J. S. ALCORN.

ROTARY ENGINE.

APPLICATION FILED OCT. 15, 1907.

914,627.

Patented Mar. 9, 1909.

4 SHEETS—SHEET 1.

FIG. 1.

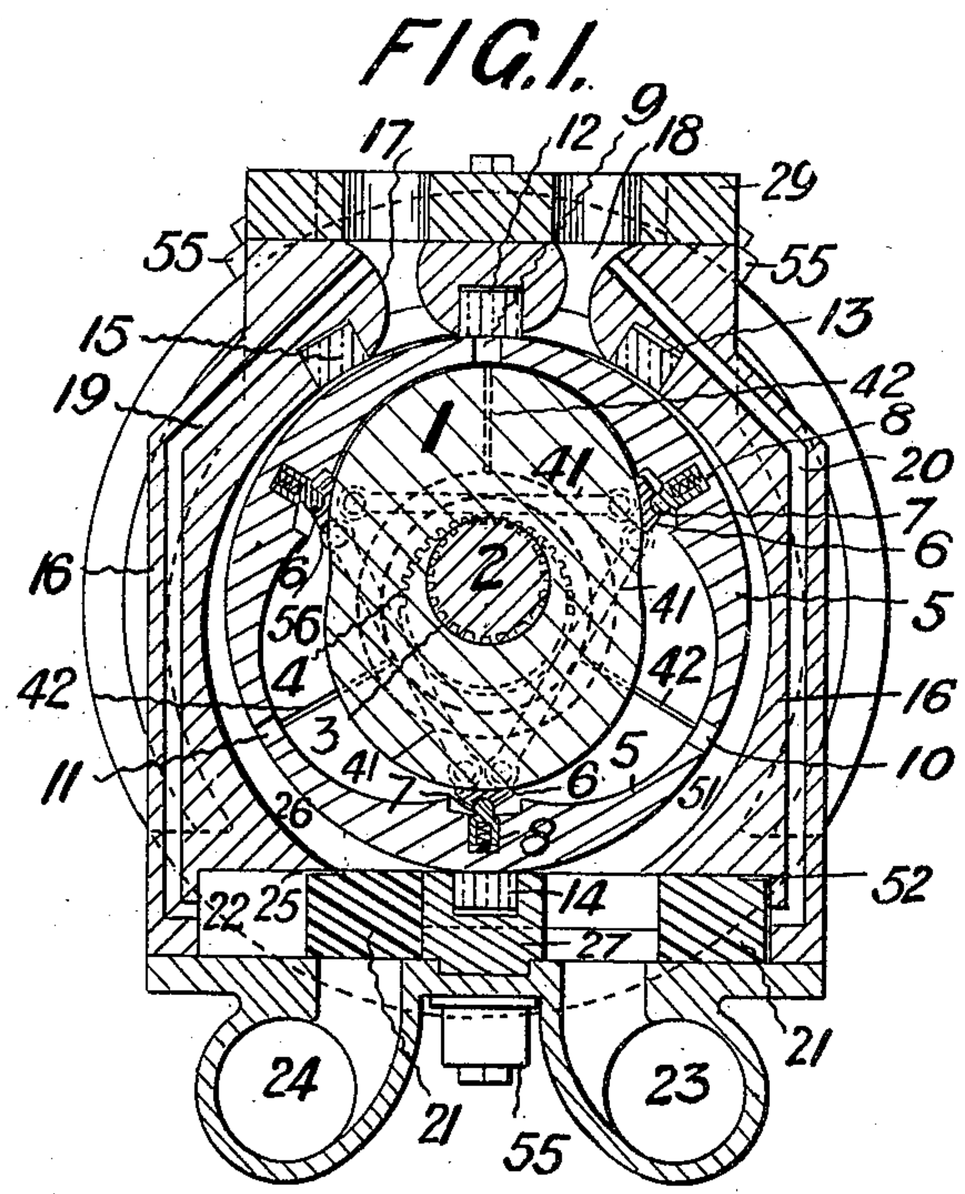
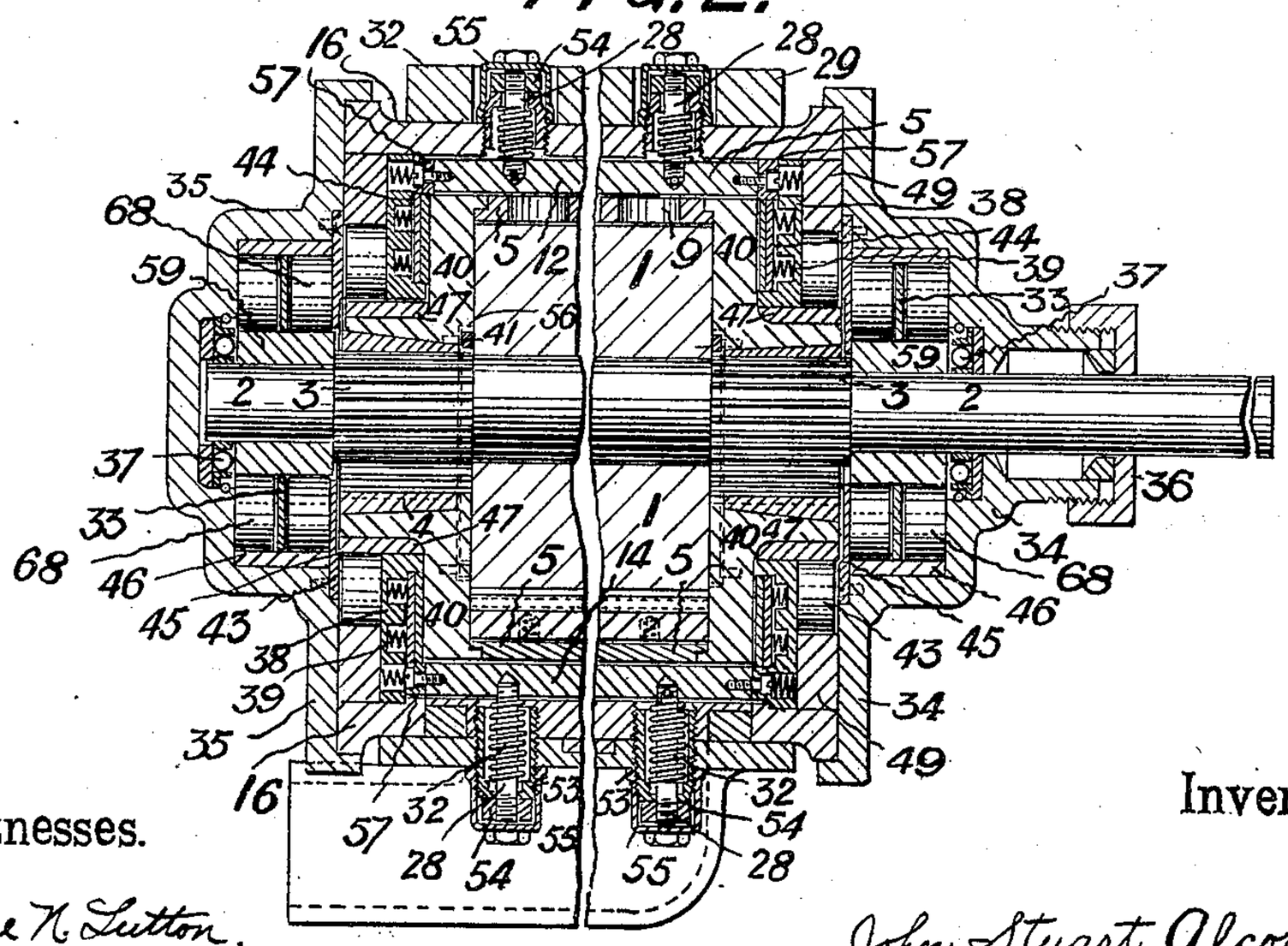


