E. & T. ERICKSON.

ROTARY ENGINE.

APPLICATION FILED MAR. 25, 1908.

951,064.

Patented Mar. 1, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

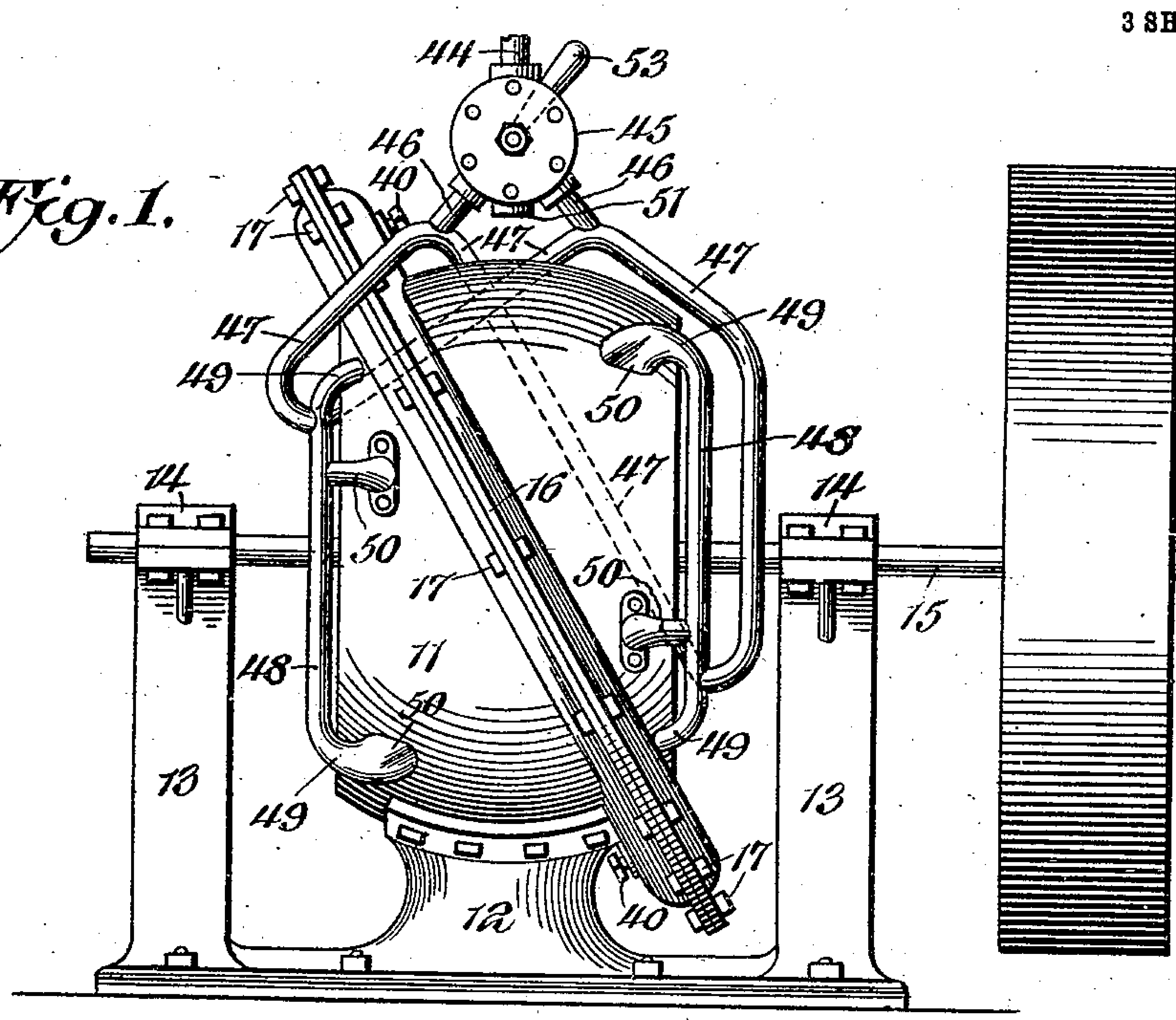
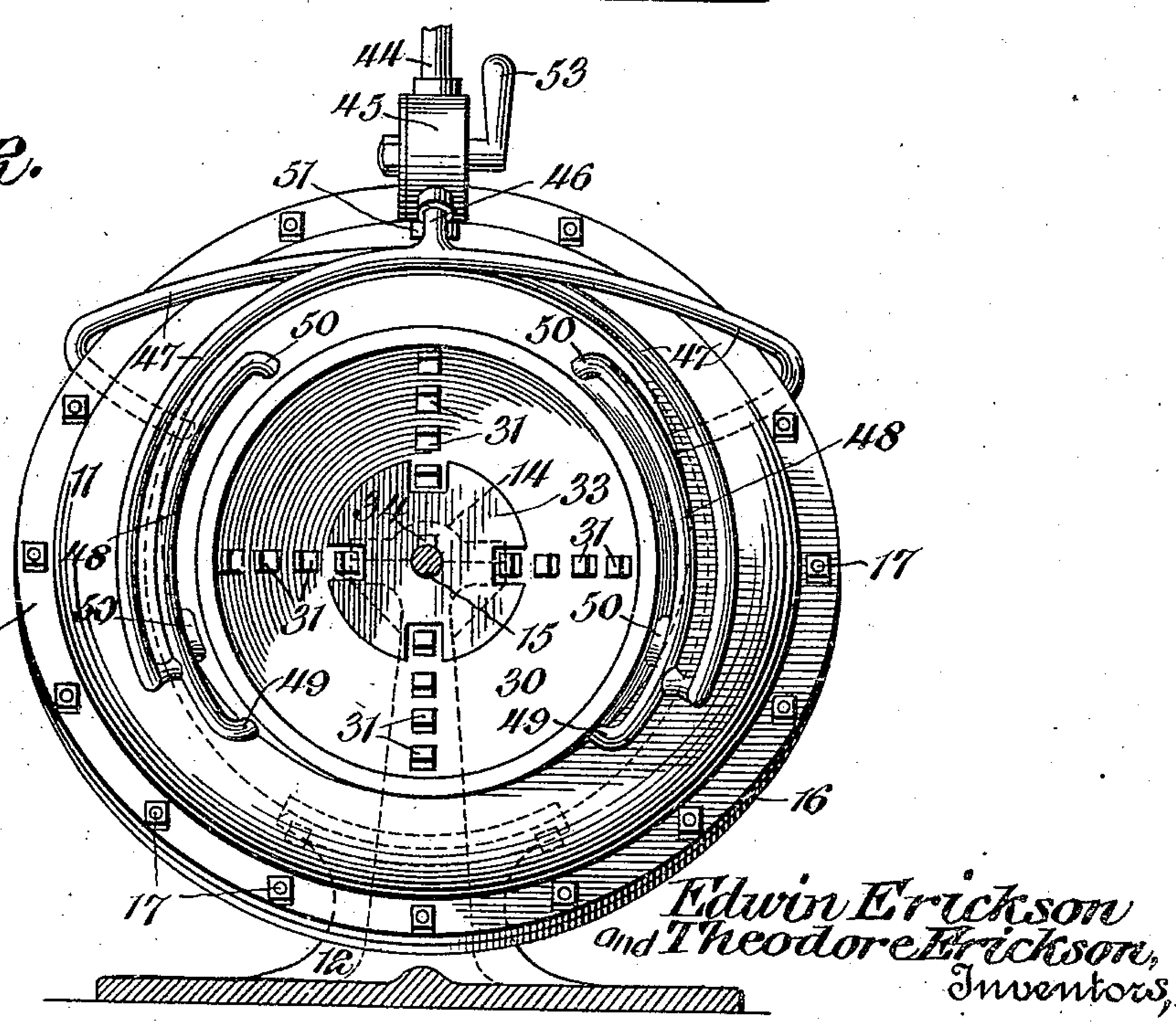


