G. A. REYNOLDS.

ROTARY GAS ENGINE CONSTRUCTION.

APPLICATION FILED NOV. 11, 1918.

1,345,808.

Patented July 6, 1920.

3 SHEETS—SHEET 1.

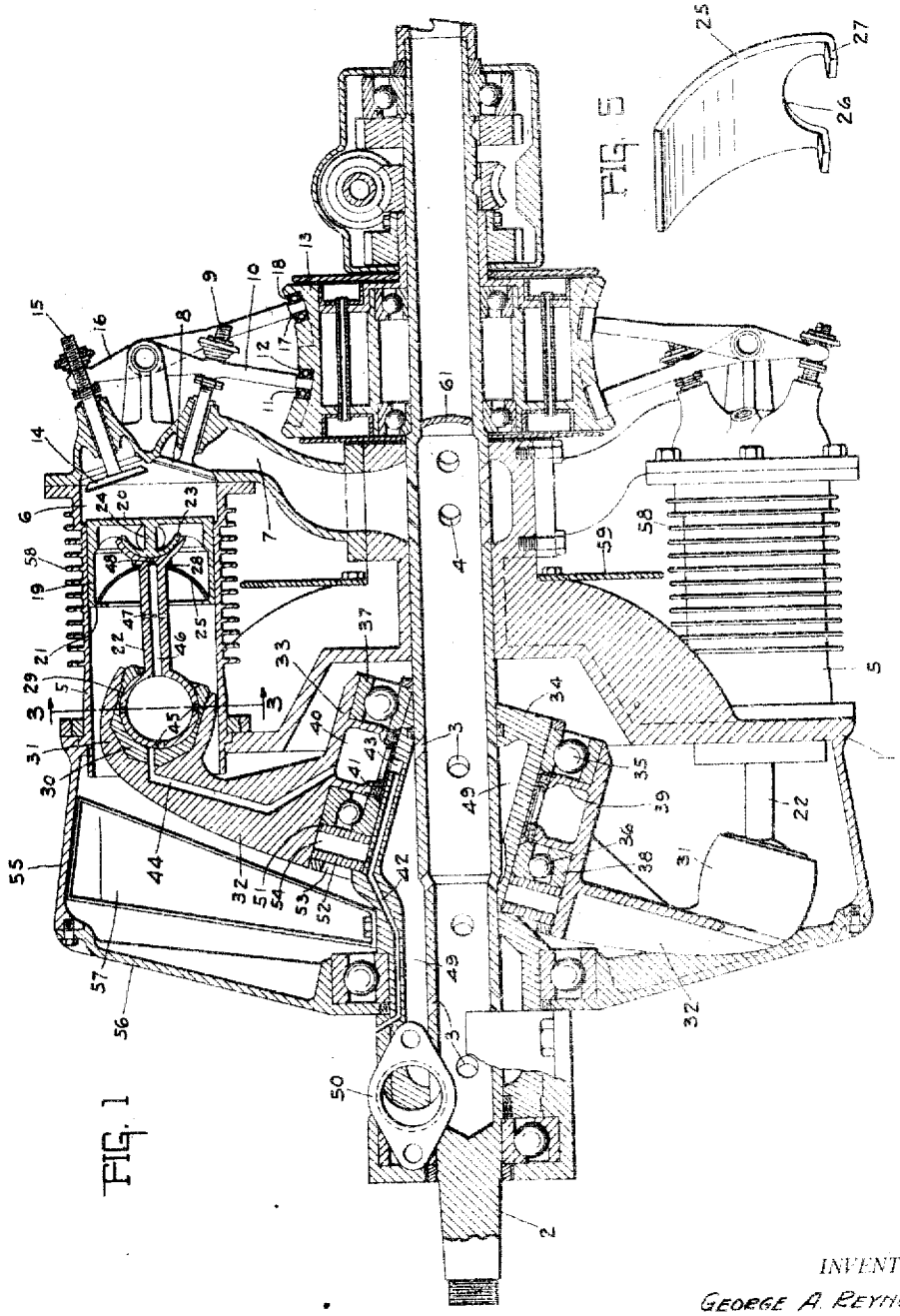

FIG. 1

FIG. 5

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3 SHEETS-SHEET 2.