FIG. 2.



Witnesses.

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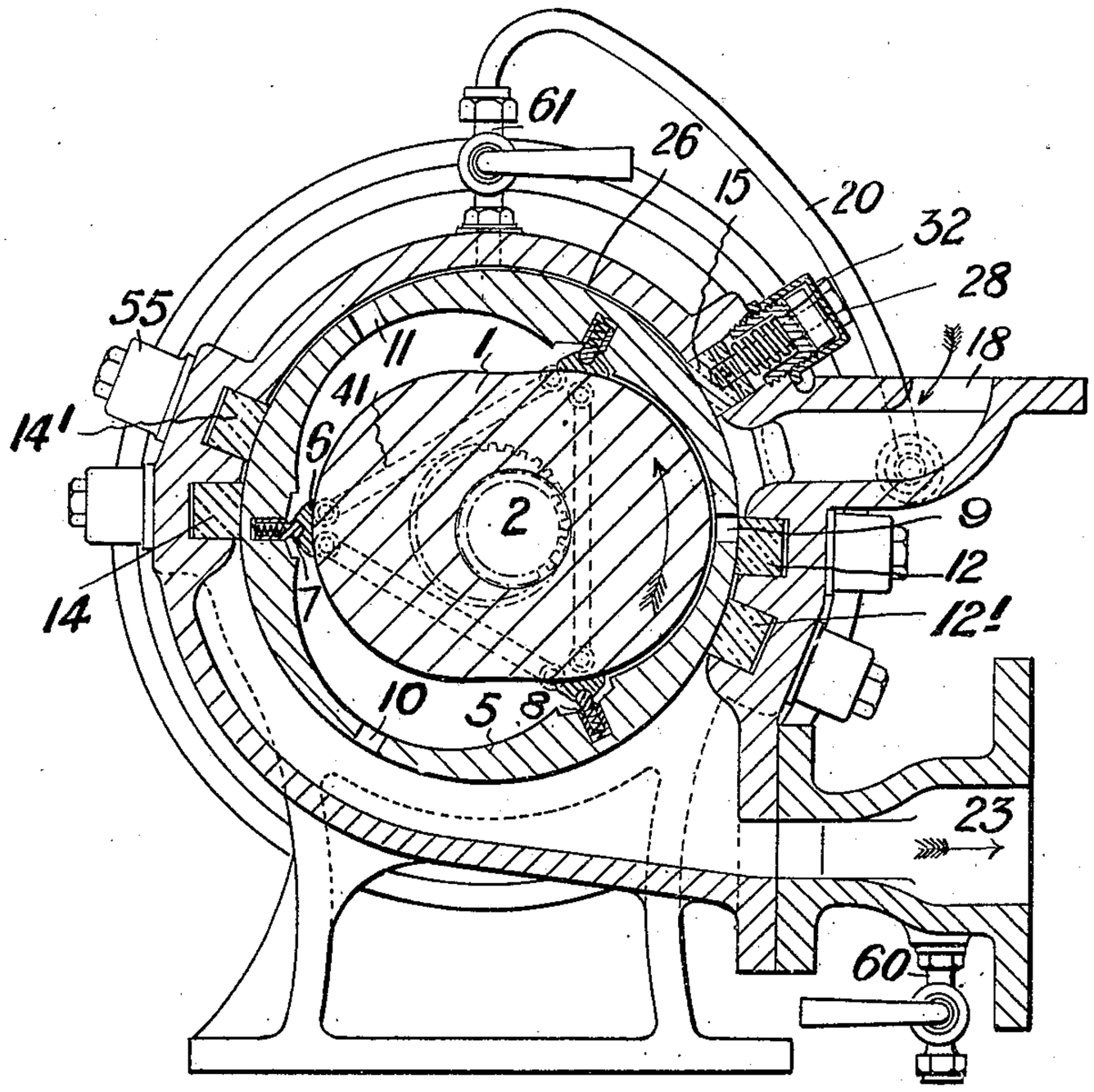
4 SHEETS—SHEET 2.