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

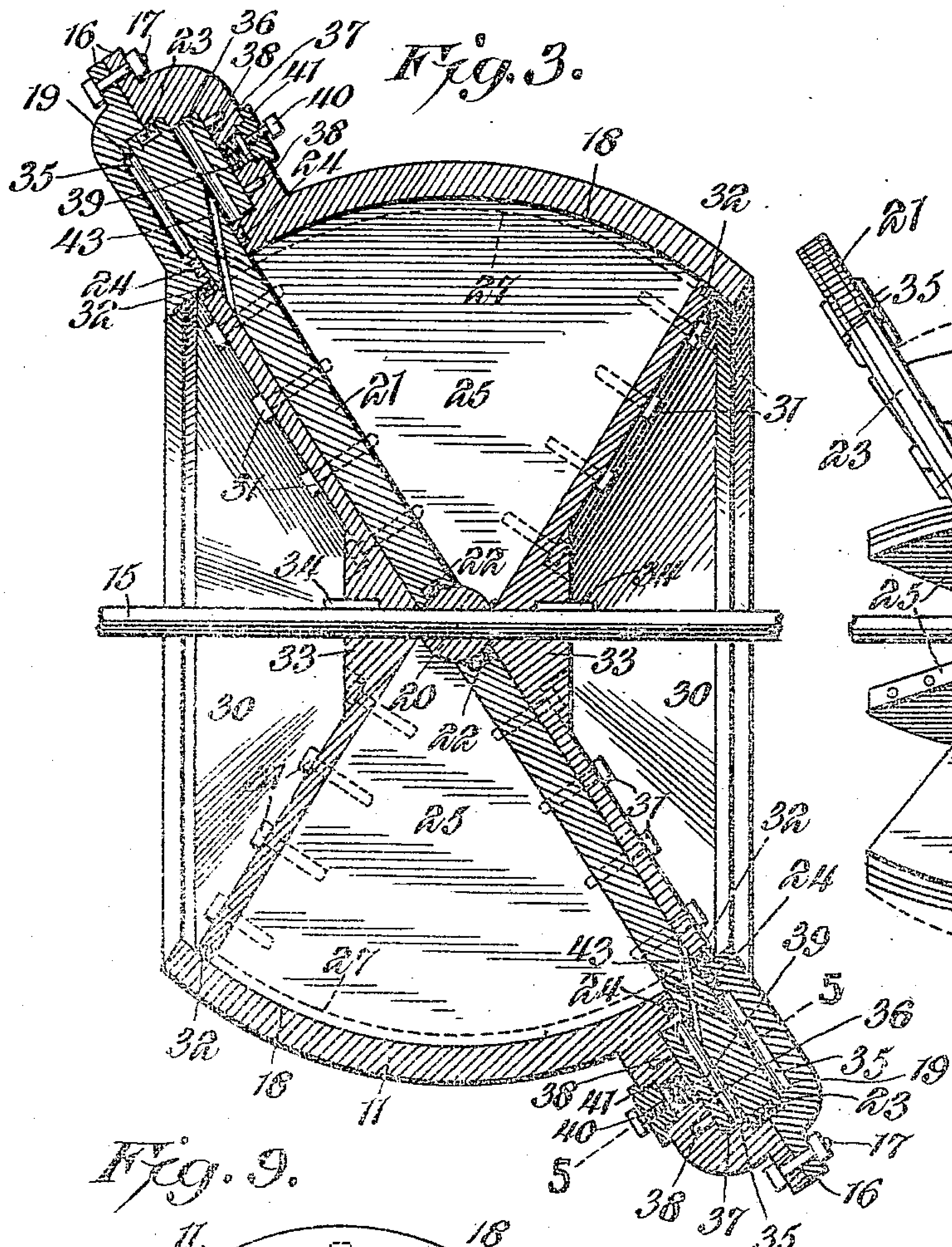


Fig. 4.

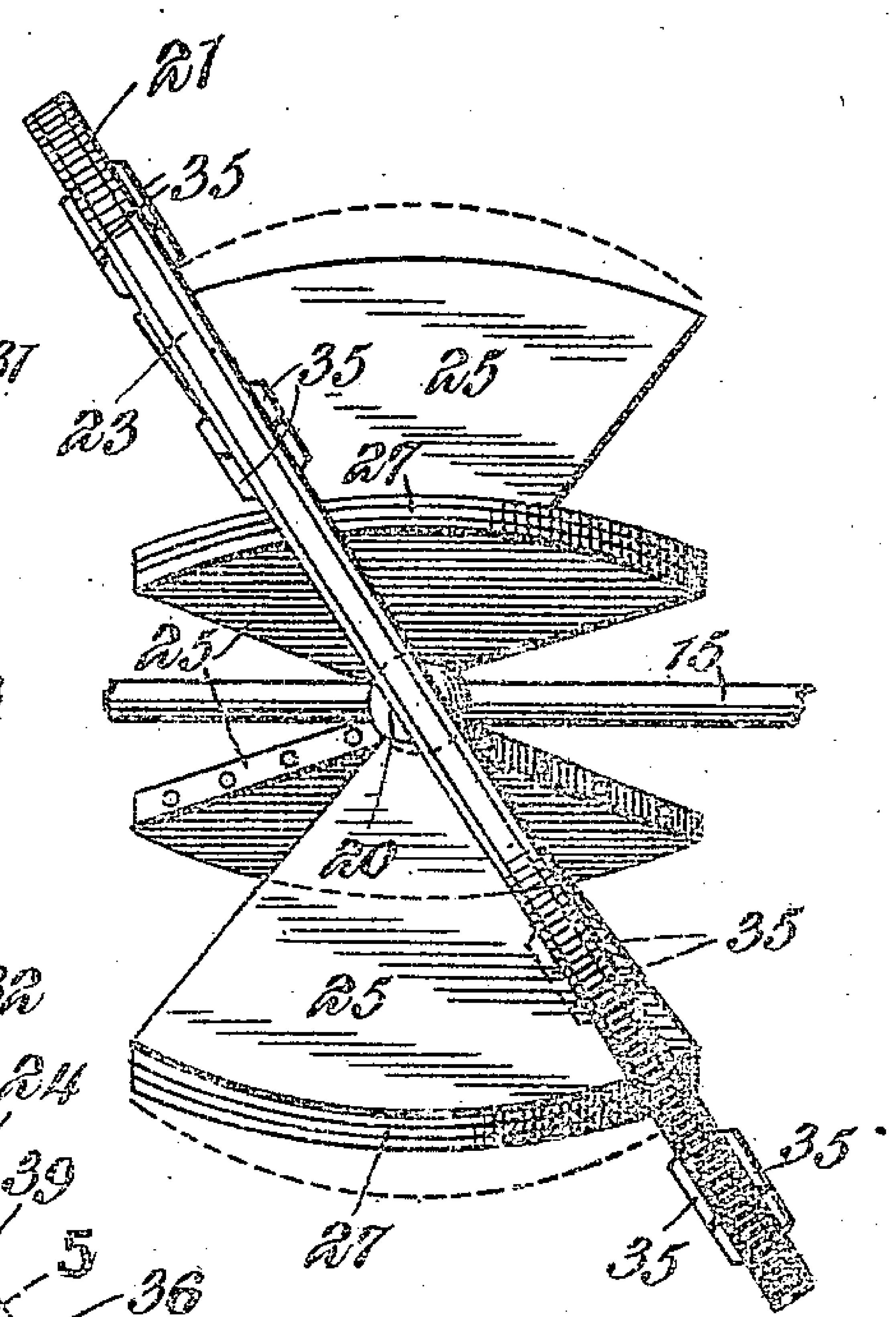


Fig. 9.

