N. H. MOTSINGER.

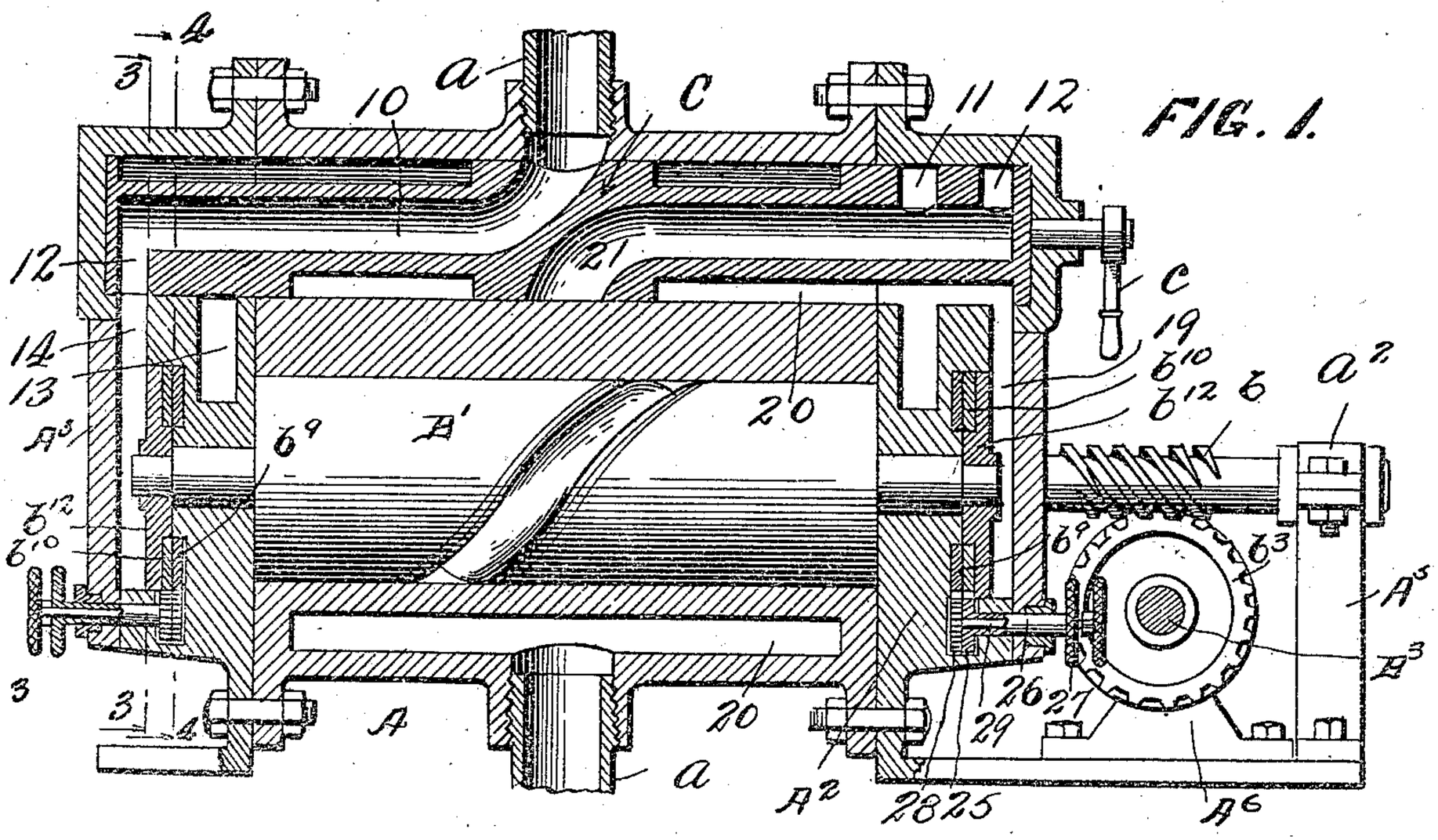
ROTARY ENGINE.

