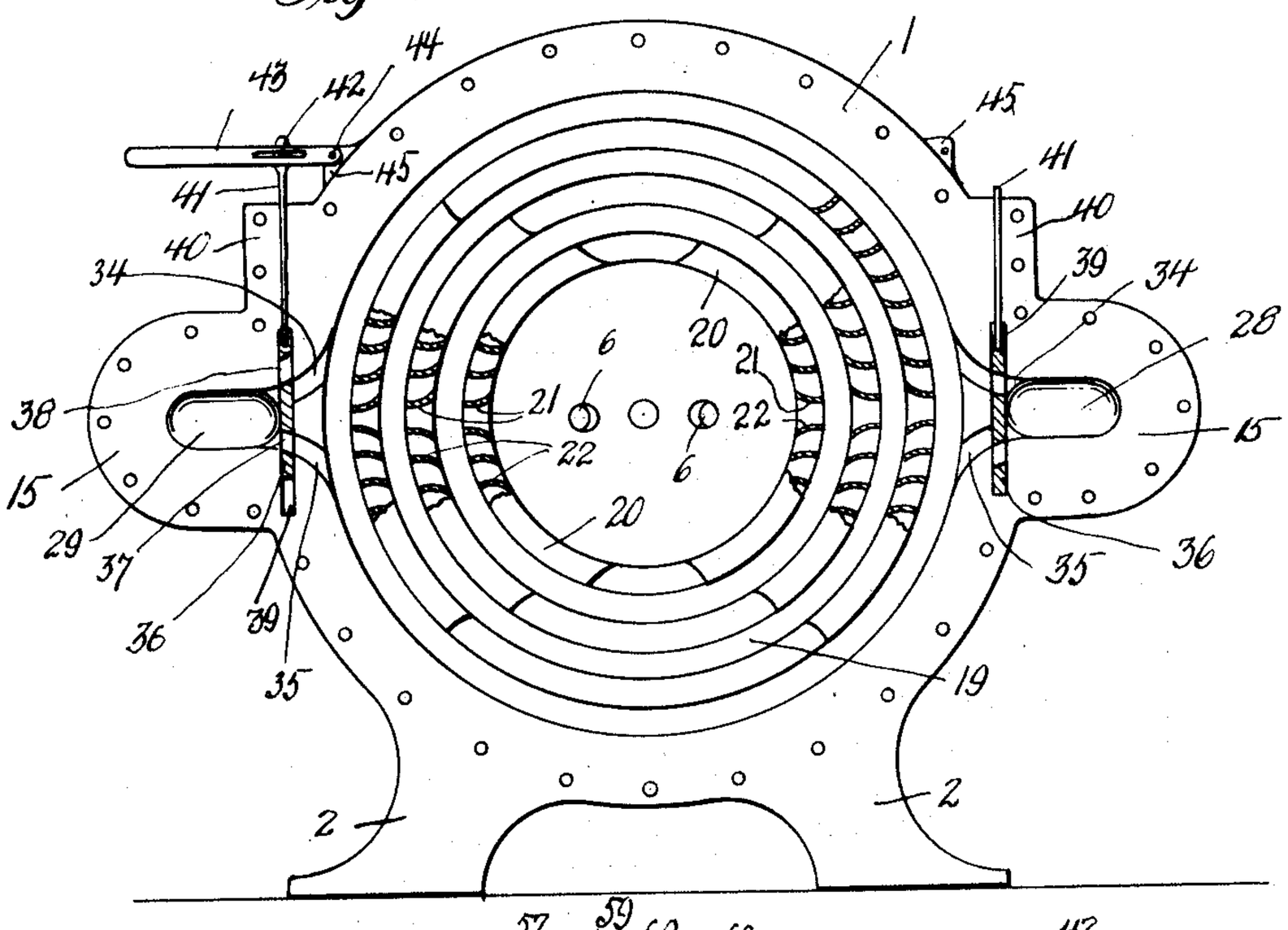

Fig. 4.

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4 SHEETS—SHEET 3.

Fig. 5.