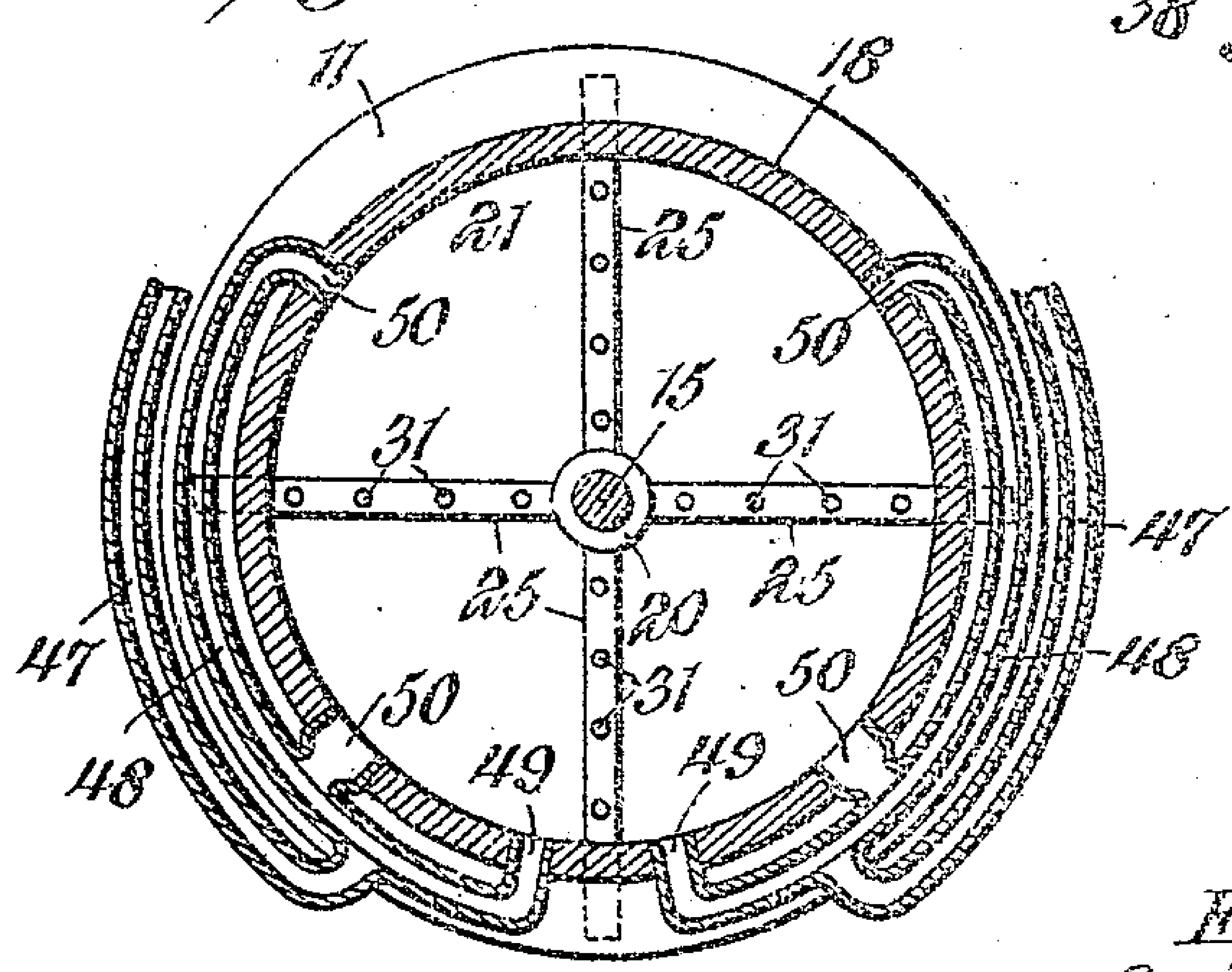
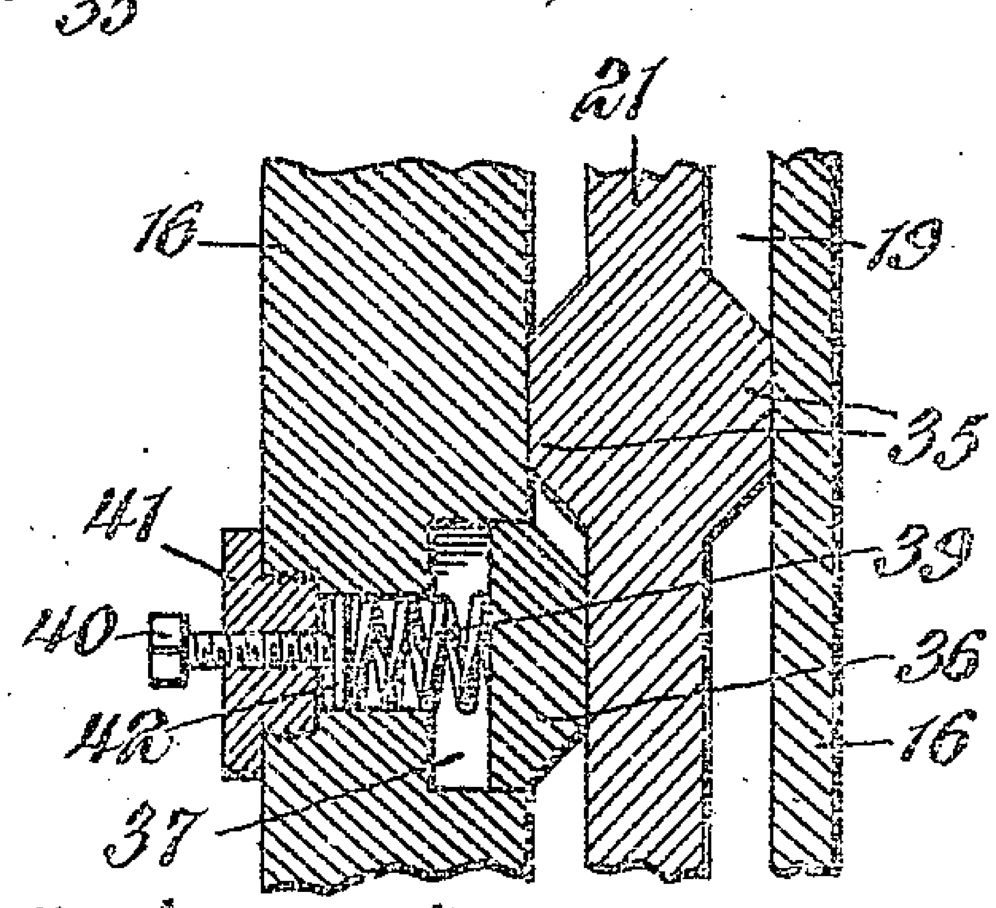