APPLICATION FILED JULY 12, 1907. RENEWED DEC. 20, 1909.

960,994. Patented June 7, 1910.

5 SHEETS—SHEET 1.

FIG. 1.



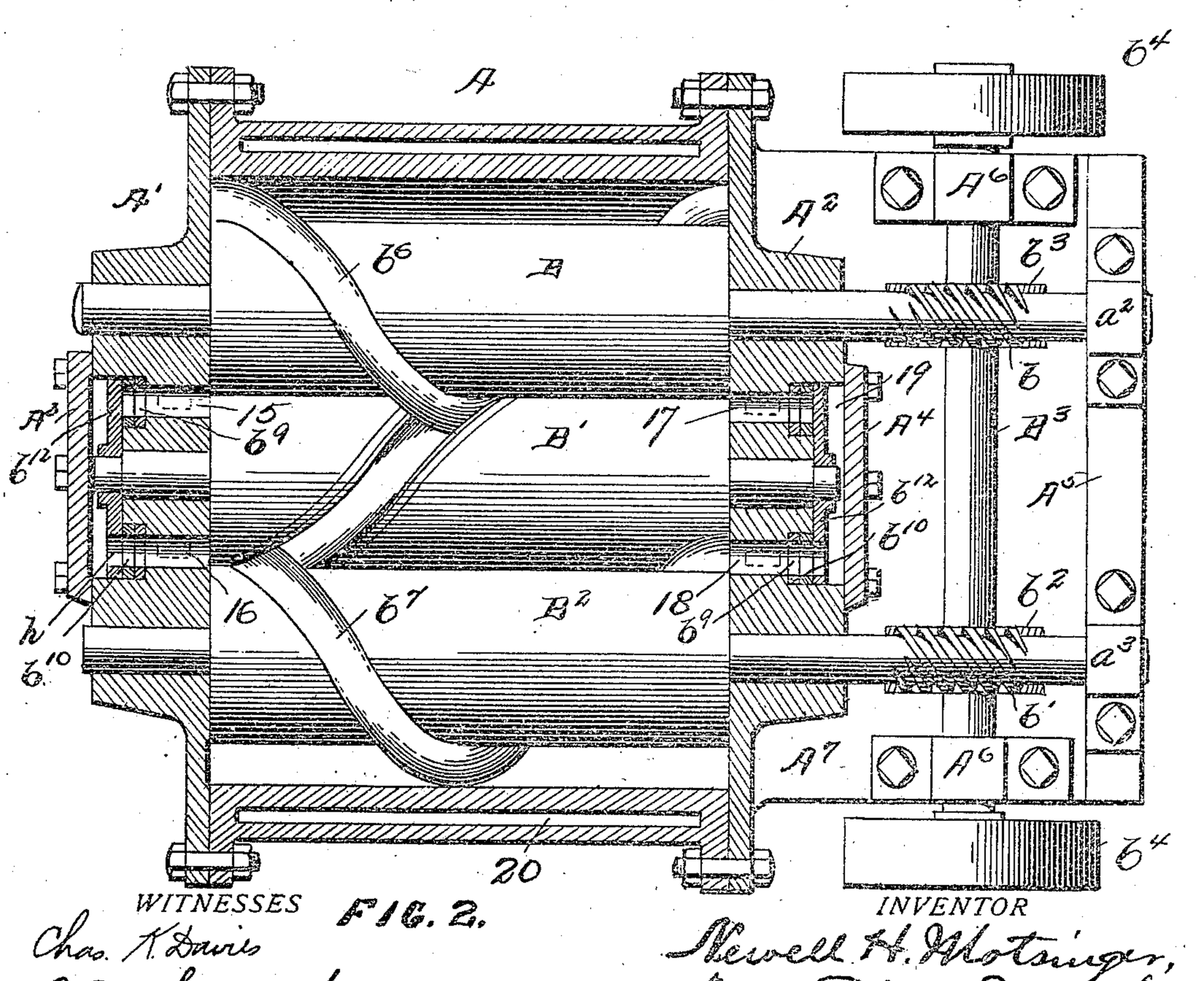


FIG. 2.