FIG. 3.



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4 SHEETS—SHEET 3.

FIG. 4.

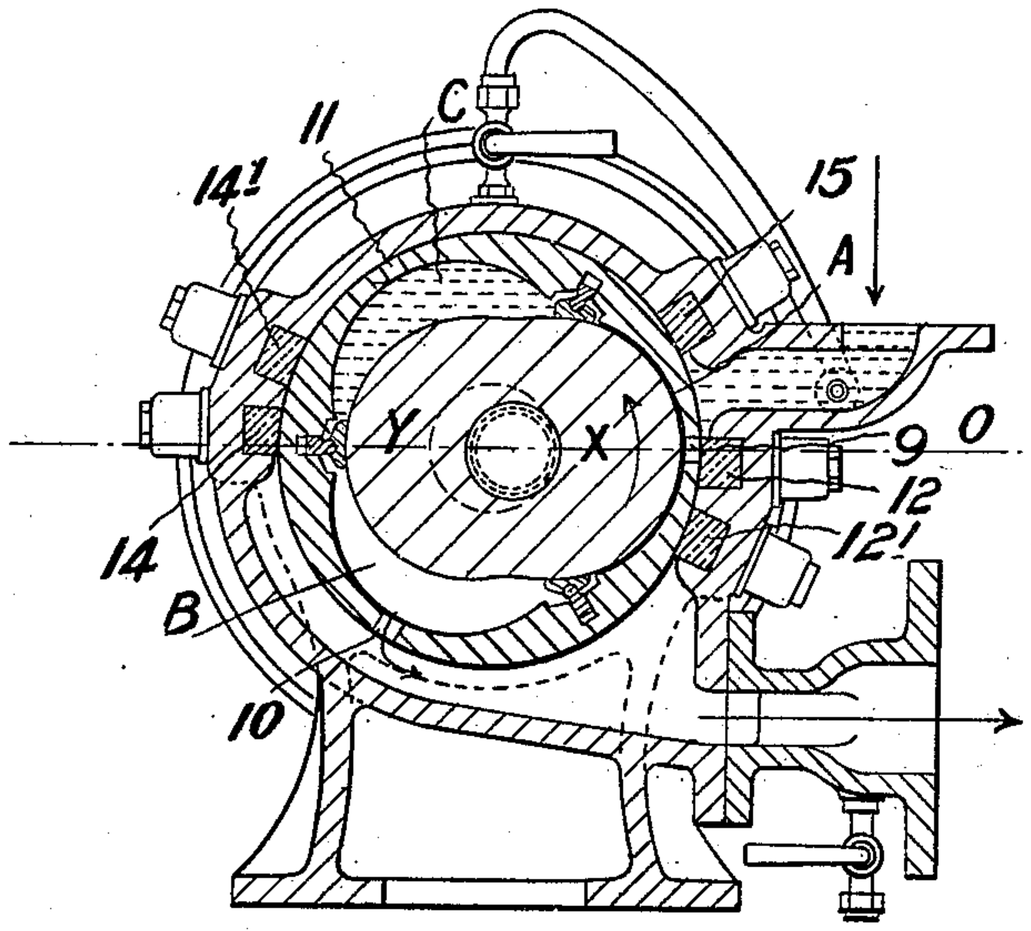
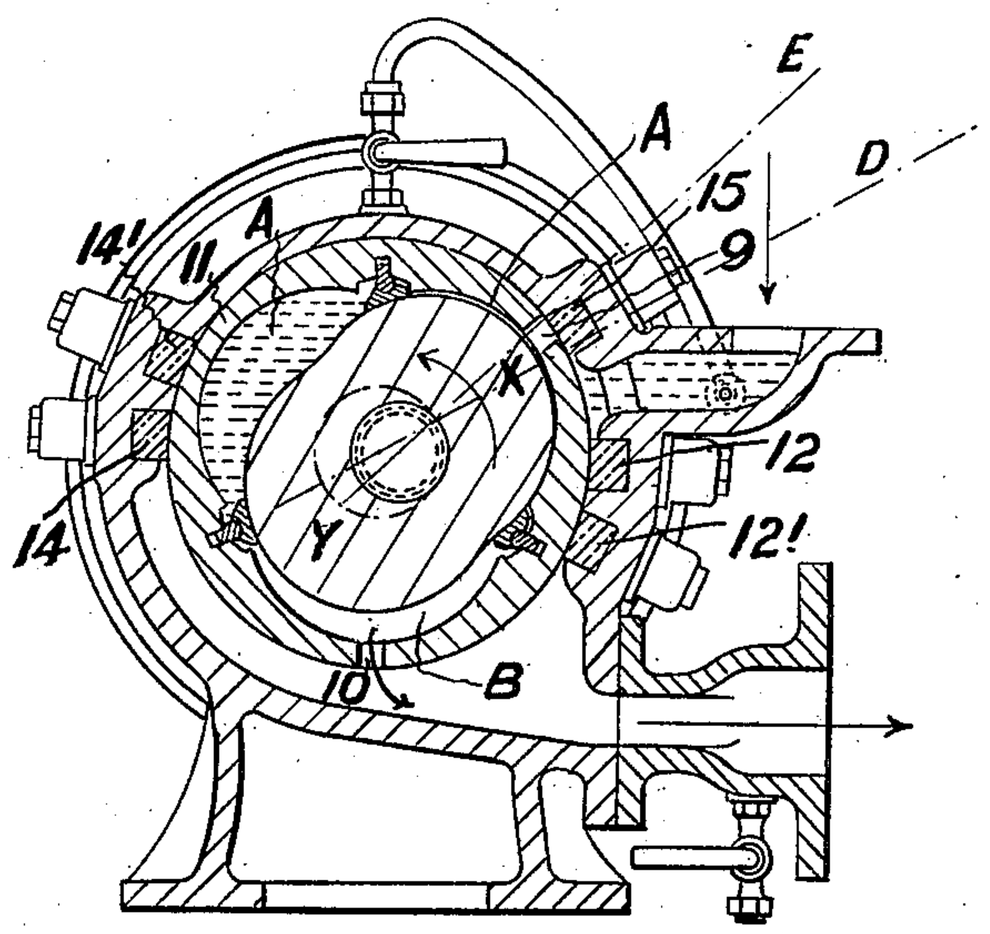