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

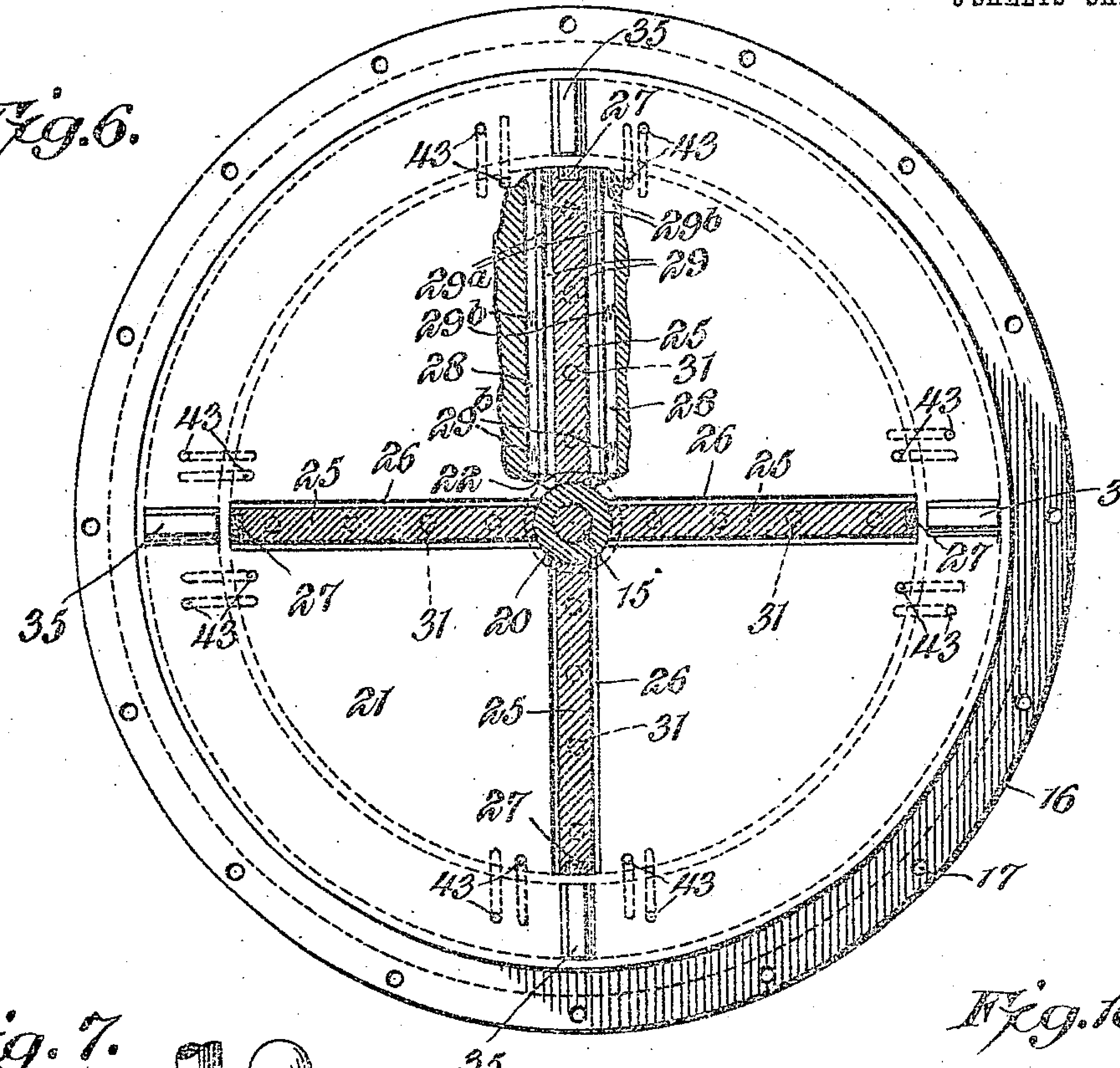


Fig. 7.

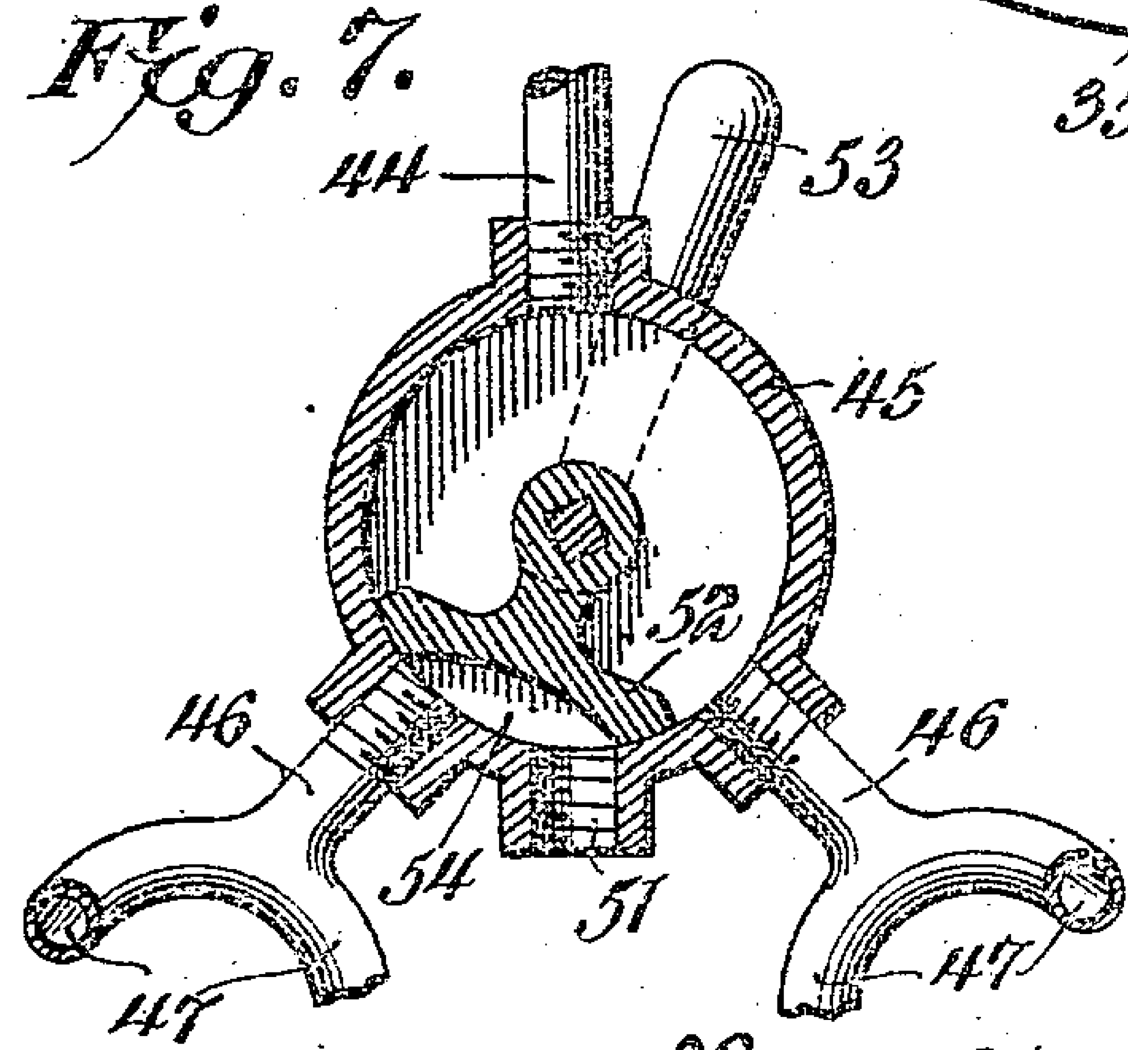


Fig. 10.

