F. STOEHR & E. W. GRAGERT.

ROTARY ENGINE.

APPLICATION FILED JUNE 23, 1906.

905,476. Patented Dec. 1, 1908.

3 SHEETS—SHEET 1.

Fig. 1.

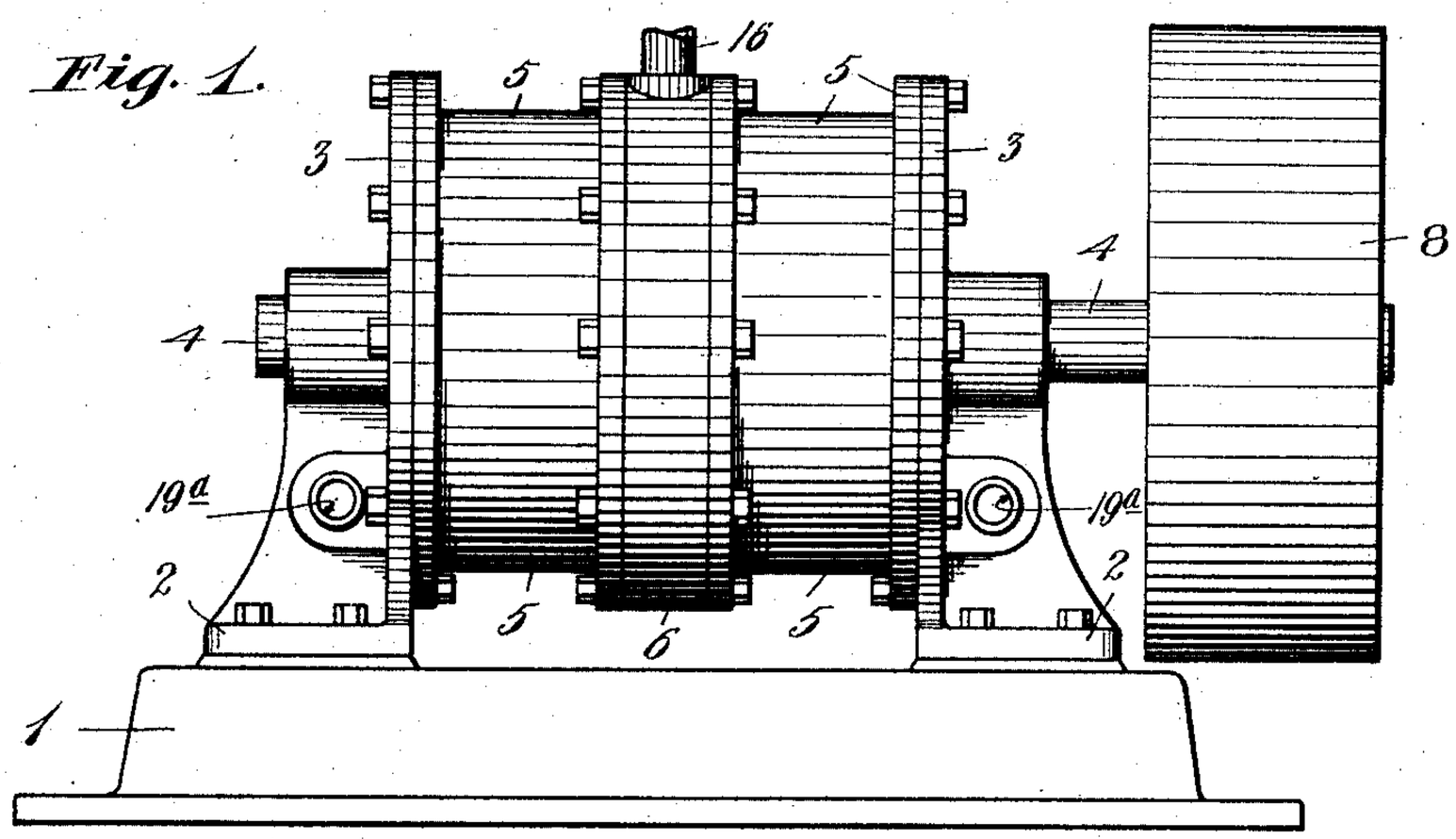
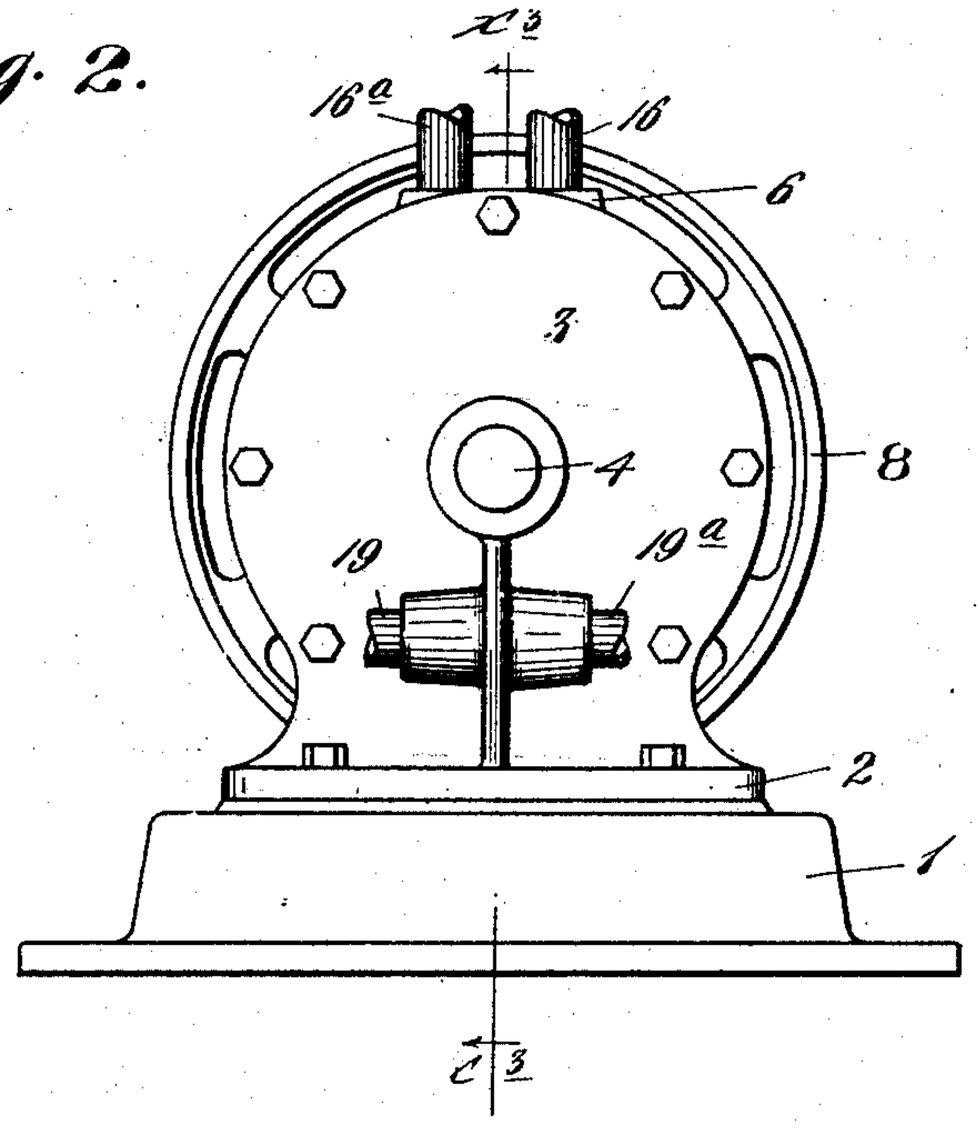