FIG. 3

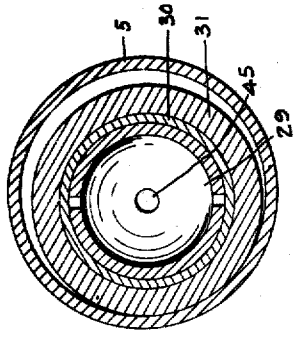


FIG. 4

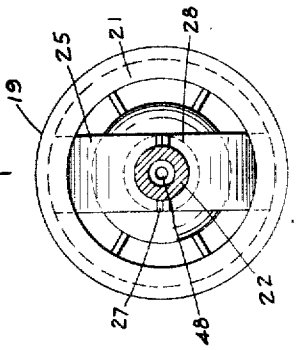
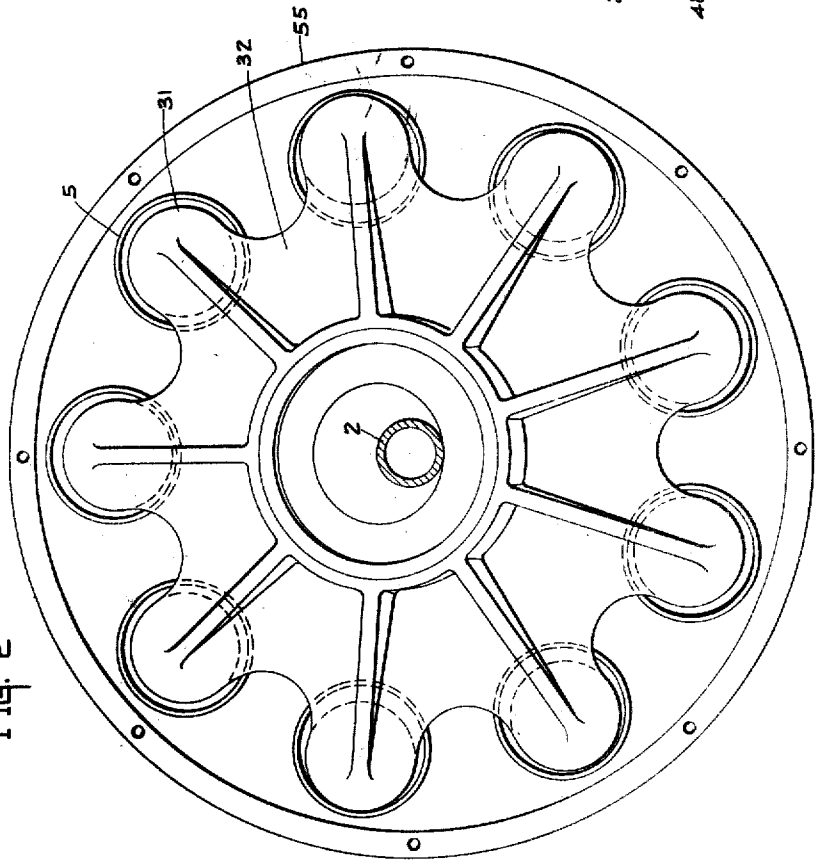


FIG. 2



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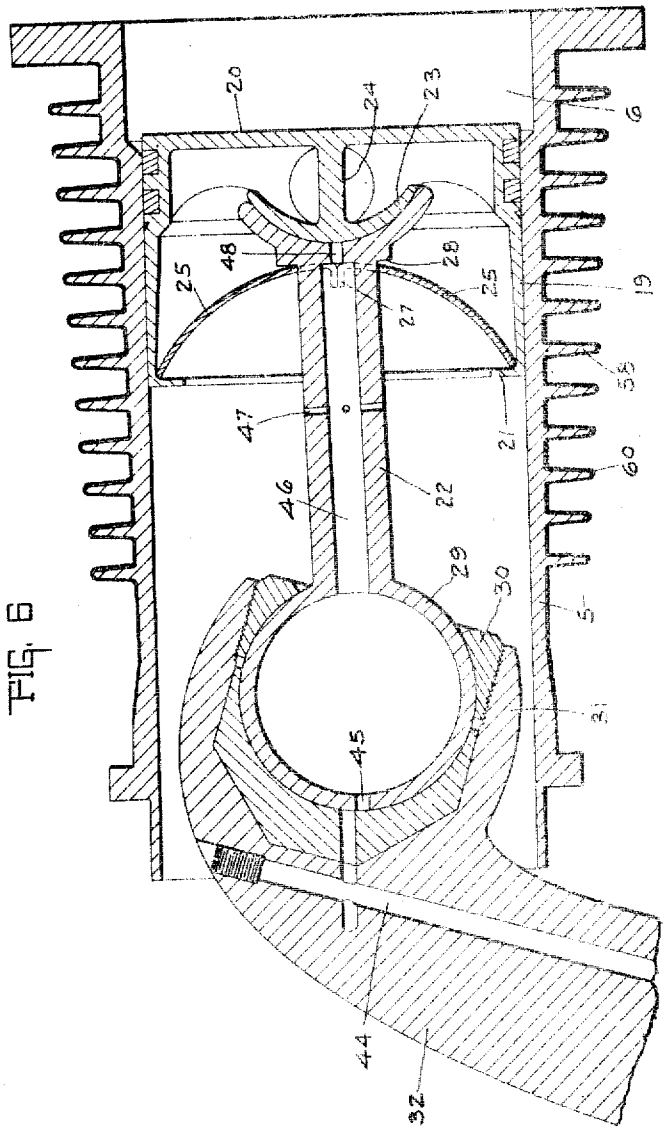