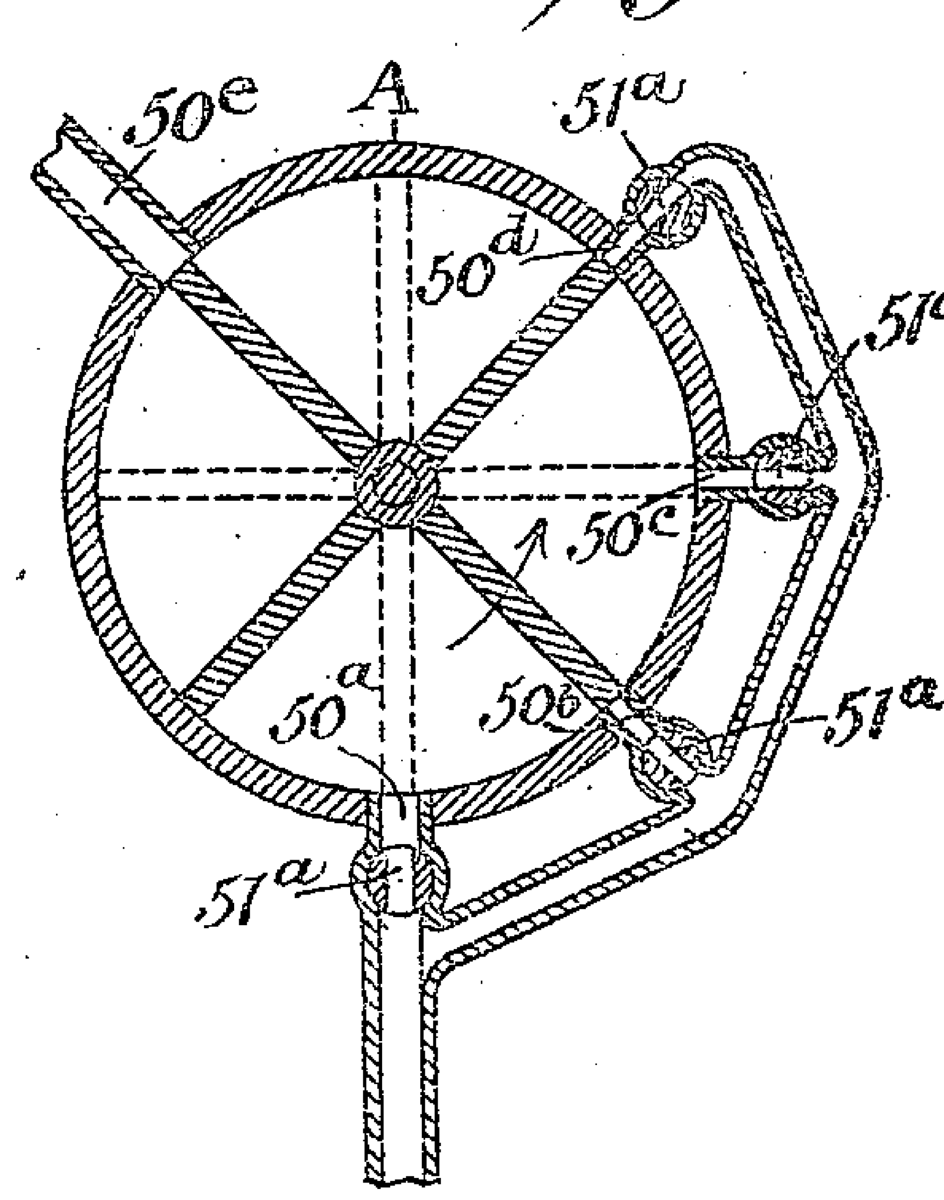
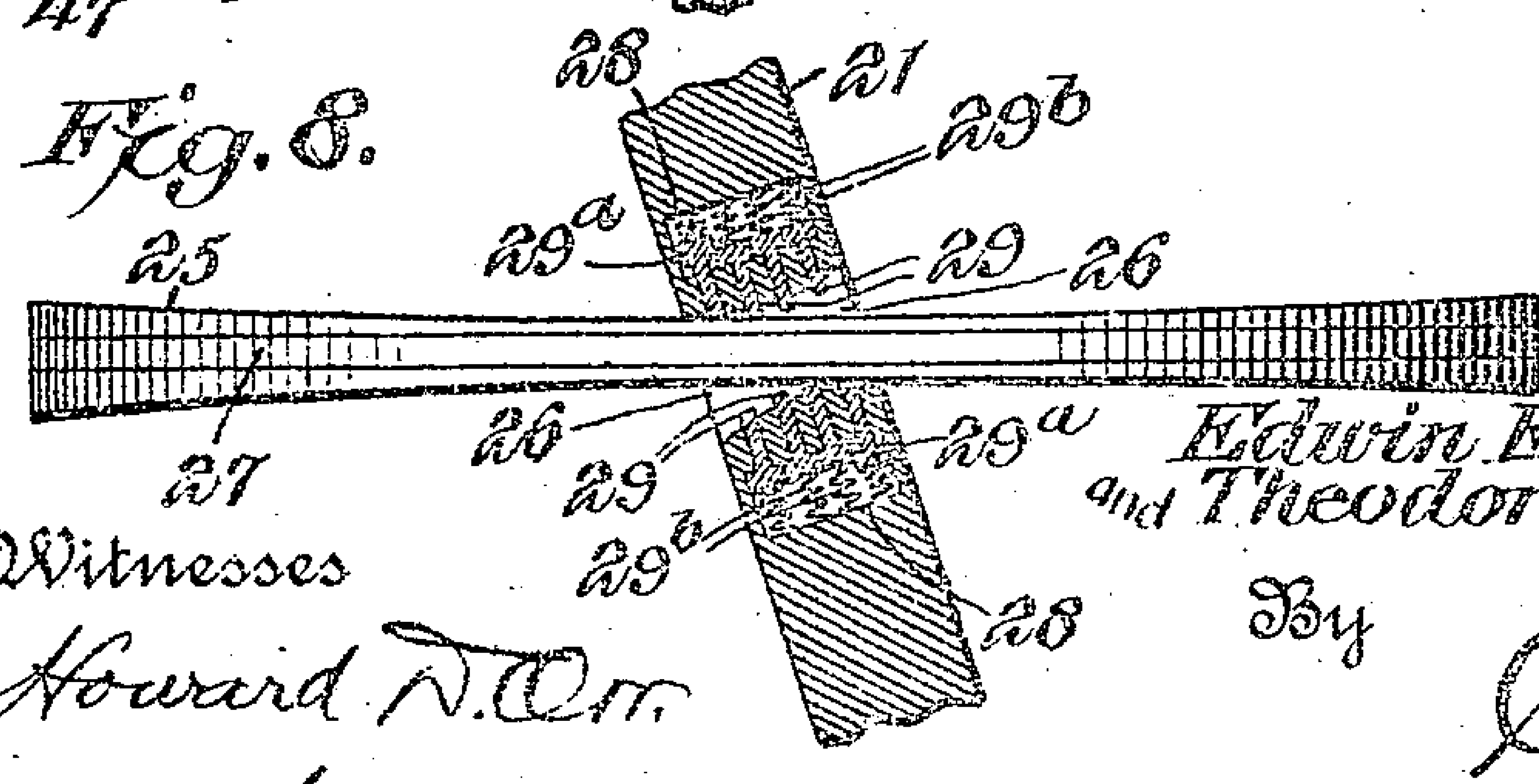


Fig. 8.