Fig. 2.



Witnesses.

E. W. Jeppesen.

A. H. Olsahl.

Inventors.

Frederick Stoehr:

Elmer W. Gragert.

By their Attorneys.

Williamson Merchant

F. STOEHR & E. W. GRAGERT.

ROTARY ENGINE.

APPLICATION FILED JUNE 23, 1906.

905,476. Patented Dec. 1, 1908.

3 SHEETS—SHEET 2.

Fig. 3.

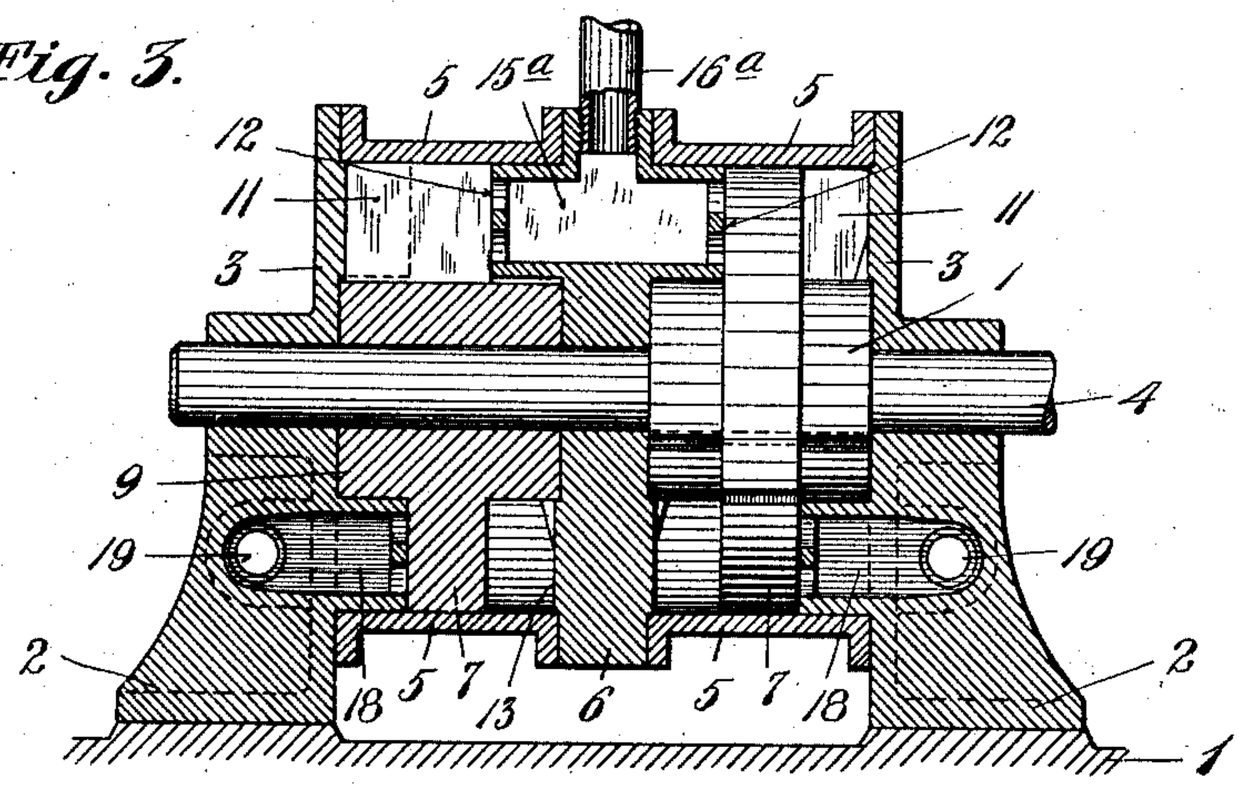


Fig. 4.