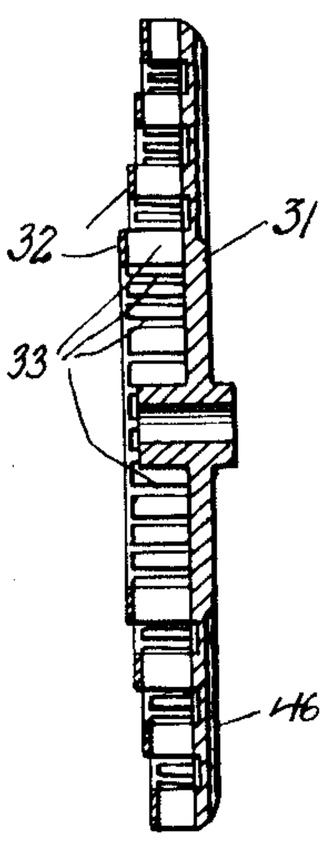


Fig. 6.

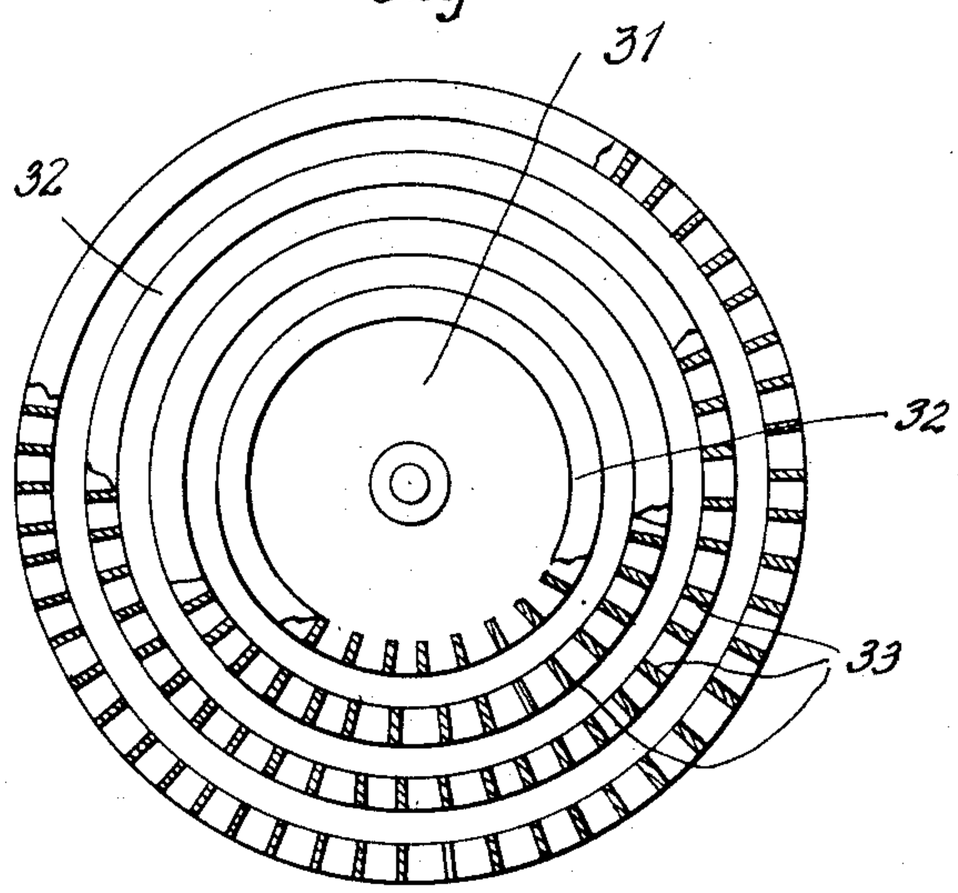