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UNITED STATES PATENT OFFICE.

EDWIN ERICKSON AND THEODORE ERICKSON, OF CHANCELLOR, SOUTH DAKOTA.

ROTARY ENGINE.

951,064. Specification of Letters Patent. **Patented Mar. 1, 1910.**

Application filed March 25, 1908. Serial No. 423,162.

To all whom it may concern:

Be it known that we, EDWIN ERICKSON and THEODORE ERICKSON, citizens of the United States, residing at Chancellor, in the county of Turner and State of South Dakota, have invented a new and useful Rotary Engine, of which the following is a specification.

One of the primary objects is to provide a rotary engine of a comparatively simple character, in which a high degree of efficiency is obtained, in which the expansive force of the motive fluid may be utilized and in which an effective counterpressure is obtained to eliminate lateral pressure and consequent friction between the stationary and revolving parts, said engine being preferably, though not necessarily reversible.

The preferred form of construction is illustrated in the accompanying drawings, wherein:

Figure 1 is a side elevation of the engine. Fig. 2 is an end elevation of the same. Fig. 3 is a vertical sectional view therethrough. Fig. 4 is a side elevation with the piston member removed from the cylinder member. Fig. 5 is a detail sectional view on the line 5—5 of Fig. 3. Fig. 6 is an elevation of the structure shown in Fig. 4, with the blades shown in section. Fig. 7 is a detail sectional view through the controlling valve. Fig. 8 is a detail cross sectional view through a portion of the partition disk showing the bearings for one of the blades. Fig. 9 is a detail sectional view that is diagrammatic in character, illustrating the character of the supply and exhaust ports. Fig. 10 is another similar view showing a slight modification of said ports.

Similar reference numerals designate corresponding parts in all the figures of the drawings.

In the embodiment illustrated, a cylinder member 11 is employed, which is in the form of a circular casing having a peripheral curved wall and open ends, this casing being secured to a suitable base 12, from which rise standards 13. The upper ends of the standards carry journal boxes 14, in which is rotatably mounted a shaft 15 that extends concentrically through the casing or cylinder member 11. This cylinder member, as shown, is composed of two sections, each section having a diagonally disposed outstanding flange 16, said flanges being bolted together, as shown at 17. The cylinder member thus forms a piston chamber 18 and the space between the bodies of the flanges constitutes what may be termed a counterpressure chamber 19.

The shaft 15 has a ball 20 secured to its central portion within the cylinder member and an inclined partition disk 21 extends diagonally across the piston chamber 18, and has its peripheral portion located in the counterpressure chamber 19. Packing strip sections 22, carried by the inner portion of the disk 21, operate against the ball 20, while the edge of said disk is provided with an annular groove in which other packing 23 coöperates with the outer end wall of the counterpressure chamber 19. Packing strips or rings 24 are also located in the walls of the cylinder member and engage opposite sides of the partition disk 21, thus preventing the leakage of motive fluid between the piston chamber and the counterpressure chamber. The partition disk 21, as will be evident by reference to Fig. 3, divides the piston chamber into two opposite compartments, and operating in said piston chamber are piston blades or wings 25, said blades or wings extending through radial slots 26 formed in the disk 21. The piston blades 25 have their outer end edges coöperating with and curved to conform to the circular wall of the cylinder member, said end edges having packing strips 27. The piston blades 25, as clearly shown in Fig. 8, have their opposite faces concaved and the opposite walls of the slots through which said blades pass, are convexed. In rear of said walls, the disk 21 is provided with sockets 28 and a plurality of packing strips 29 slidably mounted in the walls of the slots have heads 29^a located in the sockets. The outer edges of the packing strips are arranged to bear against the opposite faces of the piston blades and are so disposed that at least one of said strips is always bearing against a face of each blade. Any suitable means may be employed for urging the strips outwardly. Thus in the embodiment shown, springs 29^b are employed that are located in rear of the strips and bear against the heads thereof. The opposite side edges of the blades are disposed at the same inclination as the partition disk 21, as will be evident by reference to Fig. 3, and conical shaped end walls 30 for the cylinder member, located within the ends of the same, are bolted, as shown at 31 to the side edges of the blades. These end walls have peripheral packing rings 32 that coöperate with the ends of the casing, and have hubs 33 located upon the shaft 15 and keyed or otherwise secured thereto, as shown at 34. It will thus be evident that the end walls will rotate with the piston and that two opposite lines will be in engagement with the opposite faces of the disk 21, as shown in Fig. 3. The peripheral margins of the partition disk, divide the counterpressure chamber 19 into two parts, and said margins have on their opposite side faces, division blades 35, which are located in said counterpressure chamber, and are in line with the piston blades the purpose of which will be hereinafter described. Coöperating with these division blades are abutments 36 slidably mounted in recesses 37 in the walls and having guides 38. Springs 39 bear against the rear sides of these abutments, and urge them inwardly. Then tension of the springs is varied by adjusting screws 40 that are threaded through plugs 41 secured in the walls, said screws operating against washers 42 located at the rear ends of the springs 39. It will be observed that the edges of the division blades 35 and abutments 36 are inclined so that when the former strike the latter, said latter will be forced rearwardly against the action of the springs, permitting the blades to pass. As soon as they have passed, however, the abutments will spring inwardly, thus immediately closing the spaces. Thus the counterpressure chamber is divided into separate compartments. The piston chamber is in communication with the counterpressure chamber by crossed channels or conduits 43 that permit the motive fluid to flow freely from the piston chamber into certain of the compartments of the counterpressure chamber and against the opposite face of the partition to which the main body of the motive fluid is applied, while the exhaust is taking place from the other compartments.

Motive fluid may be supplied to the engine in a variety of ways. For instance in Figs. 1, 2 and 7, there is illustrated a main supply pipe 44 leading from any suitable source and connected to a valve casing 45. From this valve casing extend oppositely disposed pipes 46 that are branched, as illustrated at 47. These branches are connected to conduits 48 provided with nozzles 49 that communicate with the piston chamber at spaced points and in a line longitudinally of the path of movement of the piston blades. It will be observed by reference to Figs. 1 and 9 that certain of these nozzles have elongated ports 50, some of which are disposed longitudinally and others transversely of the path of movement of the blades. From the valve casing 45 extends a suitable exhaust port 51, and a rotary valve 52, located in the casing 45, and operated by an exposed lever 53, is so arranged that it will uncover the end of either pipe 46, and when one of said pipes is uncovered, the other is connected by a channel 54 with the exhaust 51, as will be evident by reference to Fig. 7. With this construction therefore, if the lever 53 is turned in one direction, motive fluid will be applied through diagonally opposite sets of ports to the piston chamber on opposite sides of the partition, and thus in advance of the lines of engagement between the partition and the end walls. Consequently double power is secured from the engine for the reason that steam is being directed against two blades on opposed sides of the diagonal partition disk instead of against one blade only. Upon reversing the lever 53, motive fluid will be supplied to the other diagonal opposite set of ports, and the first mentioned set will then constitute the exhaust ports. It will be evident that when motive fluid is so supplied, there will be great lateral pressure against the partition, which would cause great friction between said partition and the stationary cylinder member. To prevent this, the above described counterpressure chamber is provided, and it will be observed by reference to Fig. 3 that when motive fluid is supplied to the piston chamber, a portion of this motive fluid will pass through the channels or conduits 43, and will therefore produce a counteracting pressure on the opposite face of the partition to that against which the main body of the motive fluid is acting. The pressure chamber is therefore made sufficient in extent to just counterbalance the pressure in the piston chamber, and it will thus be evident that the friction which would otherwise be produced, is eliminated.

