993,399.

O. P. OSTERGREN.

ROTARY IMPACT ENGINE.

APPLICATION FILED SEPT. 27, 1909.

Patented May 30, 1911.

4 SHEETS—SHEET 1.

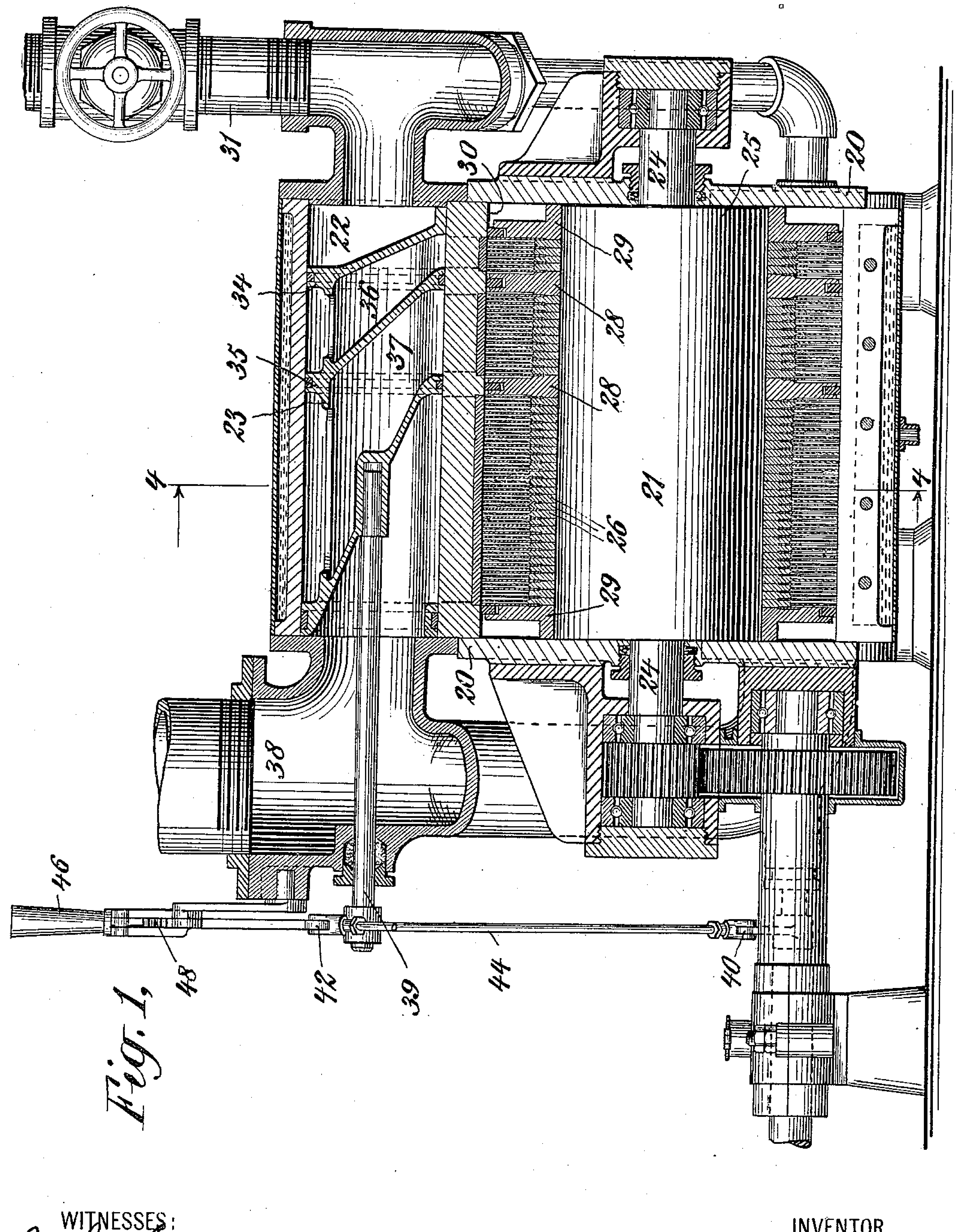

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 2.