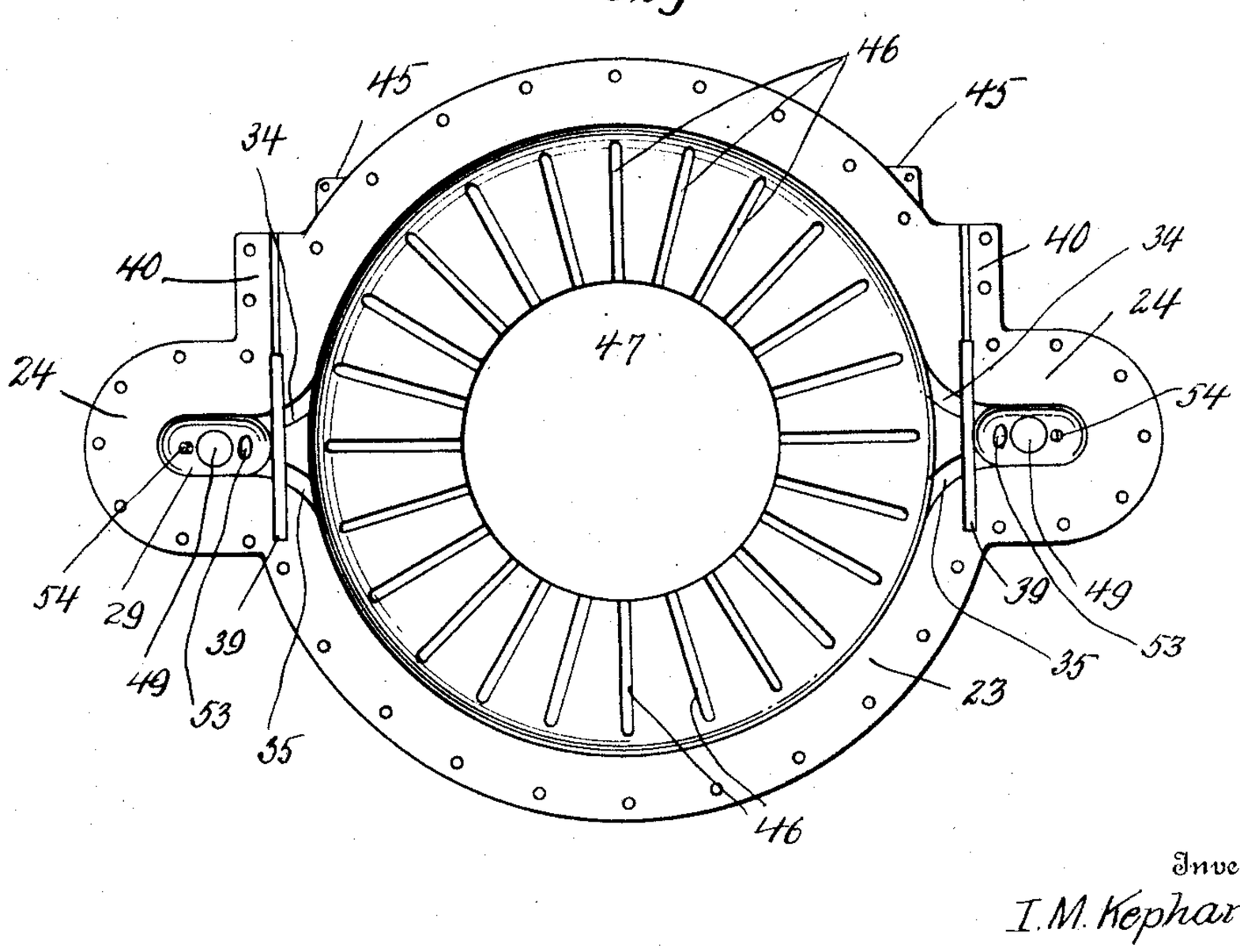


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 8.