The engine may also be arranged to operate under the expansive force of the steam or other motive fluid, and this it is believed will be evident by reference to Fig. 10 which is diagrammatic in its nature. It is to be kept in mind that the diagonal partition disk acts through the chambers or compartments formed between each two piston blades and divides these spaces or compartments into two portions, and that the space on either side of the partition disk between any two blades is bounded at the ends by the piston blades and at the sides by the wall of the cylinder and the inclined partition disk. The partition disk being inclined, the exposed areas of the piston blades of any space or compartment are not equal, but the leading blade has a greater exposed area than the next following blade. Further than this, the exposed portions of the blades as they rotate from the point of their smallest area increase to the point of maximum exposure, at which point exhaust begins. The inlet ports in Fig. 10 are designated respectively 50^a, 50^b, 50^c and 50^d the inlet port 50^a being located at the point where the space between the blades is contracted to its smallest size, and the final inlet port 50^b being located at the point on the cylinder where the space between the blades has attained its greatest area. The last port 50^d, Fig. 10, must be located at a distance from the exhaust equal to or a little greater than the distance between the outer edges of any two successive blades so that a blade will pass and close the last inlet port just before the next blade ahead opens the exhaust, it being obvious that if said port and exhaust were placed closer together, the exhaust would be opened before the inlet port closed, and live steam would be forced into the exhaust. When the engine revolves in the direction shown by the arrow, if live steam is admitted through all of the ports, it will be used for substantially five-eighths of a revolution from 50^a to 50^e, the latter designating the exhaust. The various ports are controlled by valves 51^a, so that the motive fluid can be shut off from any or all at will. If the port 50^d is closed, live steam would be used for one-half of a revolution from 50^a to substantially the point A, and from A to 50^e, the expansive force of the steam would be utilized. If the valves at 50^c and 50^d were closed, live steam would operate from 50^a to 50^d, and expansion from 50^d to 50^e. If valves at ports 50^b, 50^c and 50^d were closed, live steam will work from 50^a to 50^c, and expansion from 50^c to 50^e. It will thus be evident that the arrangement of ports can be considerably varied, and any suitable mechanism may be employed for operating the valves.

While we have shown four inlet ports, there might be any number of these ports between the ports 50^a and 50^d and the effect would be the same as if only one port were used located at 50^a so far as the total effective piston area is concerned, provided a plurality of blades were used, the terminal or exhaust pressure, however, would be greater where several inlet ports are used than where one is used, located at 50^a or 50^b, Fig. 10. The reason for this is that if one inlet is used, located say at 50^a, each blade after passing the port would take steam behind it and continue to do so until the next blade passed the port, which would cut off the supply of steam behind the first blade so that the steam would be thus held between the two blades. The blade ahead, however, having the greatest area, the pressure against it would more than balance the back pressure against the other blade so that the force of the steam held between the two blades would tend to produce rotation thereof. The size or volume between the two blades increases as the blades advance, thus allowing the steam to expand with a consequent fall in pressure per square inch. The relative areas would be the same until the leading blade passed the point of greatest area and begins to diminish and then when the areas of both blades are equal, the leading blade passes the exhaust and the steam from that compartment is exhausted.

Referring to Fig. 10 of the drawing, the highest point of the cylinder is the point of greatest blade area and the lowest point of the cylinder is the point of smallest area. With the engine revolving in the direction of the arrow, the inlet ports are located as shown in this diagrammatic view. Hence, in order for the engine to be reversed, it is necessary to provide two series of ports, as previously described. The inlet ports should be located on that part of the casing where the piston blade area is increasing from a minimum to a maximum. In other words, the first of the series must be at the point where the blade area has commenced to increase and the last of the series must be located at the point thereof where the blade area is largest.

The advantage of having some of the ports extend longitudinally of the circumference of the casing and others transversely thereto is a follows: Assuming that each of the elongated ports extends transversely to the circumference of the casing, they would then extend in the same direction as the outer edges of the blades. Now, if steam were worked expansively, by closing all the ports before the first port 50^a, and the engine were stopped after a full load and one of the blades came to rest after just passing the inlet port 50^a, then, when the engine was again to be started, the steam entering through the port 50^a could only act against the one blade which has passed it. The piston area exposed at this point, 50^a, would be nearly a minimum piston area, and if there were a load on the engine, it would be necessary to open a valve 51^a in order to secure a larger effective piston area. It will be evident, however, that if the first inlet port was elongated and disposed lengthwise along the circumference of the casing, steam admitted through the said port would not only be admitted behind a blade in the position just referred to, but would also pass into the space ahead of said blade and act against the next preceding blade, thus securing a larger effective piston area without the necessity of opening the valve 51^a. Another reason for using a circumferentially elongated port opening for the port 50^a is that the space between the inside face of the cylinder and partition disk is at this point necessarily narrow transversely so that it would be practically impossible in engines of small size to dispose a transversely elongated port at this point. From this it follows that the first of the inlet ports where the space between the blades is the narrowest is advantageously disposed so that its major axis is lengthwise of the circumference of the casing. The last of the inlet ports, 50^d, however, is preferably elongated transversely to the casing. For one reason because it opens at a point where the space between the cylinder and partition disk is widest, and for another reason that being transversely elongated, it will coincide with the outer edge of the blades so that the blades in passing said port will quickly cut off steam admitted therethrough just before the blade ahead passes and uncovers or opens the exhaust. The other ports lying between the first and last ports may also be elongated and disposed transversely to the casing so that thereby the blades, in passing, may quickly and completely cut off the supply of steam.

Referring again to the advantage resulting in using several inlet ports disposed around the casing, and one inlet port disposed at that portion of the casing where the blade area is the least, it may be stated that the terminal pressure would be less per square inch if only one inlet port were used than if several ports were used. If one inlet port were used, however, located at 50^d, the terminal pressure would be the same, but the effective piston area would be smaller than where several ports are used. If one port only were used and this was located at any point between 50^a and 50^d, the terminal pressure would be less per square inch, and the effective piston area less than if several ports were used, said pressure and area varying as the position of the one port was varied between the two points 50^a and 50^d.

From the foregoing, it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

The specific means for supplying the motive fluid to the engine is not claimed herein, as the same constitutes the subject-matter of a separate application subsequently to be filed.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is:—

1. In a rotary engine, the combination with an inclosing casing, of an inclined rotary partition therein dividing said casing into two parts, said partition having a radial slot therethrough at one side of the center of the partition, the opposed edges of said slot being convexly rounded in opposite directions, a piston blade carried transversely in the slot and laterally movable therethrough relatively to the partition and having its opposite faces concaved, and a packing at the slot for preventing leaking of motive fluid therethrough along the blade.

2. In a rotary engine, the combination with a casing, of an inclined rotary partition disk located in the casing and having a radial slot formed with rounded edges, a rotary piston blade carried in said slot and having a free movement therethrough, and a plurality of packing strips carried by the partition disk on each edge of said rounded slot and bearing successively against opposite sides of the blade as the disk and blade change their relative inclinations to each other.

3. In a rotary engine, the combination with a casing, of an inclined rotary partition disk located in the cylinder having a slot formed with oppositely rounded edges, a rotary piston blade carried in said slot and having a free movement therethrough, a plurality of packing strips movably mounted on the curved opposed faces of said slot and successively bearing against the opposite sides of the blade as the relative inclinations of the blade and partition disk change, and means for pressing said packing strips against the blade.