FIG. 6

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UNITED STATES PATENT OFFICE.

GEORGE A. REYNOLDS, OF INDIANAPOLIS, INDIANA.

ROTARY-GAS-ENGINE CONSTRUCTION.

1,345,308. Specification of Letters Patent. Patented July 6, 1920.

Application filed November 11, 1918. Serial No. 261,962.

To all whom it may concern:

Be it known that I, GEORGE A. REYNOLDS, a citizen of the United States, and a resident of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Rotary-Gas-Engine Construction; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like numerals refer to like parts.

This invention relates to rotary internal combustion engines, and the prime feature of the invention is in so constructing the piston carrying members of the motor as to enable them to cause the revolution of the cylinders of the motor. This is accomplished by the base carrying members projecting into the cylinders, so that the cylinders revolve with the piston carrying members and does away with the imperfectly operating gear mechanism heretofore employed for causing the revolution of the cylinders.

A further feature of the invention is the provision of means for forcing a lubricant to all parts of the cylinders.

A further feature of the invention is in so connecting the piston rods to the pistons that a far shorter and lighter form of piston may be used, and at the same time obtain the same results as when a longer and heavier piston is used.

A further feature of the invention is the provision of means for deflecting and diffusing an air current to the parts of the cylinders receiving the most heat.

A further feature of the invention is the provision of a coating of material on the exterior of the cylinders and parts of the motor which will render the same more sensitive to the cold air.

A further feature of the invention is the provision of means for employing a body of lubricant or oil for receiving the thrust from the piston operating means.

Other objects and advantages will be hereinafter more fully set forth in the accompanying specifications.

In the accompanying drawings, which are made a part of this application, Figure 1 is a vertical central longitudinal sectional view through the motor. Fig. 2 is an end elevation of the motor with parts removed. Fig. 3 is an enlarged sectional view as seen on line 3—3 in Fig. 1. Fig. 4 is an enlarged end elevation of one of the pistons showing the piston rod in sections. Fig. 5 is a perspective view of one of the spring members employed for forming a connection between the piston rods and their pistons. Fig. 6 is an enlarged detailed sectional view through one of the cylinders, showing a coating of material thereon for aiding in more rapidly cooling the motor.

Referring to the drawings in which similar reference numerals designate corresponding parts throughout the several views, 1 indicates the frame of the motor, which is mounted upon a hollow shaft 2, which is mounted in the stationary bearings 102 and 202 said shaft having a plurality of intake ports 3 through the wall thereof, and preferably adjacent one end of the shaft, and is also provided with a plurality of outlet ports 4. The frame 1, which is substantially in the form of a bowl shaped disk rotates with the shaft 2 and carries a plurality of cylinders 5 adjacent its periphery, said cylinders extending longitudinally of the shaft 2. One end of each cylinder 5 is open, while the opposite end thereof is provided with a combustion chamber 6, which is placed in communication with the ports 4 of the shaft 2 by means of a duct 7, extending from said ports to the combustion chamber 6. The passage of propelling medium through the duct is controlled by means of an intake valve 8, the stem 9 of which is connected to an operating lever 10, one end of which is pivoted to the head of the cylinder wall. The opposite end of the lever 10 is provided with a roller 11, which enters a cam slot 12 in the periphery of the cam wall 13. The combustion chamber 6 is also provided with an exhaust valve 14, the stem 15 of which is engaged with an operating lever 16, said operating lever being also pivoted to the end of the cylinder and having its inner end provided with a roller 17, which enters a cam slot 18 also provided in the periphery of the cam wall 13, and it will be readily seen that as the cam wall is rotated, as is also the cylinders carrying the valves, levers 10 and 16 will be rocked so as to open and close said valves.