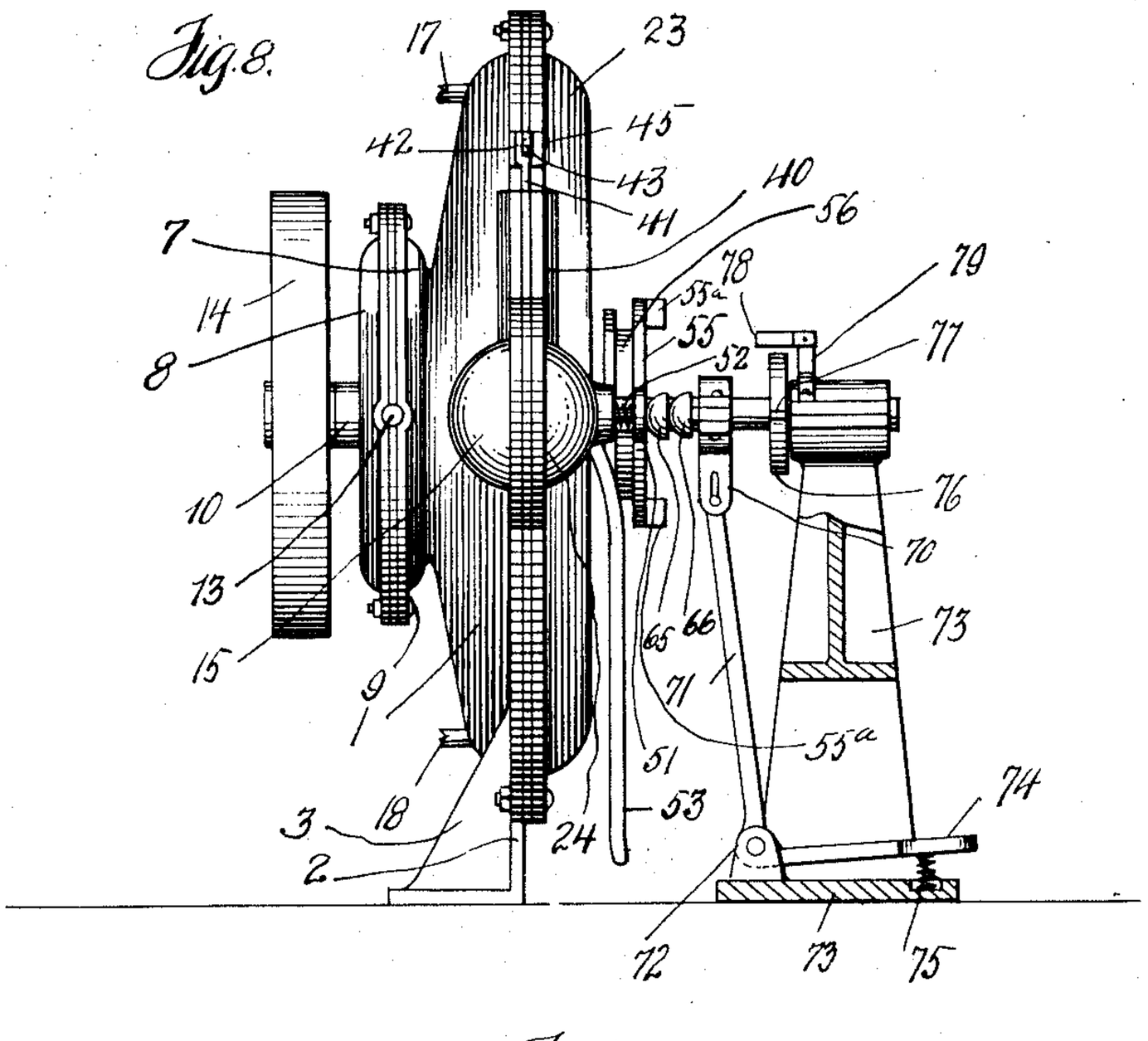
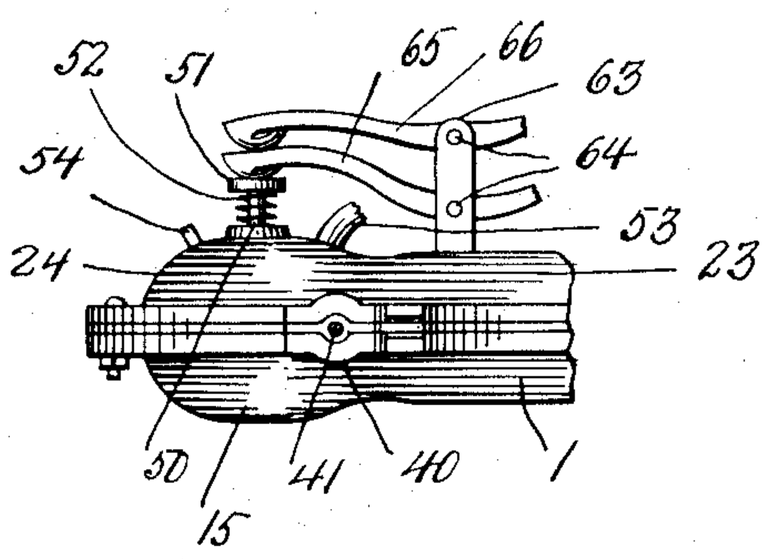