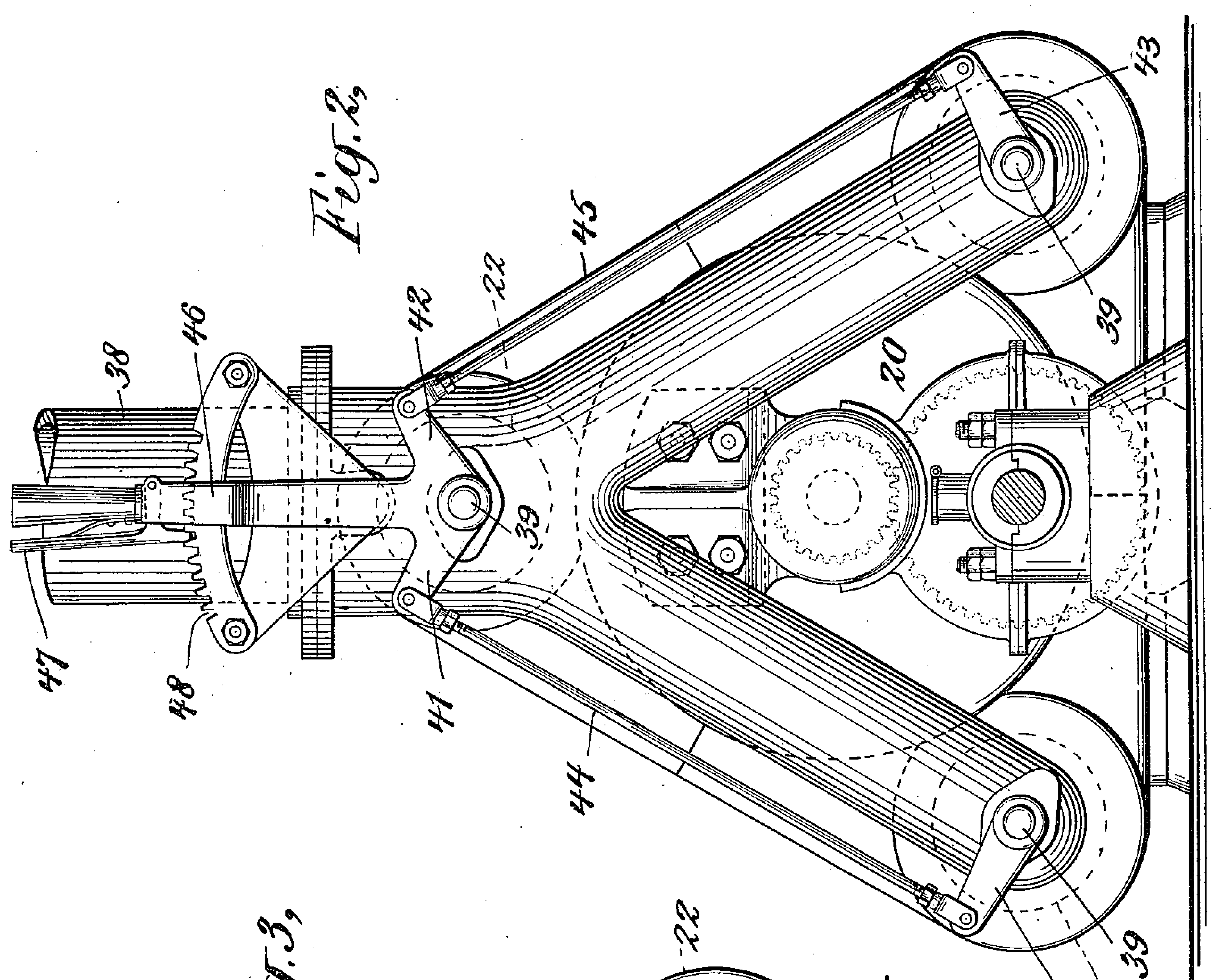
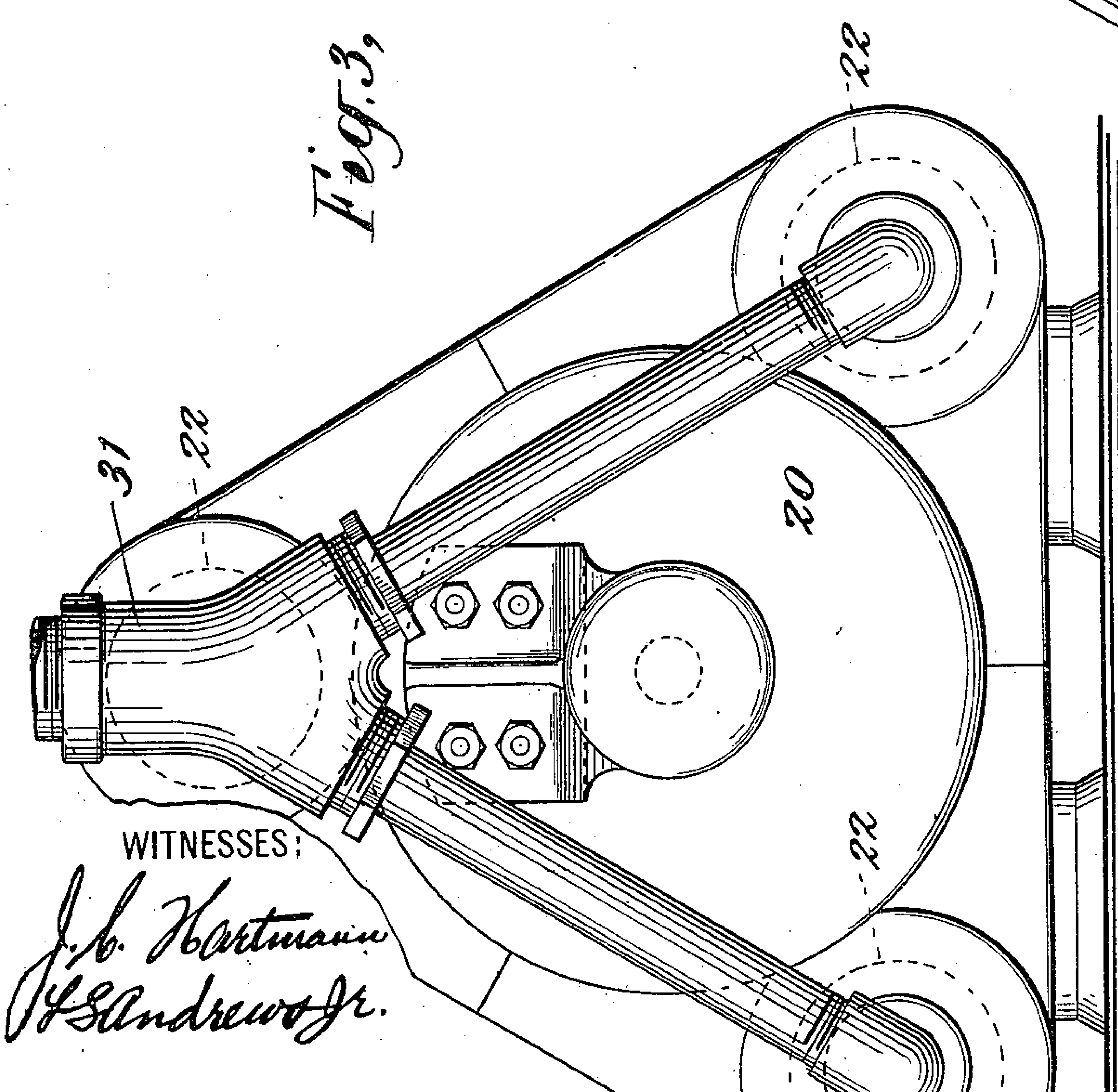