Mounted within each cylinder 5 is a piston 19 which is hollow and has a closed end 20, the open end thereof preferably having an inwardly extending flange 21. In order to cause the piston to travel in proper alinement and without binding or pinching against the wall of the cylinder, and at the

same time enable the piston to be made comparatively short and light, means is provided for causing the piston rod 22 to direct its force at the ends of the piston when moving the piston inwardly or outwardly. To this end a substantially semi-globular ball member 23 is attached, by means of the stem 24, to the end wall 20, the axial center of the ball member 23 being at the point of connection between the end wall 20 and the stem 24. Consequently when the piston rod is directing force against the semi-globular ball member to force the piston inwardly, the thrust is delivered to the piston at the point of connection between the stem 24 and the end 20, and at the axial center of the piston and at the extreme forward end thereof. In moving the piston in the opposite direction, spring arms 25 are provided which are arcuate in general outline, the inner ends thereof having semi-circular recesses 26 which fit around the piston rod 22, the meeting ends of the spring arms having laterally extending fingers 27, which abut against each other, said spring arms being held in position by placing their inner ends against a shoulder 28 adjacent the inner end of the piston rod, and their outer ends against the flange 21 at the extreme outer end of the piston 19. By this construction it is seen that when the piston rod is moving the piston outwardly, the force will be applied against the piston at its extreme outer end, consequently no side thrust will be imparted to the piston when moved in either direction.

The spring arms 25 also take up any wear that might occur between the ball member and socket member and will also permit expansion or contraction between the parts thus maintaining a perfect union between the parts of the joint.

The outer end of the piston rod 22 is provided with a hollow ball 29, which fits the bearing 30 carried by the socket 31, said socket being in turn attached to a spider 32 which rotates around the shaft 2.

The sockets 31 carried by the spider 32 are substantially globular, and at a certain portion of every revoluble movement they project into the cylinders, during the instroke of the piston, and obviously the revoluble movement of the sockets engaging walls of the cylinders will cause the frame 1 and cylinders carried thereby to revolve in unison. The spider 32 is provided with a stationary hollow hub 33, which is mounted upon a hollow sleeve 34, through the medium of bearing balls 35 and 36, said balls being arranged in the usual form of races 37 and 38. The sleeve 34 is rigidly secured to the bearing housing 102 which is always stationary. Interiorly of the hub 33, and adjacent the races 37 and 38 are inwardly extending flanges 39, which form a circular cavity 40 for the reception of any suitable form of lubricant. Between the inner ends of the flanges 39 and the wall of the hollow sleeve 34 is positioned rings of packing 41, which prevents the lubricant from leaving the cavity between the flanges and the sleeve. Lubricant is conveyed into the cavity 40 through a channel 42 from any suitable source and enters the cavity through a port 43, from whence it passes through a duct 44 extending through each arm of the spider 32. This brings the lubricant to the ball 29 which is hollow and has a port 45 which communicates with the end of the duct 44 when the socket is removed from the cylinder, and is moved out of registration with the duct, when the socket enters the end of the cylinder. The lubricant is conveyed longitudinally of the piston rod through a bore 46 and is thrown on to the walls of the cylinder through escape ports 47 and on to the ball member 23 through an escape port 48.

As the lubricant in the cavity 40, and the channel 42, is under pressure, the lubricant will be forced through the escape ports 47 with sufficient velocity to overcome the action of centrifugal force which would tend to throw all the lubricant to one side of the cylinder and thereby thoroughly lubricates the entire inner surface of the cylinder.

The end of the hollow sleeve 34, upon which the spider 32 rotates, rests at an angle to the trend of the shaft 2, while the frame 1 carrying the cylinders 5 is arranged concentrically of the shaft 2 whereby but a limited number of the sockets will enter the cylinders at any one time, that is to say, when nine of the cylinders 5 are used, but four of the sockets will engage or be in coöperation with the ends of their respective cylinders at the same time. In consequence of the inclination of the spider with respect to the cylinders, the force of the explosion within the cylinders will direct rotating movement to the spider and through the medium of the socket 31, to the cylinders 5.