FIG. 5.



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4 SHEETS—SHEET 4.

FIG. 6.

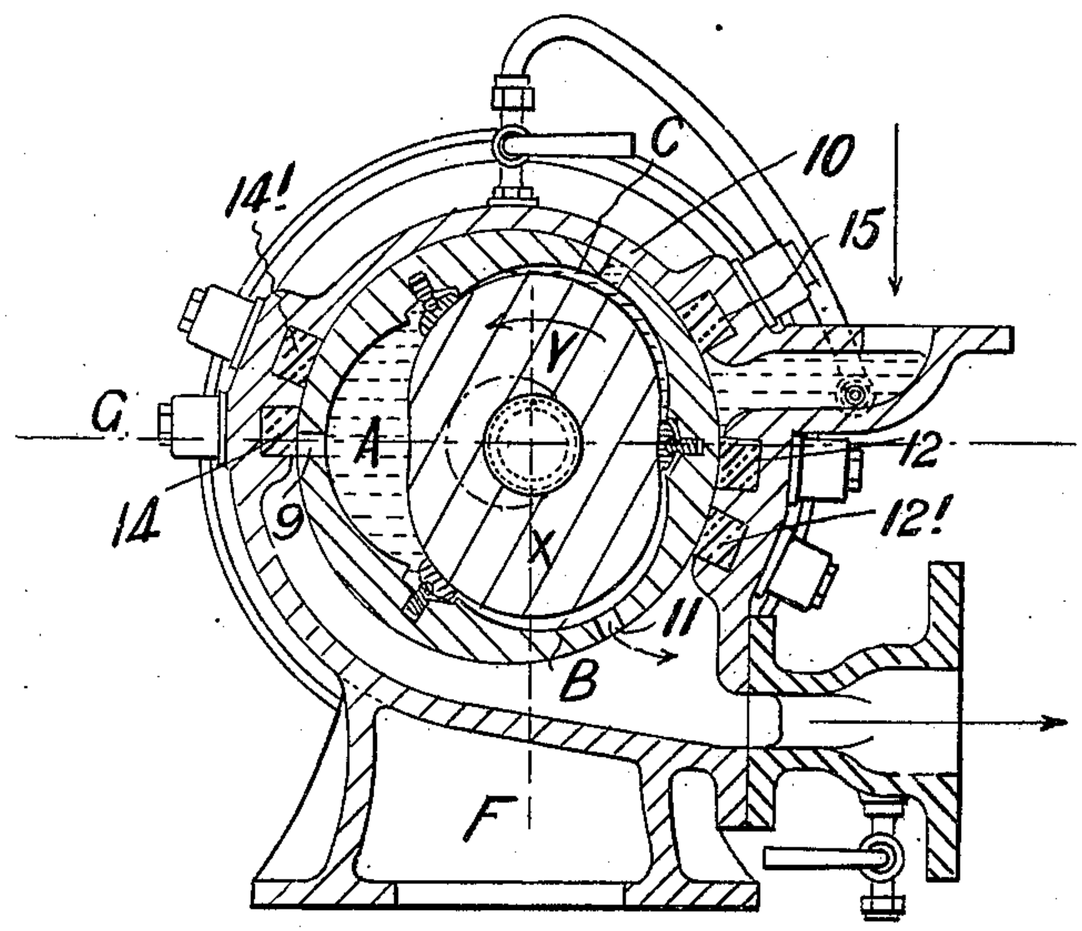
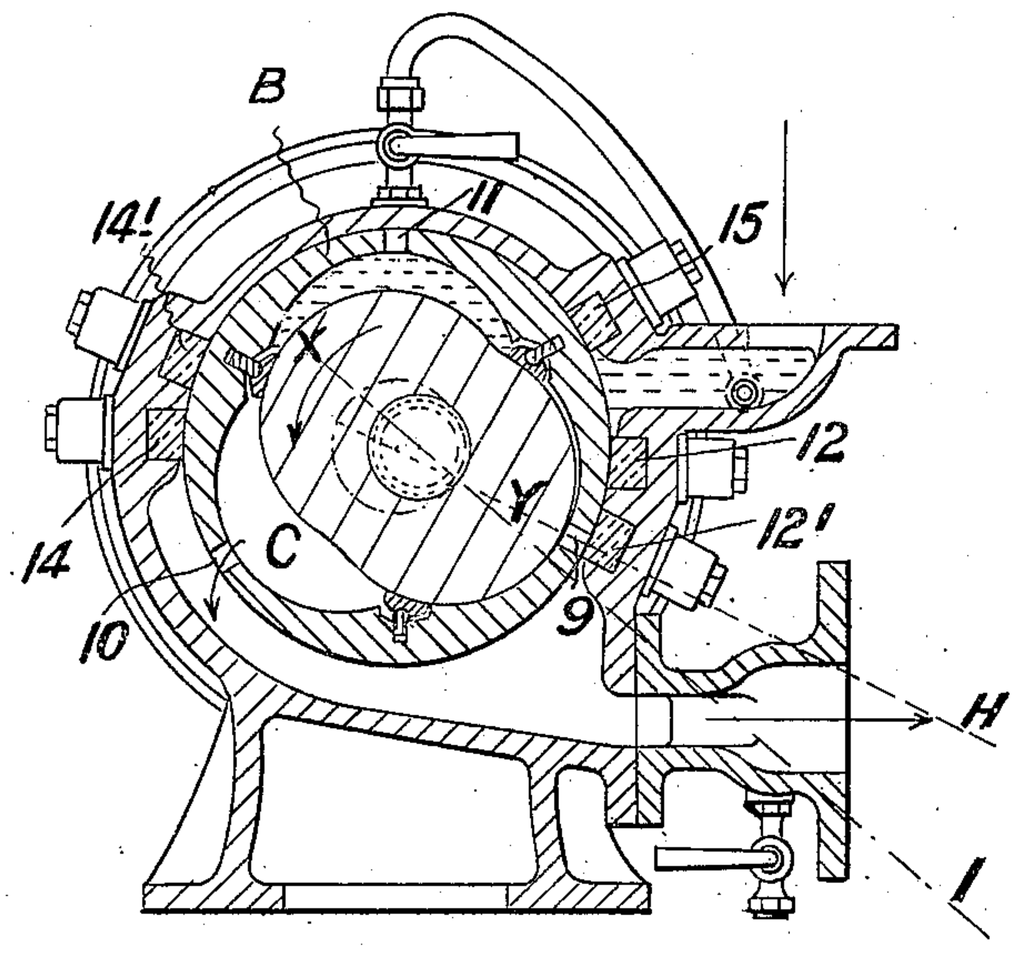


FIG. 7.



Witnesses.

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UNITED STATES PATENT OFFICE.

JOHN STUART ALCORN, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO COOLEY DEVELOPMENT COMPANY, OF BOSTON, MASSACHUSETTS.

ROTARY ENGINE.

No. 914,627. Specification of Letters Patent. Patented March 9, 1909.

Application filed October 15, 1907. Serial No. 397,542.

To all whom it may concern:

Be it known that I, JOHN STUART ALCORN, a citizen of the United States, residing at 83 Braintree street, Boston, in the county of Suffolk and State of Massachusetts, United States of America, have invented new and useful Improvements in or Relating to Rotary Fluid Engines or Machines, of which the following is a specification.

These improvements in or relating to rotary fluid engines or machines for propelling or being propelled by fluids whether of a liquid or gaseous nature have special reference to the type of engine or machine with a rotary piston and a rotary spacer having rocking shoes or abutments which bear on the peripheral curved surface of the piston, the piston and the spacer being on different axes of rotation and rotating in the same direction at relatively constant but different rates of speed within an outer inclosing cylinder wherein the spacer rotates, the spacer moreover being provided with ports.