Fig. 9.



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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

983,257. Specification of Letters Patent. **Patented Jan. 31, 1911.**

Application filed June 14, 1909. Serial No. 502,169.

To all whom it may concern:

Be it known that I, IRA M. KEPHART, a citizen of the United States, residing at Punxsutawney, in the county of Jefferson and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to certain new and useful improvements in rotary engines, and the invention has for its primary object to embody the principles of a turbine engine in a rotary engine, whereby a high degree of efficiency can be obtained from a minimum expenditure of fuel.

Another object of the invention is to provide a compact and easily controlled engine that can be used for various purposes.

A further object of the invention is to furnish novel means for starting the engine and controlling the operation of the same.

With the above and other objects in view which will more readily appear as the invention is better understood, the same consists in the novel construction, combination and arrangement of parts to be hereinafter described and then claimed.

In the drawings:—Figure 1 is a side elevation of the engine with the driven or balance wheel thereof removed, Fig. 2 is a view of the opposite side of the engine, partly broken away. Fig. 3 is an elevation of the inner side of approximately one half of the engine, partly broken away and partly in section. Fig. 4 is a horizontal sectional view of a portion of the engine, Fig. 5 is a vertical sectional view of a rotor forming part of the engine. Fig. 6 is a side elevation of the same, partly broken away and partly in section, Fig. 7 is a side elevation of the other half of the engine adapted to be secured to that half shown in Fig. 3 of the drawings, Fig. 8 is an end view of the engine, Fig. 9 is a plan of a portion of the same.

In the drawings, 1 denotes a circular dished shell supported by legs 2 having vertical reinforcing ribs 3. The shell 1 is provided with a central enlargement 4 having a central longitudinal opening 5 and diametrically opposed exhaust ports 6. The outer ends of the ports 6 terminate in an inner section 7 of a circular muffler casing, the outer section 8 of said muffler casing being secured to the inner section by bolts and nuts 9. The outer section 8 is provided with a central bearing 10 for a longitudinal shaft 11 adapted to extend through the opening 5 of the enlargement 4.

12 designates a bladed wheel or muffler mounted upon the shaft 11 within the muffler casing, said bladed wheel disseminating the exhaust gases and fumes ejected through the ports 6, prior to the gases and fumes escaping through the port 13 of the muffler casing.

14 designates a balance wheel carried by the end of the shaft 11 protruding from the muffler casing.

15 designates diametrically opposed dished extensions of the shell 1, and these extensions together with the shell 1 are bored to provide a cooling chamber 16 for water or a similar cooling agent, the water being circulated through the chamber through the medium of ports 17 and 18.

The inner side of the shell 1 is circumferentially stepped, as at 19, and arranged upon each alternate step are segment-shaped housings 20 having curved guide vanes 21 and 22. The segment shaped housings 20 are diametrically opposed relative to the shaft 11 and are located contiguous to the extensions 15 of the shell 1, with the guide vanes 21 and 22 curving in opposite directions from the middle thereof.

23 designates a circular head having diametrically opposed extensions 24. The head 23 is dished similar to the shell 1 and is adapted to fit against the shell 1 and be secured thereto by bolts 25 and nuts 26. It is preferable to interpose a gasket or washer 27 between the confronting faces of the head 23 and the shell 1 to establish a non-leakable connection between these two elements. The extensions 24 of the head 23 are adapted to register with the extensions 15 of the shell 1, and these extensions provide diametrically opposed combustion chambers 28 and 29, for a purpose that will presently appear.