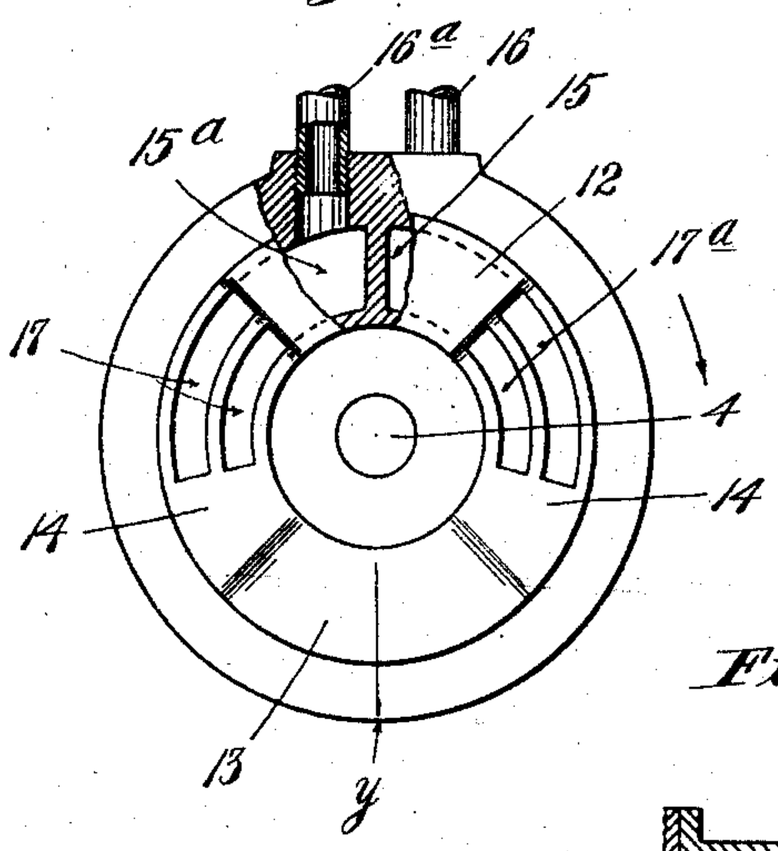


Fig. 5.

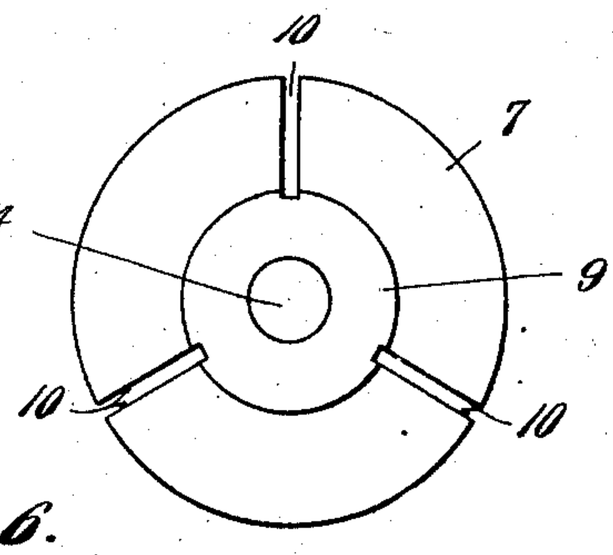
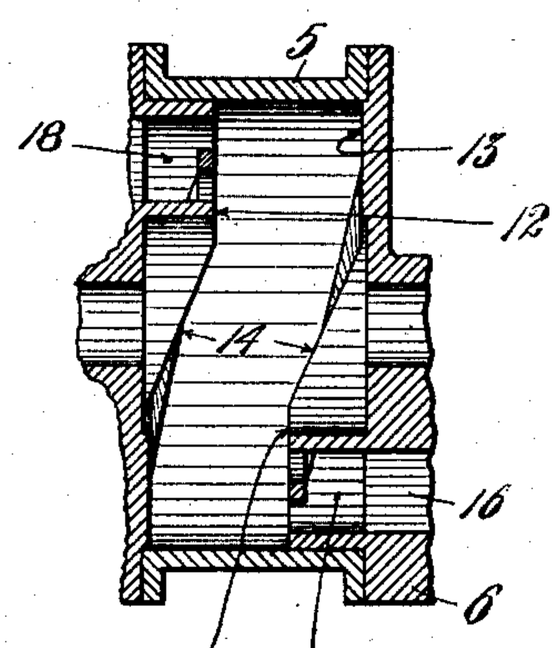


Fig. 6.



Witnesses.

E. W. Jeppesen.

A. H. Ospahl.

Inventors.

Frederick Stoehr.