Now the present improvements consist in making the spacer with entirely cylindrical outer circumference and the casing or housing non-cylindrical; in the arrangement of the packings between the piston and the spacer and between the latter and the outer inclosing cylinder wherein it rotates; in means for enabling the engine to start from any position of the rotating parts, thus doing away with so-called dead points; and in means for reversing the direction of rotation, if so required. By these improvements the engine is much improved in general construction and in the economical use of steam.

The following is a description of a reversible rotary machine, motor or engine constructed according to this invention with reference to the accompanying drawings in which—

Figure 1 is a sectional elevation. Fig. 2 a sectional side elevation of the engine, and Fig. 3 is a sectional elevation of a non-reversible engine. Figs. 4, 5, 6 and 7 are sectional elevations illustrating the action of the engine when actuated by steam.

The piston 1 is in one with or keyed to the shaft 2, which latter is provided with a tooth gearing 3 at each end of the piston, these gearings engaging with internal tooth gearing 4 in the boss of the end disk or head 40 of the spacer 5 as heretofore; 3 and 4 are in Fig. 1 represented by dotted lines. Between the circumferential surface of the piston 1 and the inner circumferential surface of the spacer are arranged the rocking shoes 6 which as heretofore are jointed to stems or splines 7 that enter recesses formed in the spacer and provided with springs 8 let into recesses formed in the said splines for the purpose of keeping the shoes in contact with the piston. The spacer is formed entirely cylindrical outside and has three equidistant ports 9, 10, and 11, and the abutments or packing pieces 12, 13 and 15, formerly called "spacer projections", instead of being recessed in the circumference of the spacer are now arranged in recesses formed in the inclosing housing or casing 16 and one 14 is placed in a bottom plate 27 presently to be described.

The packing pieces 12, 13, 14 and 15 which hereinafter are called the parallels are held in position by suitable adjustable and elastic devices by preference consisting of studs 28 screwed into the parallels and pinned thereto, each with coil spring 32 placed on the stud and abutting on the back of the parallel, being compressed by a spring box 53 screwed into the casing 16. In order to release the friction of the parallel against the spacer due to the compression of the spring 32, a nut 54 is screwed down on the stud 28 onto the top of the spring box 53, the intervening surfaces (on the bottom of the nut and the top of the spring box) being formed with shallow rounded serrations or teeth in such proportion to the pitch of the screw thread on the stud 28 that the coiled spring 32 may be further compressed to a known extent, say 1000th of an inch, thus relieving the contact between the parallel and the spacer from pressure causing friction, the serrated surfaces also locking each other and maintaining the parallel in the position due to the adjustment of the nut 54. The cover 55 is screwed onto that portion of the spring box 53 projecting above the casing 16, making a vapor tight joint therewith. As many of these attachments 28, 32, 53, 54, 55 are fitted to each parallel 12, 13, 14 and 15 as are required according to the length of the parallels. An extension piece 57 is fastened to each end of each parallel by a screw in such manner as to permit free radial movement of the parallel quite independently of the extension pieces 57. The parallels are arranged to allow the admission, cut-off ex-

pansion and exhaust of the steam in consecutive order and also to prevent leakage of steam from the pressure side of the engine to the exhaust side. In the case of a non-reversible machine there would be some difference from the arrangement shown of placing these parallels in the casing according to the degree of expansion of the actuating fluid desired; the tendency of the "spacer projections" as heretofore arranged was to be thrown outward by the centrifugal force, thus causing undue friction and also wear on the inside of the casing; by the present arrangement of the parallels this tendency is done away with. The casing 16 is not cylindrical inside in that portion which directly incloses the exhaust spaces 26. It is provided in suitable places with two fluid inlet passages 17 and 18 and two exhaust passages 26 and 51. The inlet passages 17 and 18 to which steam is admitted by means of a proper valve (not shown) admit the steam to the piston through the ports 9, 10 or 11 of the spacer, thus giving the piston and the spacer rotary motion. From the passages 17 and 18 (in this case shown at the top) two passages or pipes 19 and 20 lead to the two ends of a valve chest 22 containing a slide valve 21 which as steam is admitted to one end or the other of the valve chest 22 is shot in one direction or the other. When steam is admitted through the passage or pipe 19 it is also open to the valve chest 22 through the small passage 25 in the slide valve 21, Fig. 1 to the space 26 until the slide valve 21 is reversed when the corresponding passage 52 and space 51 connected with the passage 20 come into play. Instead of the small passages 25 for constant admission of a minute quantity of steam, the passages 19 and 20 may each be fitted with a needle valve for admitting steam from either 19 or 20 to the spaces 26 or 51. The admission of steam through the passages 25 is for the purpose of starting the engine in case of its stopping in the position shown in Fig. 1. When steam is admitted to the inlet passage 17, the slide valve 21 is in the position shown in Fig. 1, the exhaust passage 24 being closed and the exhaust passage 23 open. When steam is admitted to the inlet passage 18 the steam supply is cut off from the inlet passage 17; the passage or pipe 20 permits the flow of steam to the valve chest 22 at the right in Fig. 1, thereby shooting the slide valve from right to left whereupon the reverse action takes place. Or the slide valve might be made reversible by any suitable device fitted thereto and operated by hand. The slide valve 21 is confined in the valve chest by the bottom plate 27 which has an abutment or parallel 14 recessed therein as stated above.