The dished head 23 and the shell 1 provide a cylinder or casing 30 for a circular rotor 31, which is mounted upon the shaft 11 between the head 23 and the shell 1. The inner side of the rotor 31 bears against the head 23, while the opposite side is provided with circumferentially arranged housings 32, each housing having radially disposed impact vanes 33. The housings 32 are constructed somewhat similar to the housings 20, and are adapted to fit and revolve between the same, as best shown in Fig. 4 of the drawings. The housings 32 are stepped

in height in order to meet the stepped inner side of the shell 1.

The extensions 15 and 24 are provided with curved ports 34 and 35 establishing communication between the combustion chambers 28 and the cylinder 30. Intersecting the ports 34 and 35 are reversing valves 36, each valve having ports 37 and 38 adapted to alternately register with the ports 34 and 35. These reversing valves are movably mounted in sockets 39 provided therefor in the confronting faces of the head 23 and the shell 1. The head 23 and the shell 1 directly above the extensions thereof are enlarged at the peripheral edges of said head and shell, as at 40, and in said enlargements are arranged movable valve rods 41, said rods being loosely connected, as at 42, to operating levers 43, pivotally connected as at 44 to lugs 45, carried by the shell 1 and the head 23. These levers are simply a conventional form of valve operating mechanism, and I reserve the right to connect the valve rods 41, whereby they can be simultaneously actuated.

The inner side of the head 23 is provided with a plurality of radially disposed air conduits 46, the inner ends of said conduits terminating in a large circular opening 47 formed in the head 23, while the outer ends of said conduits terminate adjacent to the peripheral edges of said head. The air conduits coöperate with the air chamber 16 in maintaining the cylinder 30 in a cool condition during the operation of the engine.

The extensions 24 of the head 23 are provided with central tapering valve seats 48 and adapted to engage in said seats are valves 49 having valve stems 50 extending outside of the extensions 24. The outer ends of the valve stems 50 are provided with heads 51, and encircling said valve stems between the outer sides of the extensions 24 and the heads of said valve stems are coiled springs 52, these springs normally maintaining the valves 49 in a seated position.

Communicating with the valve seats 48 are supply pipes 53 through which any suitable explosive mixture may be led into the combustion chambers, the said explosive mixture being maintained under a sufficiently high pressure to overcome the pressure remaining after the explosions in the combustion chambers when the valves 49 and 50 are opened. For the purpose of igniting the explosive charge after they have been drawn into the explosion chambers, spark plugs 54 of any conventional form may be employed. The explosive mixtures are ignited immediately after entering the combustion chamber 29, and the centrifugal force of the rotor tends to prevent the escape of the charge through the port 35 before the ignition thereof.

55 designates a governor head slidably keyed upon the shaft 11 adjacent to the rotor 31, said governor head being adapted to rotate with said shaft. The head 55 is provided with a peripheral groove 56 and extending into said groove are two weighted arms 57 pivotally mounted in bearings 58 carried by the rotor 31, said bearings being diametrically opposed. The governor head 55 is provided with spring sockets 59, which are detachably connected to the governor head by bolts and nuts 60. Extending into the spring sockets 59 are coiled springs 61 having the opposite ends thereof resting in sockets 62 provided therefor upon the exposed side of the rotor 31. These springs have the ends thereof connected to the sockets to normally maintain the governor head 55 a predescribed distance from the rotor 31.

63 designates diametrically opposed outwardly extending brackets carried by the head 23, and pivotally mounted in said brackets, as at 64, are governor arms 65 and starting arms 66. The inner ends of the governor arms 65 are adapted to engage the outer side of the governor head 55, and diametrically opposed lugs 55ª carried by said head, while the outer ends of the governor arms 65 are adapted to bear against the heads 51 of the valve stems 50.

The inner ends of the starting arms 66 are loosely mounted, as at 67, between diametrically opposed bifurcated arms 68, carried by a head 69 slidably mounted upon the shaft 11 adjacent to the governor head 55. The head 69 is provided with a bifurcated hanger 70 and pivotally connected to said hanger is an L-shaped lever 71, said lever being pivotally mounted between lugs 72, carried by a bearing 73, which is employed for supporting the shaft 11 in conjunction with the shell 1. The L-shaped lever 71 is provided with a tread plate 74, and interposed between said tread plate 74 and the bearing 73 is a coiled spring 75.