Fig. 3.



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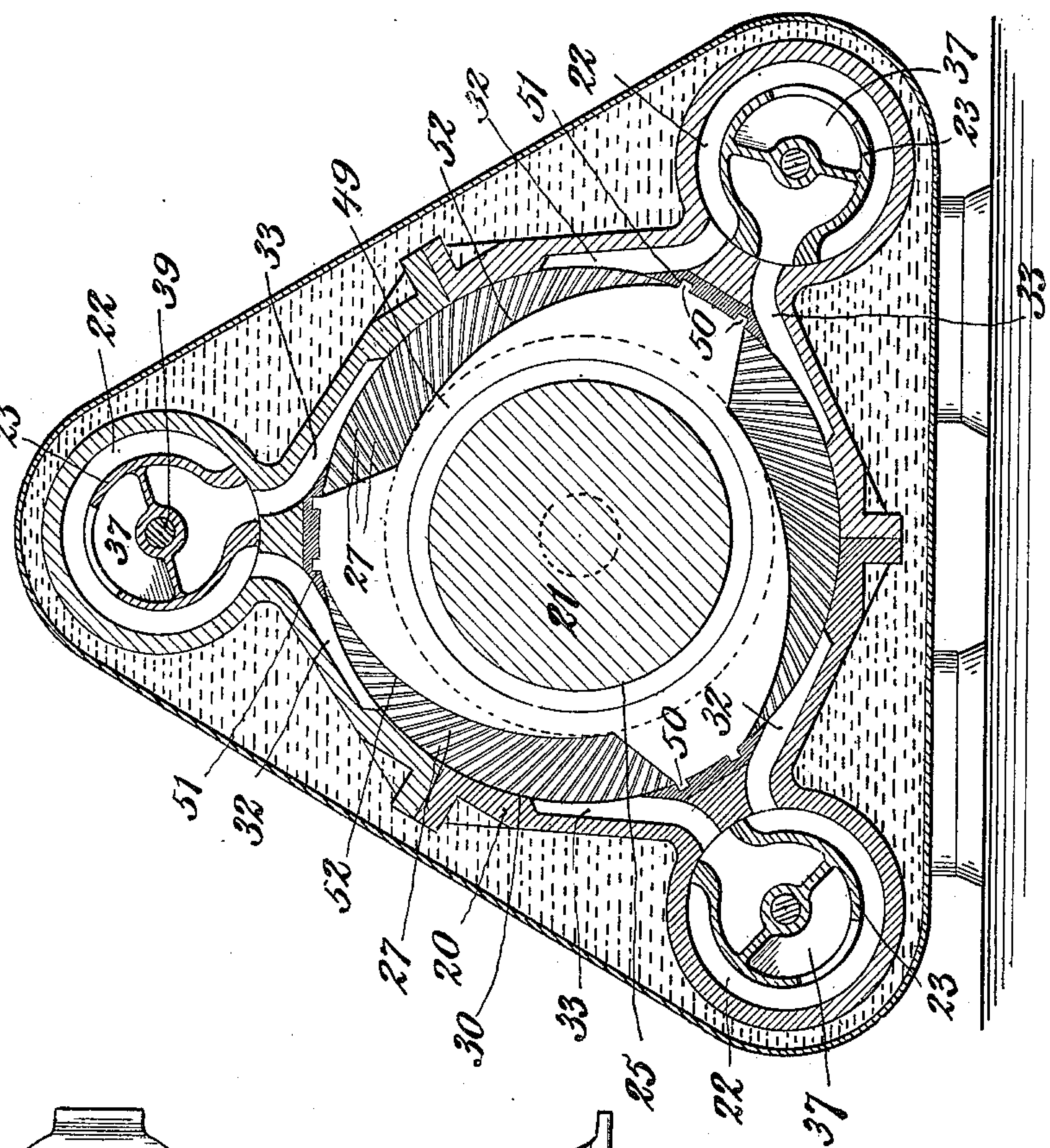