Elmer W. Gragert.

By their Attorneys.

William Merchant

F. STOEHR & E. W. GRAGERT.

ROTARY ENGINE.

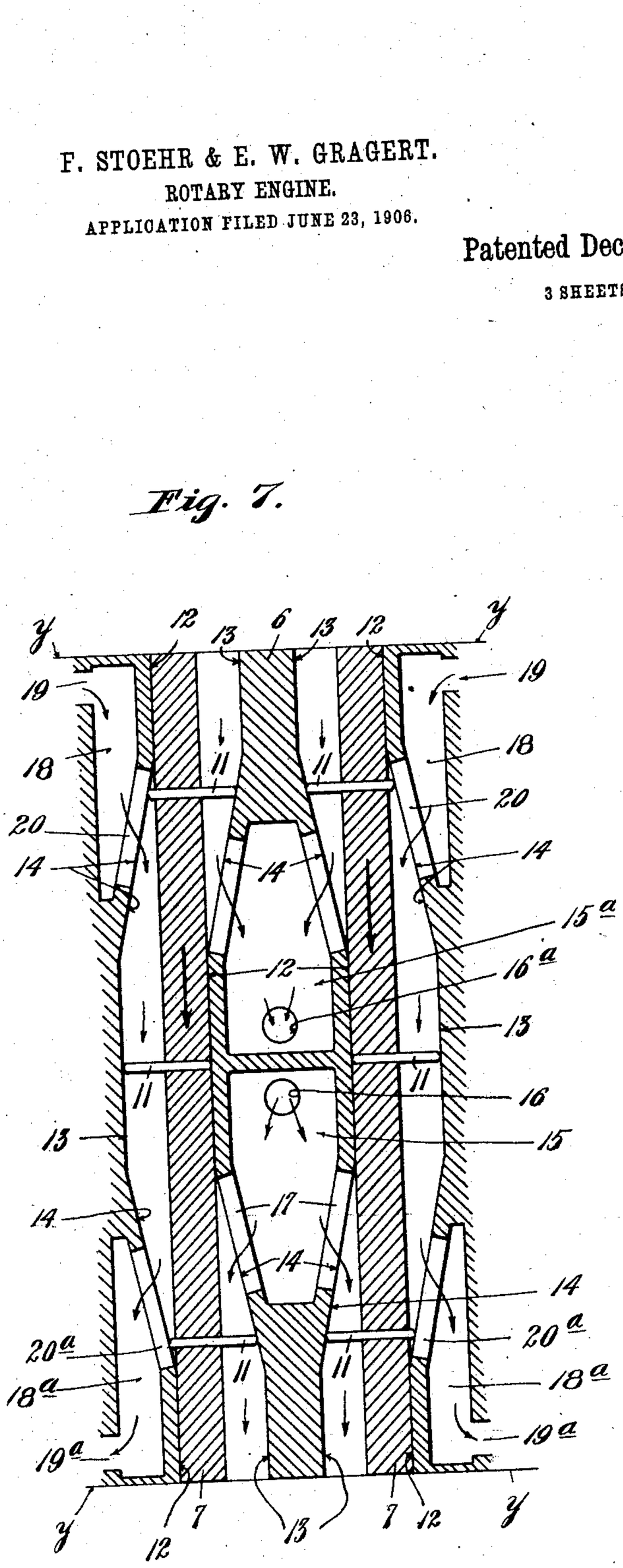
APPLICATION FILED JUNE 23, 1906.

905,476.

Patented Dec. 1, 1908.

3 SHEETS—SHEET 3.

Fig. 7.



Witnesses.

E. W. Jeppum.

A. H. Obschl.

Inventors

Fredrick Stoehr.

Elmer W. Gragert.

By their Attorneys.

Williamson & Merchant

UNITED STATES PATENT OFFICE.

FREDRICK STOEHR AND ELMER W. GRAGERT, OF MINNEAPOLIS, MINNESOTA, ASSIGNORS TO UNITED STATES DUPLEX ROTARY ENGINE COMPANY, OF MINNEAPOLIS, MINNESOTA, A CORPORATION OF MINNESOTA.