76 designates a disk carried by the shaft 11 adjacent to the bearing 73, and this disk is provided with a contact arm 77 adapted to engage a resilient contact arm 78 carried by a post 79 secured to the bearing 73. A suitable source of electrical energy (not shown) is connected to the disk 76 and to the resilient contact arm 78, whereby when the arms 77 and 78 contact, a spark will be produced in connection with the ignition device 54 for firing the explosive mixture admitted to the combustion chambers 28 and 29, when the valves 49 are opened.

Operation:—To start the engine, the operator treads upon the plate 74 and moves the head 69 toward the bearing 73, causing the outer ends of the arms 66 to strike the outer ends of the arms 65 and press the valve stems 50 inwardly, unseating the valves 49. Explosive charges then enter the respective chambers 28 and 29 through the

supply pipes 47 and 53. By then shifting the shaft 11 through the medium of the balance wheel 14, the arms 77 and 78 can be made to contact to produce a spark in one of the combustion chambers 28 or 29, and the first explosion within one of the chambers is sufficient to start the rotor 31 and cause the shaft 11 to revolve, whereby the arms 77 will again contact with the arms 78 and fire the other combustion chambers. Attention may be directed to the fact that the valves 49 are always closed at those instants when the charge is ignited, thereby preventing the flame from passing through the charge supply pipes and igniting the explosive mixture outside of the engine. The operation is now continuous, insomuch that the lugs 55ª of the governor head 55 actuates the arms 65 and intermittently opens the valves 49 to allow additional charges of the explosive mixture to enter the combustion chambers. After an explosion the products of combustion enter the cylinder 30 through either one of the ports 34 and 35, and by reference to Fig. 3 of the drawings, it will be observed that the port 34 upon one side of the cylinder coöperates with the port 35 upon the opposite side, whereby the explosions will drive the rotor 31 in either direction. The guide vanes 21 and 22 of the housings 20 properly deflect the products of combustion, whereby as the products of combustion contact with the impact vanes 33 of the housings 32 of the rotor, said rotor will be rapidly revolved, and the force of the explosions fully obtained before the products of combustion exhaust through the ports 6 into the muffler casing and then to the atmosphere. The arms 57 engaging the governor head 55 are adapted to move said head when the speed of the rotor 31 is above a predetermined point, allowing the valves 49 to remain closed until the engine has assumed its normal speed.

The springs 52 are of sufficient strength to hold the valve 49 normally closed against the pressure of the explosive mixture, and the springs 61 are of such strength as to hold the governor head in operative position and cause the cam members 55ª thereon to operate the governor arms 65 when the engine is running at a normal speed. However, should the speed of the engine be excessive the centrifugal action of the weighted arms 57 tends to move the governor head toward the rotor, and thereby reduces the effective strength of the springs 61. These springs 61 are then unable to overcome the opposition offered by the springs 52, and the combined action of the said springs 52 and the centrifugal force of the weighted arms 57 is sufficient to move the governor head toward the rotor at those instants when the cam members 55ª are brought into engagement with the ends of the governor arms, thereby rendering the said governor arms inoperative even though the speed of the engine may not be sufficient to cause the weighted arms of themselves to draw the governor head toward the rotor and prevent the cams 55ª from coming into contact with the governor arms.

It will be observed from the foregoing description taken in connection with the drawings, that I have devised a novel reversible rotary engine, wherein the principle of a turbine engine is embodied for obtaining a high degree of efficiency with a minimum expenditure of fuel. The engine can be used for performing various kinds of work, and steam or air can be used in some instances in lieu of gas or gasolene.