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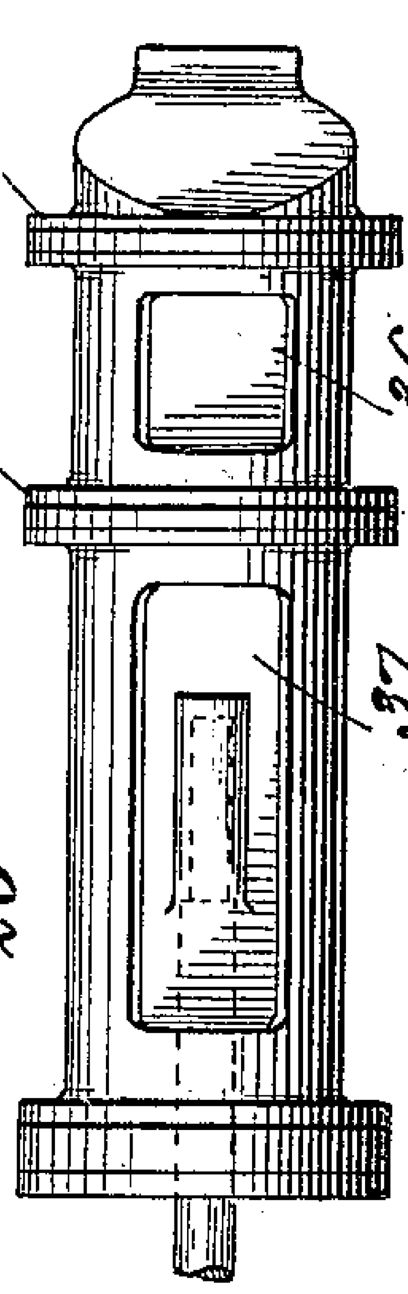

Fig. 5.

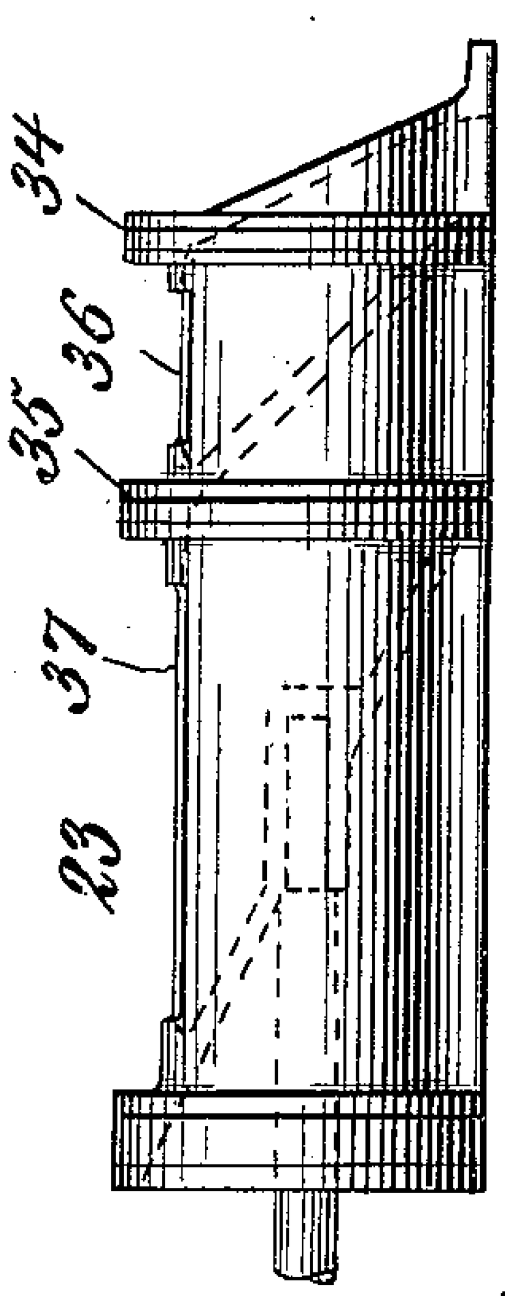

Fig. 6.

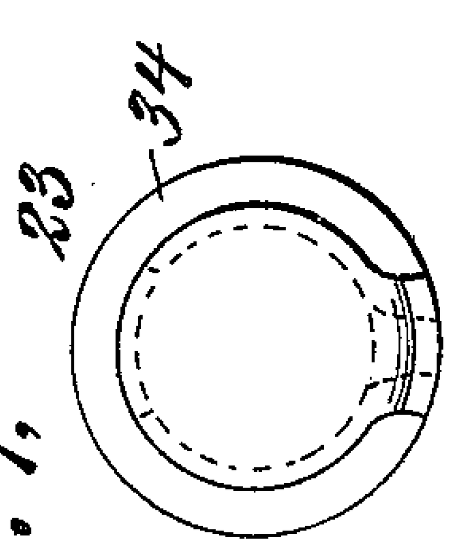

Fig. 7.

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ROTARY IMPACT ENGINE.

APPLICATION FILED SEPT. 27, 1909.

993,399. Patented May 30, 1911.