ROTARY ENGINE.

No. 905,476. Specification of Letters Patent. Patented Dec. 1, 1908.

Application filed June 23, 1906. Serial No. 323,069.

To all whom it may concern:

Be it known that we, FREDRICK STOEHR and ELMER W. GRAGERT, citizens of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Rotary Engines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention has for its especial object to provide an improved rotary engine, and to this end it consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

In the following description the device will be referred to as a rotary engine, although it is capable of use as a pump.

In the accompanying drawings which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings:—Figure 1 is a view in side elevation showing the improved engine. Fig. 2 is an end elevation of the said engine. Fig. 3 is a vertical section taken on the line x^3 x^3 of Fig. 2, some parts being left in full and some parts being broken away. Fig. 4 is a side elevation with some parts broken away, showing the so-called partition plate of the duplex cylinder of the engine, some parts being sectioned. Fig. 5 is a side elevation of one of the rotary pistons showing the same removed from working position. Fig. 6 is a detail view taken through a portion of the engine cylinder on the line x^3 x^3 of Fig. 2, some parts being broken away and the coöperating pistons being removed therefrom, and Fig. 7 is a diagrammatic section showing the cylinder, the pistons and coöperating parts as they would appear if their peripheries were cut on the line y (Fig. 4) and then turned out flatwise. Otherwise stated, if the parts shown in Fig. 7 are conceived as being bent into cylindrical form until the end portions marked by the lines y (Fig. 7) are brought together, the actual relations of said parts would be shown.

The numeral 1 indicates a suitable bed plate, to which is bolted or otherwise rigidly secured a pair of laterally spaced bearing brackets 2 having cylinder heads 3 formed integral therewith. A piston shaft 4 is journaled in and extends through the hub portions of the bearing brackets 2. The engine in its best form is a duplex engine, in which two cylinders and two rotary pistons are employed, and in which the propelling blades carried by the pistons are arranged to move alternately in reverse directions to make their thrust movements simultaneously in opposite directions, so that the inertia and momentum of the blades of the one piston offsets or neutralizes the inertia and momentum of the blades of the other piston. In carrying out this construction axially alined piston seats or cylinders 5 are secured one to each of the piston heads 3, and a heavy partition plate 6 is interposed between and rigidly secured to the opposing inner ends of said cylinders 5. The piston shaft 4 carries two rotary pistons 7, one of which works in each of said cylinder or piston seats 5.

8 indicates a pulley carried by one end of the piston shaft 4, and over which a belt (not shown) is adapted to run to transmit power from the engine.

The rotary pistons 7 are in the form of thick flat disks having heavy hub portions 9 that project from the opposite faces thereof. These rotary pistons are provided with a plurality of (as shown 3) radially extended transversely cut blades seats 10, in which rectangular propelling blades 11 are held for movements transverse of the said pistons, or, in other words, for sliding movements back and forth in a direction longitudinally of the axis of the shaft 4. The opposing faces of the partition plate 6 and of the piston heads 3 are formed with parallel laterally offset flat surfaces 12 and 13, that are connected by parallel inclined cam surfaces 14. The said coöperating parallel surfaces 12, 13 and 14 form annular runways for the propelling blades 11, which runways are zigzag laterally, so that under rotary movements of the pistons the said blades will be caused to project first in the

one direction and then in the other from the sides of said pistons. As clearly shown in Fig. 7, the transversely alined propelling blades of the two pistons are caused to move simultaneously outward and then simultaneously inward under the actions of the said laterally zigzag channels or runways.

As shown, the upper portion of the partition plate 6 is its thickest portion, and this portion is recessed to form two independent chambers 15 and 15ª, into which lead pipes 16 and 16ª respectively. The chamber 15 is provided with segmental ports 17, and the chamber 16ª is provided with similar segmental ports 17ª that open through the corresponding cam surfaces 14 of said partition plate into the opposite cylinder or piston seats 5, all as best shown in Fig. 7.