The shaft 2 works in double or single roller ring bearings in the covers 34, 35 of the casing 16 at each end of the spacer. Upon the shaft 2 are fastened steel liner rings 59 that are supported on and revolve on the rollers 68, which in turn travel in the race ring 46. This latter is forced into the casing cover 34, 35 and retained therein by the ring 45, which by means of screws is fastened to the casing cover 34, 35 and which also retains and maintains the rollers 68 in their proper place. The ring 45 also separates the shaft bearing rollers 68 from the similar rollers 43 upon which the spacer revolves. The rollers, liner rings and other bearing surface parts are by preference made of steel, hardened. The casing cover 35 may close in the end of the shaft as shown, the casing cover 34 at the other end having a stuffing box and gland 36 through which the shaft 2 passes out. Or both ends may be so arranged. Ball bearings 37 may be provided at the ends of the steel rings 59 for taking up any end thrust in the engine itself.

The spacer is a chamber wherein the piston works and consists of a circumferential ring 5, against the cylindrical outside surface of which the aforesaid parallels 12, 13, 14, 15 abut, and two end disks or heads 40, 40 secured to the spacer ring 5 by screws. Each spacer head 40 is formed with three shallow recesses or channels triangularly disposed, see Figs. 1 and 3; three thin packing strips 41 of steel, phosphor bronze or other suitable material are placed in the three channels. The strips are at each end bounded by the heads of the screws 56 screwed into the spacer head 40 their heads being flush with the surface of the disk and must be placed in the position shown relatively to the shoes 6. Small passages 42 may be provided for admitting a small quantity of steam to the inner side of these strips so as to press them out from the head 40 of the spacer, with or without springs underneath to keep the strips 41 up to the end face of the piston 1. Antifriction bearing devices such for instance as the rollers 43, are provided for the spacer head to work in between the steel ring 47 on the boss of the spacer head 40 and the inner surface of a ring 49, of steel, in the circumferential part of the inclosing casing 16, the rollers revolving between the packing ring plate 38, and the disk 45 which latter is fixed in the end cover 34. Between the ring plate 38 and the spacer head 40 are provided two or more thin rings 44. Each of these thin rings 44 is by preference provided with a small hole (not shown) for allowing the lubricated steam to pass through it, and a small channel is cut eccentrically to the circumference in the end face of each ring 44 for the purpose of effectually distributing the lubricated steam; the rings 44 are allowed to revolve freely against each other and against the end of the revolving spacer head 40 and against the aforesaid ring plate 38. Springs

39 placed in recesses in the ring plate 38 serve to exert elastic pressure upon the rings 44. By the provision of the parallels 12 to 15 the thin triangularly arranged strips 41, the thin rings 44 and other arrangements described, leakage is practically prevented and a great economy of steam permanently effected heretofore generally only experienced in rotary engines when the working parts are new or unworn. The reversing can be easily effected many times in one minute as practice has proved.

If the engine or machine is not intended to be reversible the duplication of the inlet and outlet ports, and the slide valve with its means for reversing will obviously not be needed. Fig. 3 is a sectional elevation of such a non-reversible engine. One small passage such as the pipe 20 with a shut-off valve or cock 61 is then provided for admitting a small quantity of steam to the space 26 between the spacer 5 and the casing 16, for enabling the engine to be started in any position of the rotating elements. The steam from the inlet 18 enters the spacer by the port 9 and finally escapes to the exhaust passage 23 by the same port. The speed of the engine may be controlled by opening the admission cock or valve more or less. A drain cock 60 may be provided at the bottom of the exhaust chamber for carrying off any water that may collect at this place. Figs. 4 to 7 show the working parts of such an engine in four different sequential positions. In Fig. 4 the port 9 in the spacer is admitting steam to the space A while the spacer B is exhausting. The steam in the space C exerts expansive turning effort on the cycloidal end Y of the piston which end is gradually working into the space B. The narrow space between the piston end X and the spacer gradually enlarges thereby causing the piston to advance the spacer following through the action of the piston at a speed ratio of 3 to 2 until, as in Fig. 5, the spacer reaches a point indicated by the line D from the starting position indicated by the line O Fig. 4 and the piston has then advanced to the point indicated by the line E. When the following edge of port 9 passes the leading edge of the parallel 15 the expansion begins. The exhaust at the same time continues from space B, and the expansive turning effort in C acts on the end Y of the piston which end is gradually working into the space B. The steam which fills the narrow space A in Fig. 5 constitutes a charge, which then is expanded until the position shown in Fig. 6 is reached where the exhaust begins from the space A, the leading edge of port 9 being on the point of passing the exhaust parallel 14, the steam having exerted a turning effort on the piston end X during its travel through 270° as indicated by line F and the spacer through 180° as indicated by the line G. The exhaust now continues until as shown in Fig. 7 the following edge of the port 9 reaches the leading edge of the parallel 12′, as indicated by the line H while the end Y of the piston has reached the position indicated by the line I. The spacer will next assume the position shown in Fig. 4 but the end Y of the piston in Fig. 7 will then be in the position X in Fig. 4 because the piston has made 1½ revolutions while the spacer has made one revolution. It will thus be seen that there is a continuous turning effort maintained throughout the entire revolution of the piston and that during that revolution and before the charge A admitted to the X end of the piston has been fully expanded and begins to exhaust a similar charge has been admitted to the Y end of the piston. In this example, Figs. 3 to 7 the steam is expanded about nine times.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A rotary fluid machine comprising a casing having a non-cylindrical interior and provided with fluid inlet and outlet passages, a cylindrical spacer provided with ports and rotatable in the casing, a piston rotatable in the spacer in the same direction thereof, abutments between the piston and spacer, and an abutment between the spacer and the casing on each side of the inlet passage, said abutments located in recesses formed in the casing and provided with means for accurate adjustment from without.