4 SHEETS—SHEET 4.

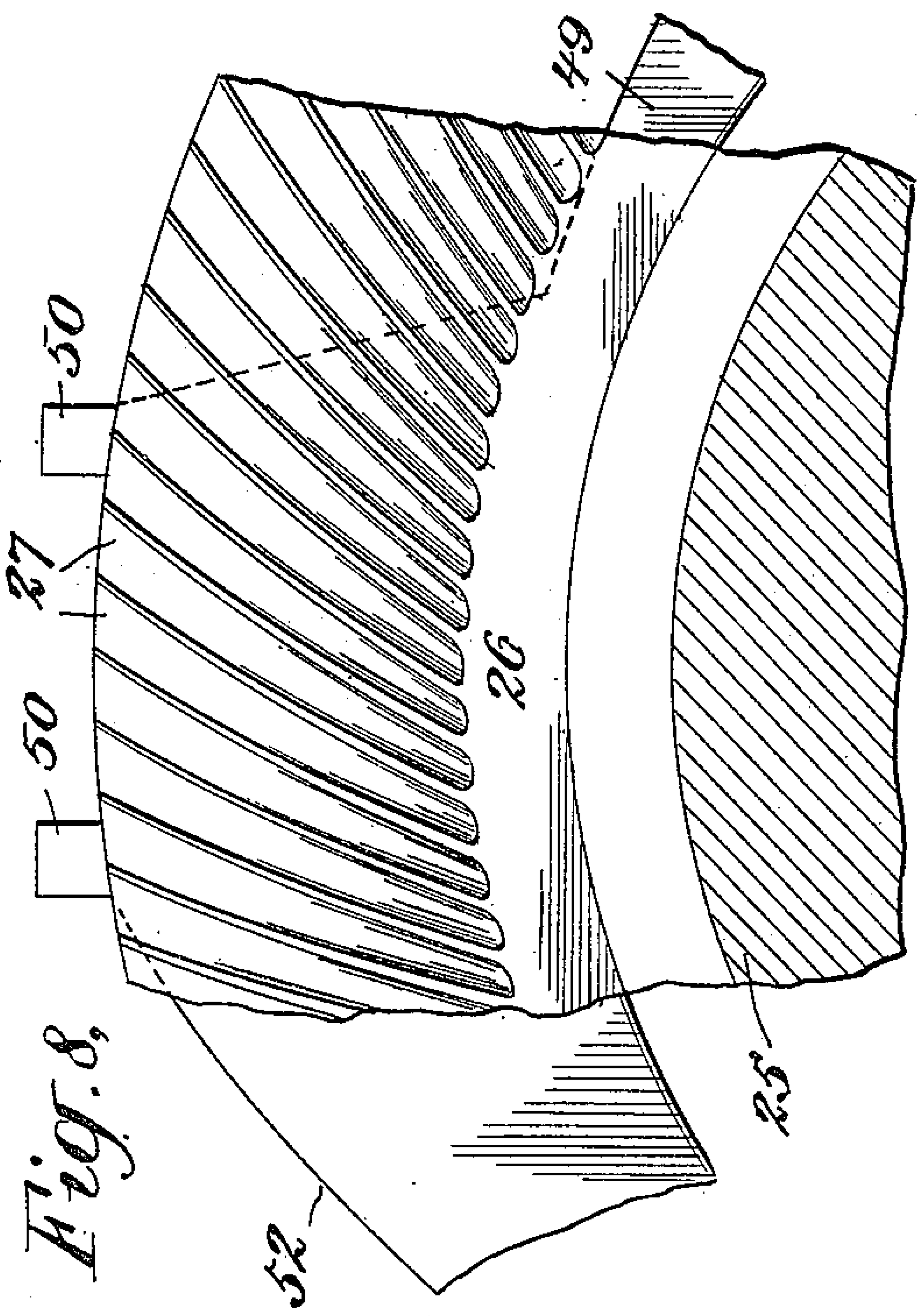

Fig. 8.

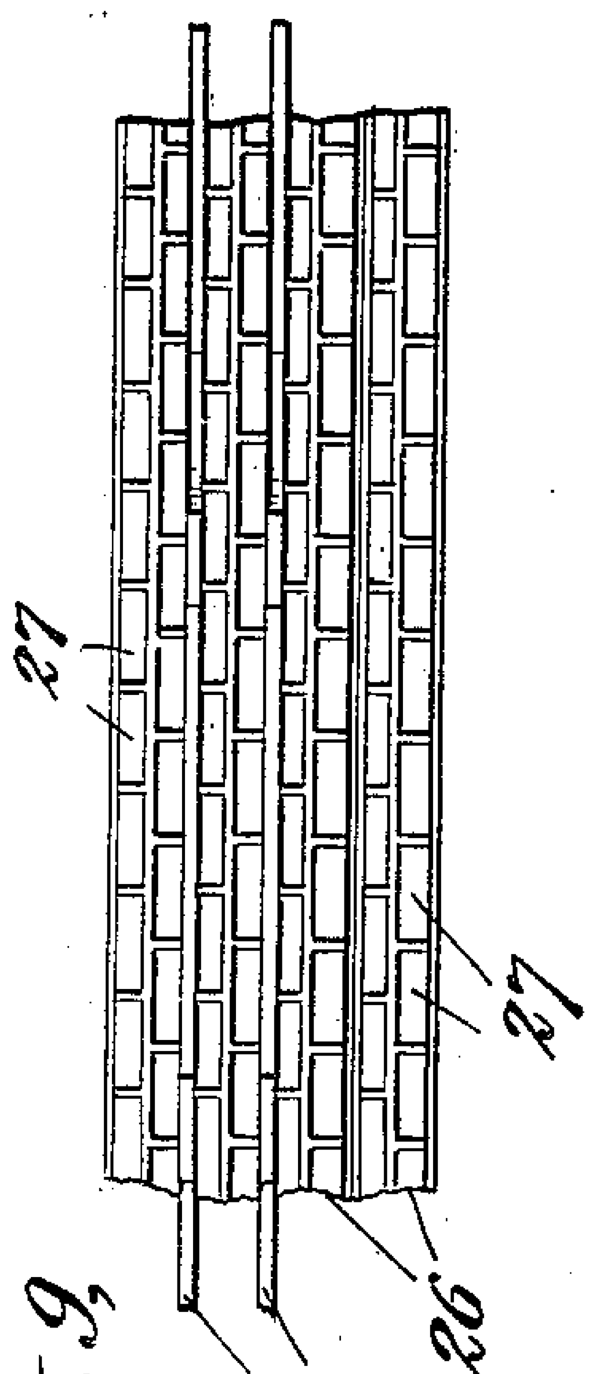

Fig. 9.