4. In a rotary engine, the combination with a casing, of a rotary partition disk located therein and having a plurality of slots therethrough, each slot having opposed convexly rounded edges, a plurality of rotary piston blades, each blade extending through one of said slots and having free movement therethrough and said blades having their opposed faces concaved, a plurality of outwardly movable packing strips located in the curved edges of each slot and arranged to bear against opposite sides of the piston blades, and means for yieldingly forcing the strips against the piston blades.

5. In a rotary engine, the combination with a casing, of a rotary partition disk therein having a radial slot provided with convexly rounded side walls, a rotary piston blade extending through said slot and freely movable therethrough, and packing for the joint between the partition disk and said blade comprising a plurality of packing elements supported on the opposed walls of the slot and contacting with the opposed faces of the blade, said packing elements successively bearing against the blade during its sliding movement through the slot of the partition disk as the relative inclination of the partition disk and blade change.

6. In a rotary engine, a casing, a shaft, a series of radial driving blades on the shaft, dividing the interior of the casing into a plurality of compartments carried rotatably

around said shaft, an oblique partition disk mounted on the shaft through which said radial blades freely pass, the said partition dividing the compartments each into two portions in each one of which exhaust and admission alternately occurs, means for alternately admitting steam behind said oblique disk, at those portions of the disk which are opposed to that compartment or space between two blades in which live motive fluid is being admitted, and for exhausting fluid from those portions of the disk opposed to that space wherein the motive fluid has been exhausted, and means for preventing the passage of the motive fluid from the same side of the partition as that on which the fluid is admitted to the opposite side.

7. In a rotary engine, a casing having a chamber formed around its circumference oblique to the axis of the casing, a shaft, a series of radial driving blades on the shaft dividing the interior of the casing into a number of compartments rotatable around the axis of said shaft, an oblique partition mounted on the shaft through which said radial driving blades have free movement and dividing each compartment between the blades into two portions in each one of which exhaust and admission of motive fluid alternately occurs, the margin of said disk projecting into said circumferential chamber, means for alternately admitting steam behind the margin of said oblique disk within said chamber at those portions of the disk margin which are opposed to that space between the two blades in which live motive fluid is being admitted and for exhausting fluid from those portions of the disk margin within said chamber opposed to that space or compartment wherein the motive fluid has been exhausted, and means for preventing the passage of the motive fluid from the chamber on one side of the margin of said disk into the space within the chamber on the opposed side of the disk margin.

8. In a rotary engine, a casing having a chamber surrounding the circumference of the same, said chamber being in a plane oblique to the axis of the casing, a shaft concentric to the casing, a series of radial driving blades on the shaft, dividing the interior of the casing into a plurality of compartments movable around the axis of the shaft, an oblique partition disk mounted on the shaft through which said blades have free movement and dividing each compartment between each two of said blades into two portions in each one of which exhaust and admission alternately occurs, the margins of the partition disk extending into said circumferential chamber, and radial ribs on said partition disk corresponding in position with the position of the driving blades and in line therewith, the partition disk having channels or conduits extending from one side of the disk inward of said chamber to the other side of the disk and opening on the margin thereof within said chamber and between said ribs, and means for admitting motive fluid behind said blades and for exhausting the motive fluid held between the blades.

9. A rotary engine having a central shaft, a series of radial driving blades thereon, and an oscillating cut-off partition disk mounted on the shaft having radial slots through which said blades pass, a casing surrounding said blades having a circumferential oblique counter-pressure chamber in which the margin of the cut-off disk is received and moves, the margin of the disk moving within the counter-pressure chamber being divided by radial ribs coinciding and in line with the radial driving blades, said disk being formed with passages or conduits extending from opposite faces of the main portion of the disk across each other to opposite faces of the margin of the disk within the pressure-chamber, and means for admitting motive fluid to the cylinder behind the blades and for exhausting said fluid.

10. A rotary engine having a casing provided on its circumference with a counter-pressure chamber whose plane is oblique to the axis of the casing, a shaft, a series of radial driving blades on the shaft dividing the interior of the casing into a plurality of compartments movable around the axis of the shaft, an oblique partition disk oscillatory on said shaft through which the said driving blades are free to pass, the disk thereby dividing each compartment between said blades into two portions in each one of which exhaust and admission of motive fluid alternately occurs, the margin of said disk projecting into said circumferential counter-pressure chamber, packing strips closing the circumferential entrance to said pressure chamber, and radial ribs formed on the margin of said partition disk, each coincident and in line with one of said driving blades, said disk being provided with channels or conduits crossing each other and opening on opposed sides of the main portion of the disk and opposed faces of the margin of the disk within said counter-pressure chamber.

11. A rotary engine having a central shaft, a series of radial driving blades on the shaft, and an oscillating cut-off partition disk having slots through which said blades freely pass, a casing surrounding the blades and forming the cylinder of the casing, said casing having on its circumference a counter-pressure chamber oblique in plane to the axis of the shaft in which the margin of the cut-off disk is received and through which it moves, radial ribs formed on the

opposed faces of the margin of said disk in line with the radial driving blades, said disk having passages or conduits crossing each other extending from one face of the main portion of the disk to the opposed face of the margin of the disk within said counter-pressure chamber and between the radial ribs on the margin of the disk, the opposed faces of the counterpressure chamber being provided with radial abutments bearing against the opposed faces of the disk margin and adapted to be forced outward by the said ribs in their passage.

12. In a rotary engine, a central shaft, a series of radial driving blades on the shaft, an oscillating cut off disk mounted on the shaft having slots through which the blades pass, a casing surrounding the blades and forming the cylinder of the engine provided with a circumferential counter-pressure chamber connected by a circumferential slot with the interior of the cylinder, the plane of said pressure chamber being oblique to the axis of the shaft and the said chamber being adapted to receive the margin of the oscillating cut-off disk, packing on either side of the entrance slot to the counter-pressure chamber contacting with opposed faces of the disk, radial ribs on the opposed faces of the margins of the disk within the chamber, said disk having passages formed in the body thereof crossing each other from opposed faces of the main portion of the disk and extending to the opposed faces of the margin of the disk within the counter-pressure chamber between said ribs, radial abutments formed in the walls of the counter-pressure chamber, and springs behind said abutments adapted to force the same outward against the opposed faces of the margins of the disk and into engagement with the radial ribs.

13. In a rotary engine, a central shaft, a series of radial driving blades on the shaft, an oscillating cut off disk mounted on the shaft having slots through which the blades pass, a casing surrounding the blades and forming the cylinder of the engine provided with a circumferential counter-pressure chamber connected by a circumferential slot with the interior of the cylinder, the plane of said pressure-chamber being oblique to the axis of the shaft and the said chamber being adapted to receive the margin of the oscillating cut-off disk, packing on either side of the entrance slot and the counter-pressure chamber contacting with opposed faces of the disk, radial ribs on the opposed faces of the margins of the disk within the chamber, said disk having passages formed in the body thereof crossing each other from opposed faces of the main portion of the disk and extending to the opposed faces of the margin of the disk within the counterpressure chamber between said ribs, yielding abutments having beveled side faces, and elastic means for forcing said abutments outward into contact with the opposed faces of the margin of the disk, said ribs being formed with beveled side edges adapted to engage with the beveled sides of the abutments in their passage.

In testimony, that we claim the foregoing as our own, we have hereto affixed our signatures in the presence of two witnesses.

EDWIN ERICKSON.
THEODORE ERICKSON.

Witnesses:
ALBIN ERICKSON,
A. E. GRIFFIN.