The lower portions of the cylinder heads 3 are their thickest portions, and these thick portions are formed with chambers 18 and 18ª, into which open pipes 19 and 19ª respectively. Segmental ports 20 and 20ª open respectively from the chambers 18 and 18ª, through the corresponding cam surfaces 14 into the opposite cylinder or piston seats 5.

By reference to Fig. 7 it will be noted that all of the admission ports and all of the exhaust ports extend in the cam surfaces in which they are located from the points where the said cam surfaces make contact with the flat surfaces of the coöperating rotary pistons. This feature of construction is highly important because, in the first instance, it permits live steam to act upon a blade the very instant that it begins to project from the rotary piston into engagement with the cam surface; and, in the second instance, because it permits the exhaust of steam up to the very instant that said blade has been retracted or moved back into the said piston. This, as is evident, gives a maximum efficiency of steam and relieves the pistons entirely from back pressure.

The engine above described is a reversible engine. When it is desired to rotate the pistons and the shaft 4 in the direction of the arrows marked on said pistons in Fig. 7, the live steam should be admitted into the chambers 18 through the pipes 19, and live steam should also be admitted into the chamber 15 of the partition plate through the pipes 16. The steam admitted into the chambers 18 and 15 escapes through the ports 20 and 17 into the piston seats, and acts directly upon the propelling blades 11, as clearly indicated by arrows marked on Fig. 7. In driving the pistons in the direction just noted, the pipes 16ª and 19ª should be open to exhaust, so that the steam caged within the cylinder or piston seats, ahead of the propelling blades, finds free escape in the one instance through the ports 17ª, chamber 15ª, and pipes 16ª, and in the other instance through the ports 20ª, chambers 18ª, and pipes 19ª.

To reverse the direction of the rotation of the pistons, the pipes 19 and 16, above described as admission pipes, should be open to exhaust, and the pipes 16ª and 19ª, above described as exhaust pipes, should then be used as admission pipes and live steam should be introduced therethrough.

Any suitable valve mechanism (not shown) may be employed for opening and closing the pipes 16, 16ª, 19 and 19ª in the manner above described.

The engine above described is of simple construction; has few parts that are likely to get out of order, and in practice has been found to be highly efficient for the purposes had in view. It has also been found that the engine when in action runs free from vibrations, and produces very slight noise.

As is evident, the lateral pressures in reverse directions put upon the outer surfaces of the rotary piston 7, by the live steam, are equal, and also the outward lateral pressures put upon the inner surfaces of the said two rotary pistons are equal, so that the said rotary pistons are balanced. Otherwise stated, the resultant lateral pressure of the steam upon the two pistons is zero, and there is no endwise thrust put upon the piston shaft 4.

It is of course evident that the device described may be used as a pump. To convert the same into a pump it is only necessary to positively rotate the shaft 4 and pistons carried thereby.

We claim as our invention:

1. In a device such as a rotary engine, a cylinder having an annular laterally zigzagged blade runway formed with laterally offset flat surfaces and with inclined cam surfaces and having elongated admission and exhaust ports opening through said cam surfaces, in combination with a rotary piston working in said cylinder and constantly engaging with the flat parallel surfaces of said runway, and propeller blades carried by said piston, working in the blade runway of said cylinder and adapted to move transversely of the plane of rotation of said piston, and which admission and exhaust ports extend from points where their respective cam surfaces make contact with the faces of said rotary piston, substantially as described.

2. In a device such as a rotary engine, the combination with a cylinder having a pair of axially-alined laterally-spaced laterally zig-zagged blade runways, which blade runways are formed with parallel flat surfaces and with parallel inclined cam surfaces and with admission and exhaust ports opening through said cam surfaces, of a pair of laterally spaced rotary pistons working in said cylinders and constantly engaging with the flat parallel surfaces of said runways, and

propeller blades movable transversely in said pistons and working in said blade runways, the said two blade runways being zig-zagged in opposite directions so that said rotary pistons will be balanced or free from lateral thrust due to steam pressure, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

FREDRICK STOEHR.
ELMER W. GRAGERT.

Witnesses:
C. MACNAMARA,
F. D. MERCHANT.