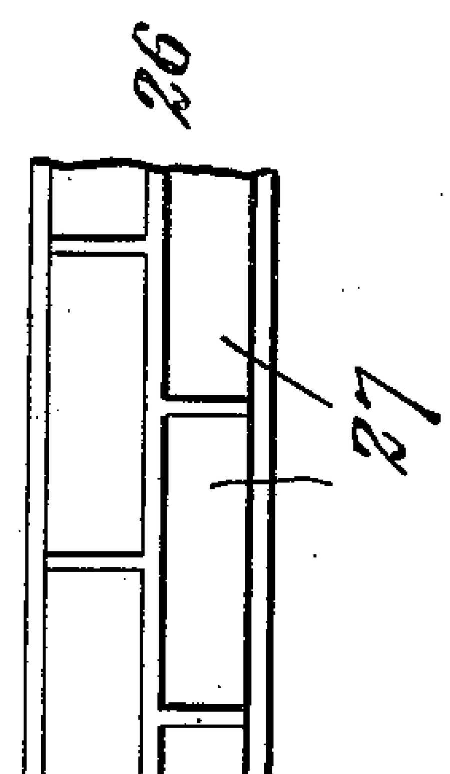

Fig. 10.

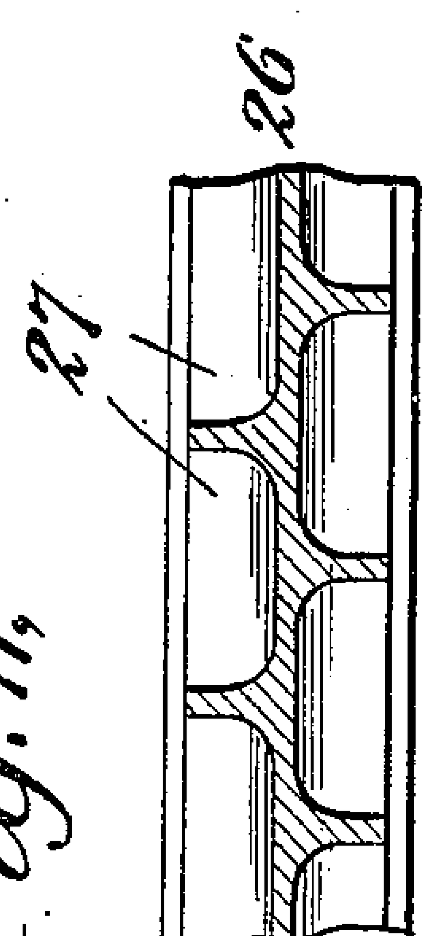

Fig. 11.

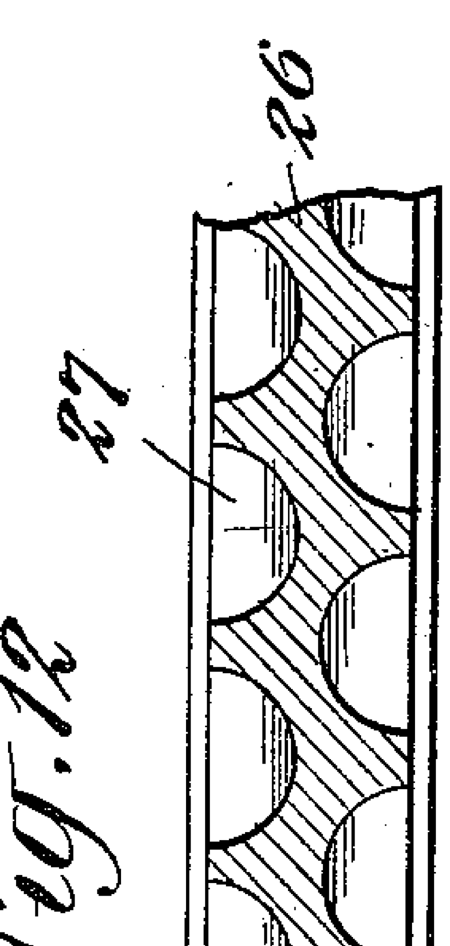

Fig. 12.

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UNITED STATES PATENT OFFICE.

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ROTARY IMPACT-ENGINE.

993,399. Specification of Letters Patent. Patented May 30, 1911.

Application filed September 27, 1909. Serial No. 519,711.

To all whom it may concern:

Be it known that I, OSCAR P. OSTERGREN, formerly a subject of the Crown of Sweden, having announced my intention to become a citizen of the United States of America, and a resident of the city of New York, in the borough of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Rotary Impact-Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to improvements in rotary impact engines of the turbine type and consists, first, in an improved form and construction therein whereby the channel for motive fluid through the rotor is formed of a progressively increasing cross-sectional area; second, in an improved form, construction and arrangement of reversing and cross-over valve employed for use in a compound reversing engine of this type, and third, in an improved form and construction of the rotor member and its parts.

My invention also consists in many novel features of construction and combinations of parts such as will be pointed out hereinafter, and in order that my invention may be fully understood, I will now proceed to describe an embodiment thereof, having reference to the accompanying drawings illustrating the same, and will then point out the novel features in claims.