Having now described my invention what I claim as new, is:—

1. An engine of the type described, comprising a dished shell, said shell having a cooling chamber formed therein, said shell having side extensions, a muffler casing carried by said shell, a shaft extending through said shell and said muffler casing, said shell having ports formed therein communicating with said muffler casing, a head mounted upon said shell and having extensions confronting the extensions of said shell and providing explosion chambers, a rotor mounted upon said shaft between said head and shell, a plurality of circumferentially arranged deflectors carried by said shell, a plurality of circumferentially arranged impact vanes carried by said rotor and adapted to extend in between the circumferentially arranged deflectors of said shell, said head and said shell having ports formed therein establishing communication between said rotor and said explosion chambers, valves carried by said head for controlling the admission of gasolene and air to said chambers, governor arms carried by said head for controlling the movement of said valves, a governor actuated by said rotor for moving said arms, a starting device coöperating with said governor arms, and valves slidably mounted in said head and said shell for controlling the passage through the ports between said explosive chambers and said rotor.

2. An engine of the type described, comprising a dished shell, said shell having side extensions, a shaft extending through said shell, said shell having ports formed therein, a head mounted upon said shell and having extensions confronting the extensions of said shell and providing explosion chambers, a rotor mounted upon said shaft between said head and shell, a plurality of circumferentially arranged deflectors carried by said shell, a plurality of circumferentially arranged impact vanes carried by said rotor and adapted to extend in between the circumferentially arranged deflectors of said shell, and said shell having ports formed therein es-

tablishing communication between said rotor and said explosion chambers, valves carried by said head for controlling the admission of gasolene and air to said chambers, governor arms carried by said head for controlling the movement of said valves, a governor actuated by said rotor for moving said arm, a starting device coöperating with said governor arms, and valves slidably mounted in said head and said shell for controlling the passage through the ports between said explosive chambers and said rotor.

3. An engine of the type described, comprising a dished shell, said shell having side extensions, a shaft extending through said shell, said shell having ports formed therein, a head mounted upon said shell and having extensions confronting the extensions of said shell and providing explosion chambers, a rotor mounted upon said shaft between said head and shell, a plurality of circumferentially arranged deflectors carried by said shell, a plurality of circumferentially arranged impact vanes carried by said rotor and adapted to extend in between the circumferentially arranged deflectors of said shell, said head and said shell having ports formed therein establishing communication between said rotor and said explosion chambers, valves carried by said head for controlling the admission of gasolene and air to said chambers, and valves slidably mounted in said head and said shell for controlling the passage through the ports between said explosion chambers and said rotor.

4. An engine of the type described, comprising a dished shell, said shell having side extensions, a shaft extending through said shell, said shell having ports formed therein, a head mounted upon said shell and having extensions confronting the extensions of said shell and providing explosion chambers a rotor mounted upon said shaft between said head and said shell, a plurality of circumferentially arranged deflectors carried by said shell, said head and said shell having ports formed therein establishing communication between said rotor and said explosion chambers, and valves carried by said head for controlling the admission of gasolene and air to said chambers.

5. In a rotary engine, the combination of a casing, oppositely deflected sets of guide vanes projecting from the casing, a rotor mounted within the casing, impact vanes carried by the rotor in coöperative relation to the guide vanes, an explosion chamber communicating with the casing, means for producing an explosion within the said explosion chamber, and means for causing the force of the explosion to act upon the impact vanes of the rotor through either set of the guide vanes.

6. In a rotary engine, the combination of a casing, a rotor mounted within the casing, oppositely deflected sets of guide vanes projecting from the casing, an explosion chamber communicating with the casing, means for producing an explosion within the explosion chamber, and valve controlled means for causing the force of the explosion to act upon the rotor through either set of the guide vanes.

7. In a rotary engine, the combination of a casing, a shaft journaled upon the casing, a rotor mounted upon the shaft, an explosion chamber communicating with the casing and formed with a charge inlet opening, a valve normally closing the said valve inlet opening, a pivoted governor arm adapted to open the valve, a governor head slidably mounted upon the shaft so as to rotate therewith, a cam member upon the governor head for coöperation with the governor arm to open the before mentioned valve, means normally holding the governor head yieldingly in an operative position, and weighted arms engaging the governor head and acted upon by the centrifugal force to render the same inoperative when the speed of the engine exceeds a fixed limit.

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

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Witnesses:

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M. BAYAN.