The hollow sleeve 34 is so arranged as to provide a cavity 49 with which communicates a feed pipe 50, and through which propelling medium is carried to the intake ports 3. In order to provide a cushioning thrust bearing for the outer end of the hub 33 a pair of plates 51 and 52 are positioned in the outer end of the hub, and spaced apart, the plate 51 resting against one face of the ball race 38, while the plate 52 rests against a locking ring 53 in the end of the hub. By separating the plates 51 and 52 a space 54 is formed into which is introduced any suitable form of oil, and by entering the oil in the space under high pressure said oil will serve as a bearing to receive the end thrust of the spider hub, and by connecting the space with a supply of the oil, the amount of oil within the space will re-

main substantially constant. Surrounding the open ends of the cylinders 5 is a casing 55, to the other end of which is attached a hub 56, thus completely inclosing the spider and the open ends of the cylinders and protecting them from dirt, dust and the like. Owing to the rapid rotation of the cylinders and spider the lubricant escaping from the cylinders is given a whirling action by the rotation of the spider and cylinders, and in order to gather such oil or lubricant, a trough 57 is attached to the hollow sleeve 34 and so arranged that the whirling lubricant will be collected thereby and carried to a suitable discharge opening. Surrounding the exterior portion of the cylinders are the usual form of radial cooling wings 58, against which air is forced in order to cool the cylinders and to more readily distribute the air or rather to direct a greater volume of air upon the parts of the cylinders receiving the greatest degree of heat, a deflector plate 59 is attached to the frame 1 so that as the air strikes said plate it will be thrown outwardly and on to the end of the cylinder in which the explosion occurs.

It has been found that copper and similar metals are more susceptible to heat and cold than iron and in order to cause the cylinders to more readily cool, a covering 60 of copper or like metal is electroplated or otherwise disposed over the wings 58 and the outer wall of the cylinders 5.

By entering the propelling medium through the hollow shaft 2, it becomes vaporized or converted into a gas, owing to the fact that parts of the shaft and the ducts 7 are heated from the cylinders, the hollow shaft 2 having a wall 61 therein, which limits the passage of the propelling medium longitudinally of the shaft.

The operation of the device is as follows: the outer stroke of the piston through the piston rod pivoted to the spider causes the revolution of the spider and the sockets projecting from the spider into the cylinders during the instroke thereof obviously carry or push the cylinders around with them and as the cylinders are all united the result is that the series of cylinders is caused thereby to revolve with the spider. Heretofore in practical use of such devices there has been a gear on the cylinder frame concentric with the tube 2 in mesh with the angularly positioned angular gear of the spider for enabling the spider to cause the revolution of the cylinders. The chief object of this invention is to avoid that means or method of revolving the cylinders because it has been a source of great trouble, as the gears referred to do not always accurately coöperate and when they do not, it breaks up the machine. In other words it is necessary that the cylinders revolve exactly along with the spider so that the piston rods and pistons will operate just right. With this invention there can be no irregularity in the relative revolutions of the spider and the cylinders, because the means whereby the piston rods are connected with the spider is also the means which moves the cylinders in their revolutions, that is the socket from the spider connects the piston rod with the spider and it also, on the instroke of the piston, projects into the cylinder and naturally moves or carries the cylinder along with it in revoluble movement.

There is always one of these sockets projecting into one cylinder, as shown at the top of Fig. 1, and usually the socket on each side of the socket just referred to also projects to some extent into its corresponding cylinder so that several of these sockets are acting against the inner walls of some of the cylinders and as they swing around cause the revolution of the set of cylinders.

The invention claimed is:

1. A rotary gas engine including a plurality of revoluble cylinders, pistons in said cylinders, and a spider near the ends of the cylinders and rotatable on an axis at an angle to the axis of revolution of the cylinders and connected with and actuated by the pistons and parts of the spider adapted to engage the walls of the cylinder and cause their revolution along with the spider.

2. A rotary gas engine including a plurality of revoluble cylinders, pistons in said cylinders, and a spider near the ends of the cylinders and rotatable on an axis at an angle to the axis of revolution of the cylinders and connected with and actuated by the pistons, the connection between the spider and each piston adapted to enter the corresponding cylinder and engage the inner wall thereof and cause the cylinder to revolve and travel with the spider.