In the drawings: Figure 1 is a view in central longitudinal section through a turbine engine constructed in accordance with my invention. Fig. 2 is an end view thereof looking toward the exhaust end of the engine. Fig. 3 is an opposite end view thereof looking toward the inlet end. Fig. 4 is a view in vertical transverse section through the engine, the plane of section being taken substantially upon the line 4—4 of Fig. 1. Figs. 5, 6 and 7 are detail views of one of the reversing valves employed. Fig. 8 is an enlarged detail view in side elevation of a portion of one of the rotor members, and of a separating plate employed in connection therewith. Fig. 9 is a similarly enlarged detail top view of portions of several of the rotor members, and of the separating plates employed in connection therewith. Figs. 10, 11 and 12 are further enlarged views respectively in end elevation and transverse section through one of the rotor members showing particularly the shape of the buckets of the rotor members.

The engine comprises, in general, a stationary casing or cylinder 20 and a rotor or piston 21 mounted therein. The casing is provided with a plurality of valve chambers 22, equidistantly disposed around the same and a reversing valve 23 is mounted in each casing. The rotor is provided with trunnions 24 which are suitably journaled in the casing and with a concentric cylindrical hub 25. A plurality of disks 26 having peripheral buckets 27 are mounted upon the said hub, the said disks being divided into three groups by means of spacing rings 28 and pressed together at the ends by means of end heads 29. The disks, end heads, and spacing pieces are all secured fast upon the hub, all of the said parts constituting a rotor, as a whole. The peripheries of the disk portions 26 of the rotor are fitted to a cylindrical bore 30 in the casing, and the spacing pieces and end heads are conveniently provided with peripheral packing rings in order to maintain steam tight joints. The spacing pieces 28 divide the disks into three successively larger groups, the three groups representing, respectively, a high pressure element, an intermediate pressure element, and a low pressure element whereby the motive fluid operates expansively from one element to the other, the engine constituting a compound multi-stage engine.

The casing is provided with inlet passages 32 which lead from each of the valve chambers 22 to the interior bore 30 connecting with each of the three rotor elements, there being nine of such inlet passages in the embodiment of my invention shown, three from each of the valve chambers 22 and three sets of exhaust passages 33 are similarly provided, one set of three for each of the valve chambers 22. As will presently be shown, the passages 32 and 33 may be employed alternatively as inlet and exhaust passages, but the passages 32 are normally the inlet passages and the passages 33 are normally the exhaust passages, that is to say, the passages 32 and 33 are respectively the inlet and exhaust passages when the engine is running forward. The question as to which of the passages are employed as inlet passages and which are employed as exhaust passages, is determined by the position of the valves 23. Each of these valves is provided with ring-like portions 34 and 35 which divide the steam chambers into three compartments corresponding to the high, intermediate and low pressure elements of the rotor, and each of the said valves is also provided with diagonal heads which provide cross-over passages 36—37 through the valves, the former of which connect the exhaust passages of the high pressure exhaust passage with the intermediate steam chamber compartments, and the latter of which connect the intermediate pressure exhaust passages with the low pressure steam chamber compartments. Live steam is admitted to the high pressure compartments of the steam chambers 22 through a main steam valve 31 and branches therefrom, and an exhaust pipe 38 connects through its branches with the low pressure exhaust passages 33. The passage of the steam as it passes through the engine is as follows: The high pressure steam passing through the inlet pipe 31 and its branches enters the high pressure compartments of each of the three valve chambers 22, thence it passes through the high pressure inlet passages 32 to the buckets of the high pressure group of the disks 26 of the rotor, thence to the high pressure exhaust passages 33 connecting with the steam chambers in advance of those in which the high pressure steam was admitted. Thence the steam passes through the cross-over passages 36 in the valves 23 to the intermediate compartments of the steam chambers 22, thence around the valves to the intermediate pressure inlet passages 32, thence to the buckets of the intermediate group of the rotor disks, thence through the intermediate pressure exhaust passages 33 leading to the steam chambers 22 next in advance, thence through the cross-over passages 37 in the valves 23 to the low pressure compartment of the steam chambers 22, thence around the valves to the low pressure inlet passages 32 to the buckets of the low pressure group of disks of the rotor, and thence through the low pressure discharge passages 33 through the rear ends of the steam chambers 22 into which the high pressure steam was first admitted, out through the several branches to the exhaust pipe 38. The valves 23 are provided with stems 39 which extend through stuffing boxes in the said exhaust pipe branches, the ends of the stems carrying arm 40—41—42—43 which are connected together by links 44—45, and the stem of one of the valves is provided with a hand operating lever 46. The said lever carries a rocking dog 47 adapted for engagement with the teeth of a quadrant 48. By manipulation of the lever 47, movements of rotation may be imparted simultaneously to all of the valves so as to partially or wholly close the passage of motive fluid whereby to regulate the speed of the engine or the position of the said valves may be reversed so as to cause the cross-over passages 36—37 to register with the passages 32 instead of with the passages 33. In such a case, the steam chamber compartments will register with the passages 33, and the passages 33 will thereby become the inlet passages, and the passages 32, the exhaust passages. From the foregoing, it will follow that by manipulation of the hand lever 46, the engine may be completely controlled as to speed and may be reversed at will.

I will now proceed to describe the manner in which the steam acts upon the rotor.