2. A rotary fluid machine, comprising a casing having a non-cylindrical interior to form an exhaust space and provided with fluid inlet and outlet passages, a cylindrical spacer provided with ports and rotatable in the casing, a piston rotatable in the spacer in the same direction thereof but at a different speed, abutments between the piston and spacer, and an abutment between the spacer and casing on each side of the inlet passage, said abutments located in recesses formed in the casing and provided with means for accurate adjustment from without.

3. In a rotary fluid machine of the character described, a spacer formed cylindrical outside, a casing provided with a non-cylindrical interior exhaust space, an actuating fluid inlet passage and adjustable spacer abutments on each side of the latter, said abutments located in recesses formed in the casing and provided with means for accurate adjustment from without, an exhaust passage, and a small passage for admitting actuating fluid for starting the machine with full power and from any position of the rotating elements.

4. In a rotary fluid machine of the character described, a spacer formed cylindrical outside, a casing provided with two non-cylindrical interior exhaust spaces and two exhaust passages, two actuating fluid inlet

passages each between a lateral and an upper and a lower adjustable abutment said abutments located in recesses formed in the casing, means for admitting actuating fluid to one or other of said inlet passages, a valve chest in the casing, a slide valve adapted to slide in the said valve chest, and two small passages, one from one actuating fluid inlet passage to one end of the valve chest and the other from the other inlet passage to the other end of the valve chest for starting the machine to rotate in one direction or the other.

5. In a rotary fluid engine, a casing, a spacer rotatable therein, a piston rotatable in the spacer, abutments in recesses formed in the casing, a valve chest, a slide valve therein, a bottom plate for the valve chest provided with a recess, an abutment in said recess, and means for adjusting the contact between the abutments and the spacer.

6. In a rotary fluid engine; a casing, a spacer rotatable therein, a piston rotatable in the spacer, abutments in recesses formed in the casing, studs secured in each abutment, a coil spring on each stud, a spring box secured over the spring, screw threads on the outer end of the stud, a nut thereon for regulating the tension of the spring and thus adjusting the contact between the abutment and the spacer, and shallow, round serrations on the top of the spring and the bottom of the nut, said serrations bearing a certain relation to the pitch of the screw thread on the stud so that the amount of adjusting elastic pressure answering to each partial turn of the nut is known, while the serrations also lock the parts together sufficiently to prevent their coming apart.

7. In a rotary fluid engine, a casing, a spacer rotatable therein, a piston rotatable in the spacer, triangularly disposed recesses in the end surfaces of the latter, packing strips in the recesses, recesses in the interior circumferential surface of the spacer, shoes having splines in said recesses, said shoes being adapted to work against the piston and arranged so as to prevent leakage at the places where the packing strips adjoin.

8. In a rotary fluid engine, a casing, a spacer rotatable therein, a piston rotatable in the spacer, triangularly disposed recesses in the end surfaces of the latter, packing strips in the recesses, minute passages for admitting actuating fluid to the back of the strips, recesses in the interior circumferential surface of the spacer, shoes having splines, springs in recesses of said splines, the shoes being adapted to work against the piston and arranged so as to prevent leakage at the places where the packing strips adjoin.

9. In a rotary fluid engine, a casing, a spacer rotatable therein, a piston rotatable in the spacer, thin rings between the ends of the spacer and the ends of the casing, said rings formed each with a fine pin hole and free to rotate against said ends, against one another and against the casing, for the purpose of preventing leakage and undue friction between the spacer and the casing.

10. In a rotary fluid engine, a casing, a spacer rotatable therein, a piston rotatable in the spacer, thin rings on the outside of the ends of the spacer, said rings formed each with a fine pin hole, an antifriction roller device around the boss of the spacer and placed in the inside of the end of the casing, a ring having recesses, springs in the recesses between the thin rings and the roller device, the springs exerting elastic pressure against the spacer end and the thin rings, and the latter free to rotate against the spacer end, against one another and against the ring with springs in its recesses.

11. In a rotary fluid engine, a casing, a spacer rotatable therein, a piston rotatable in the spacer, a roller device around a boss on the spacer and placed in each end of the casing, a shaft, a roller bearing therefor in each end of the casing, and a ring recessed and fixed in each end of the casing for the purpose of keeping the roller device and roller bearing in place.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses this 25 day of June 1907.

JOHN STUART ALCORN.

Witnesses:

H. D. JAMESON,

TH. RAND.