3. A rotary gas engine including a shaft, a plurality of cylinders united in a unit and adapted to revolve about the axis of the shaft, a spider near the ends of the cylinders and rotatable on an axis at an angle to the axis of revolution of the cylinders and arranged obliquely thereto, pistons in the cylinders, and projections from the spider with which the pistons are connected and which in the instroke of the pistons project into the cylinders, whereby the pistons rotate the spider and the projections from the spider engage the cylinders and cause their revolution.

4. A rotary gas engine including a shaft, a plurality of cylinders united in a unit and secured rigidly to said shaft, a spider near the ends of the cylinders and rotatable on an axis at an angle to the axis of revolution of the cylinders and arranged obliquely thereto,

pistons in the cylinders with piston rods, and projections from the spider with which the piston rods are connected and which in the instroke of the pistons project into the cylinders, whereby the pistons rotate the spider and the projections from the spider engage the cylinders and thereby drive the shaft.

5. A rotary gas engine including a shaft, a plurality of cylinders united in a unit and adapted to revolve about the axis of the shaft, a spider near the ends of the cylinders and rotatable on an axis at an angle to the axis of revolution of the cylinders, and arranged obliquely thereto, pistons in the cylinders with piston rods with balls on the ends thereof, and sockets projecting from the spider in which the balls of the piston rods have bearing, said sockets adapted on the instroke of the pistons to enter the cylinders and engage the side walls thereof, whereby the pistons rotate the spider and the spider through the sockets causes the revolution of the cylinders, substantially as set forth.

6. A rotary gas engine construction including a plurality of cylinders, pistons in said cylinders, hollow piston rods connected with said pistons, said piston rods having a plurality of transverse ports between their ends, a spider having sockets adapted to receive and form a bearing for one end of said piston rods, said spider having ducts for containing lubricant under pressure, one of the ports in each piston rod being adapted to communicate with one of the ducts in the spider when the piston is in one position and to move out of registration therewith when the piston is in another position.

7. A rotary gas engine including a plurality of cylinders, hollow pistons in said cylinders with one end of each piston closed, a ball member connected with said end closure and with its center of curvature located in said end closure, a piston rod, a socket member thereon having a spherically disposed concave surface coöperating with the surface of said ball member of the piston, and yielding means for normally holding the socket member in coöperation with the ball member.

8. A rotary gas engine construction, including a cylinder, a piston in said cylinder, a semiball member carried by the piston and positioned between the ends thereof, a piston rod having a socket member for cooperation with the ball member, and yielding means for holding said socket member against said ball member whereby any variation in size between these parts will be taken up and a close fit between the parts maintained.

9. A rotary gas engine including a cylinder, a hollow piston in said cylinder with one end thereof closed, a ball member in said piston connected with said end closure and having its center of curvature located in said end closure, a piston rod, a socket member thereon coöperating with the ball member of the piston, and a spring construction seated in the open end of the piston and engaging said socket member and yieldingly holding it against said ball member.

10. A rotary gas engine construction including a rotatably mounted spider, a bearing upon which said spider is mounted, and a fluid thrust bearing between the spider and the part upon which it is mounted.

11. A rotary gas engine construction including a sleeve, a spider rotatable on said sleeve, spaced plates at one end of the hub of the spider means for limiting the separating movement of said plates and means to retain fluid under pressure between said plates for providing a cushioning thrust bearing for one end of the spider.

12. A rotary gas engine construction, including a cylinder, a piston in said cylinder, a semi-ball member carried by the piston and secured to one end thereof, a piston rod having a socket member for coöperation with the ball member, and spring arms between the socket member and the end of the piston farthest from the ball member for yieldingly holding the socket member against the ball member, and for directing the force incident to the movement of the piston in one direction directly against the advancing end of the piston.

13. In a rotary gas engine construction, the combination with a frame, and a plurality of cylinders carried at the periphery of the frame, of a deflector plate surrounding and attached to the hub of the frame between the ends of the cylinders adapted to diffuse the current of air and direct the same against the heated portions of the cylinders.

14. A rotary gas engine construction, including a cylinder, a piston in said cylinder having a closed end and an open end, a semi-ball member attached to the closed end of the piston and positioned a distance therefrom, a piston rod having a socket member for coöperation with the ball member, and spring arms having one of their ends attached to the socket member and their opposite ends engaged with the interior of the piston adjacent the open end thereof, the tension of said spring arms holding the socket member in engagement with the ball member and directing the force incident to moving the piston in one direction directly against the open advancing end of the piston.

In witness whereof I have hereunto affixed my signature.

GEORGE A. REYNOLDS.