Referring to Figs. 8, 9, 10, 11 and 12, the bucket forming recesses 27 of the rotor members or disks 26 are formed reëntrantly from the opposite faces thereof, the buckets of adjacent disks being in staggered relation with each other, thereby leaving a tortuous path for the steam. In the plane of the rotation of the wheel, these buckets are formed substantially tangent to a circle about one-half the diameter of the wheel, and the general direction thereof is preferably slightly curved. At their upper ends, the walls are preferably as thin as possible, while the walls may be conveniently thickened at the lower end for the purpose of lending strength to the structure. The disks are reduced in thickness at the parts wherein the bucket forming recesses are located, and between each pair of disks is an abutment 49, of annular spider-like form, the said abutments being maintained against rotation by means of projections or keys 50 from the periphery thereof which engage keyways 51 in the walls of the cylindrical bore 30. The keyways 51 preferably run continuously along the walls of the bore 30 so that the said abutments will be free to move longitudinally with respect to the axis of rotation of the rotor whereby any tendency to cramping of the parts will be obviated, and friction between the abutments and the faces of the disks will be largely reduced. The arms of the said abutments are preferably formed with their outer surfaces 52 gradually diminishing in diameter from the beginning to the end thereof, the portion of the greatest diameter being located in proximity to the inlet passages 32. This closes up a gradual decreasing portion of the spaces between the disks, and hence forms a chamber or passage for incoming steam of a constantly increasing cross-sectional area. From this it follows that the incoming steam admitted from the inlet passages 32 will, in passing through the rotor to the discharge or exhaust passages 33, be permitted to expand so that its velocity will be progressively increasing as is desirable in this form of engine. It will be understood that the buckets or recesses in the rotor members, and the spaces between them, form together a passage for the steam, but that the laterally extending walls of the buckets constitute a series of impediments to the passage of the steam whereby the continued impact of the steam upon these impediments will have a powerful rotative effect upon the rotor. The distance between the inlet and the discharge passages by which the distance of travel of the steam is determined is designed to be such as to give the maximum efficiency, that is to say, that the steam is not permitted to exhaust until it has expended all the force possible upon the portion of the rotor presented thereto, but that immediately it has expended such force it is promptly exhausted to be carried over to a lower pressure chamber wherein it is expanded into a chamber of larger cross-sectional area. From this it follows that to obtain a maximum efficiency the number of points at which the steam is admitted around the rotor must be governed entirely by the diameter of the rotor and the size of the same spaces or channel therethrough. The steam may hence be admitted at one point only, or at any desired number of points around the rotor. In the present instance I have shown three such points of admission but it must be distinctly understood that the number may be varied at pleasure. It will also be noted that I have shown three stages, wherein the steam is re-admitted expansively twice after it has been exhausted from the high pressure chamber. Again it must be understood that any number of stages may be employed at will, such merely being a question of design, and it will also be noted that the number of points of admission around the rotor, and hence the number of reversing valves employed, has no relation to the number of times the steam is used expansively in various chambers, the selection of three points of admission, and three chambers being purely arbitrary, and being dependent in no way upon each other.

What I claim is:

1. An engine of the turbine type comprising a rotor provided with an annular channel, and a casing provided with an abutment extending within the said channel, the said abutment occupying a progressively smaller portion of the cross-sectional area of the said channel in the direction of rotation of the said rotor.

2. An engine of the turbine type including a rotor comprising a plurality of disks having annular channels between them, a stationary casing, and abutments secured against rotation to the channel, the said abutments entering the said channels and occupying a progressively smaller portion thereof in the direction of rotation of the said rotor.

3. In an engine of the turbine type the combination with a rotor comprising a plurality of disks whose adjacent faces are recessed to form buckets, and are spaced apart contiguous to said bucket forming recesses, to form annular channels, of a casing within which the said rotor is mounted, and abutments secured against rotation to the said casing, the said abutments occupying progressively smaller portions of the channels in the direction of rotation of the said rotor.

4. In an engine of the turbine type the combination with a casing, of a rotor having an annular channel therein, and an abutment in the said channel, the said casing having a longitudinal keyway, and the said abutment provided with a projection fitted to the said keyway whereby the said abutment is secured against rotative movement but is permitted longitudinal movement in the said casing.

5. In an engine of the turbine type the combination with a casing, of a rotor having an annular channel therein for the passage of motive fluid, a ring mounted in the said channel, and means securing the said ring against rotative movement but permitting relative longitudinal movement thereof with respect to the casing.

6. In an engine of the turbine type the combination with a casing, of a rotor comprising a plurality of disks having inlet channels between them, and rings mounted in the said channel, the said rings being secured against rotative movement in the casing but permitted longitudinal movement with respect thereto.

7. In an engine of the turbine type the combination with a casing having a plurality of motive fluid inlets around the same, of a rotor comprising a plurality of disks having inlet channels between them, and rings secured against rotation within the said channels, the said rings having spider arms constituting abutments to progressively close the channel in a direction toward the said inlet passages, and opposite to the direction of rotation of the rotor.

8. In a multi-stage engine of the turbine type, the combination with a cylindrical valve chamber, and inlet and exhaust passages connecting therewith, of a rotary valve fitted to the said valve chamber, the said valve having a hollow cylindrical body portion, a plurality of exterior flanges, diagonal partitions, and diagonally opposite openings to the interior thereof.

9. In a multi-stage engine of the turbine type, the combination with a casing having a cylindrical valve chamber and inlet and exhaust passages connecting therewith, of a rotary valve fitted to the said valve chamber, the said valve provided with a plurality of annular inlet channels around the same, and with a plurality of diagonal exhaust channels through the same.

10. In an engine of the turbine type the combination with a casing, of a rotor comprising a plurality of disks, the contiguous faces of which are recessed to form buckets which stand in staggered relation to each other in the adjacent disks, the said buckets being substantially rectangular at the periphery of the disks, the walls converging into curves as the buckets recede from the periphery.

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