WITNESSES

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5 SHEETS—SHEET 2.

FIG. 3.

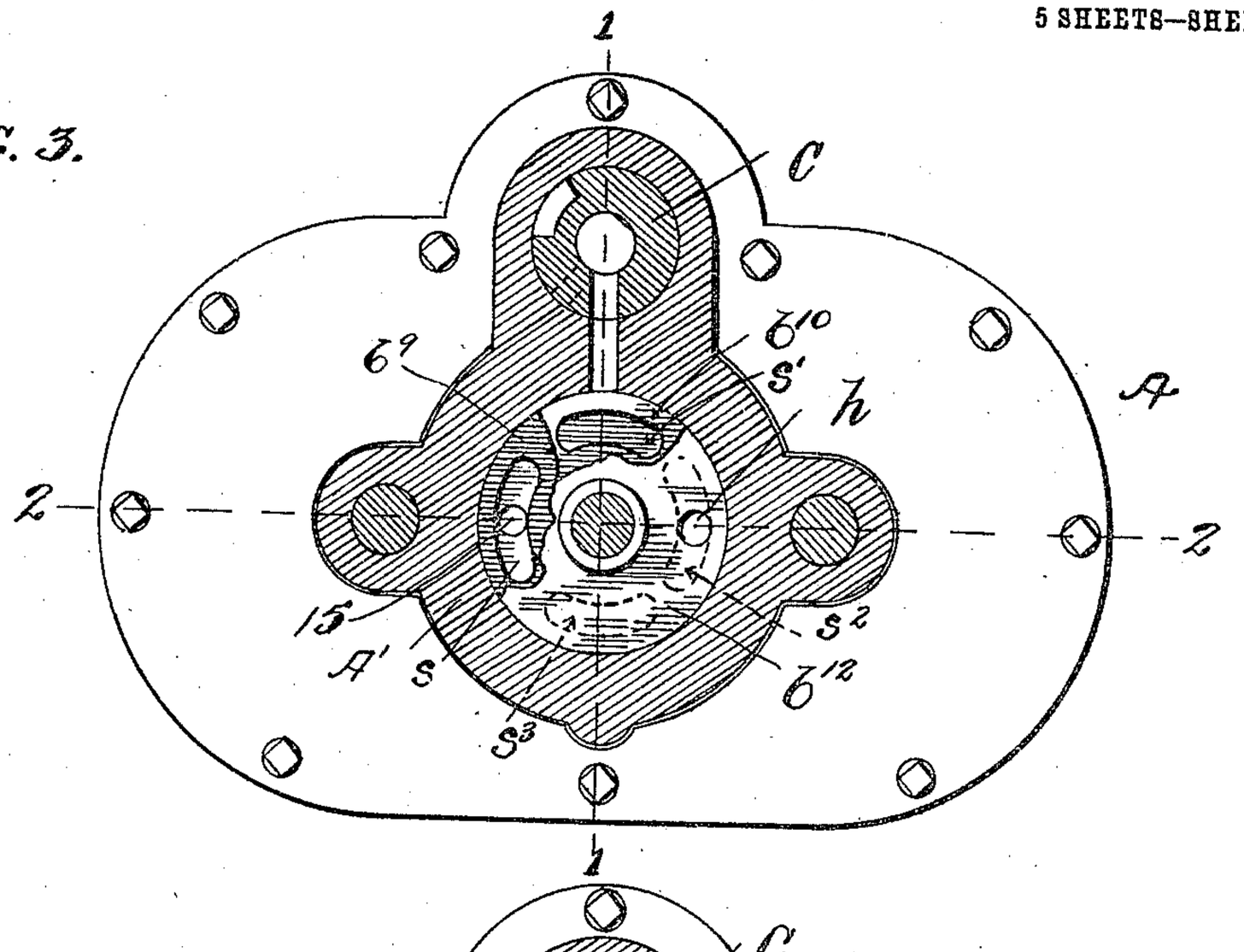


FIG. 4.

FIG. 5.

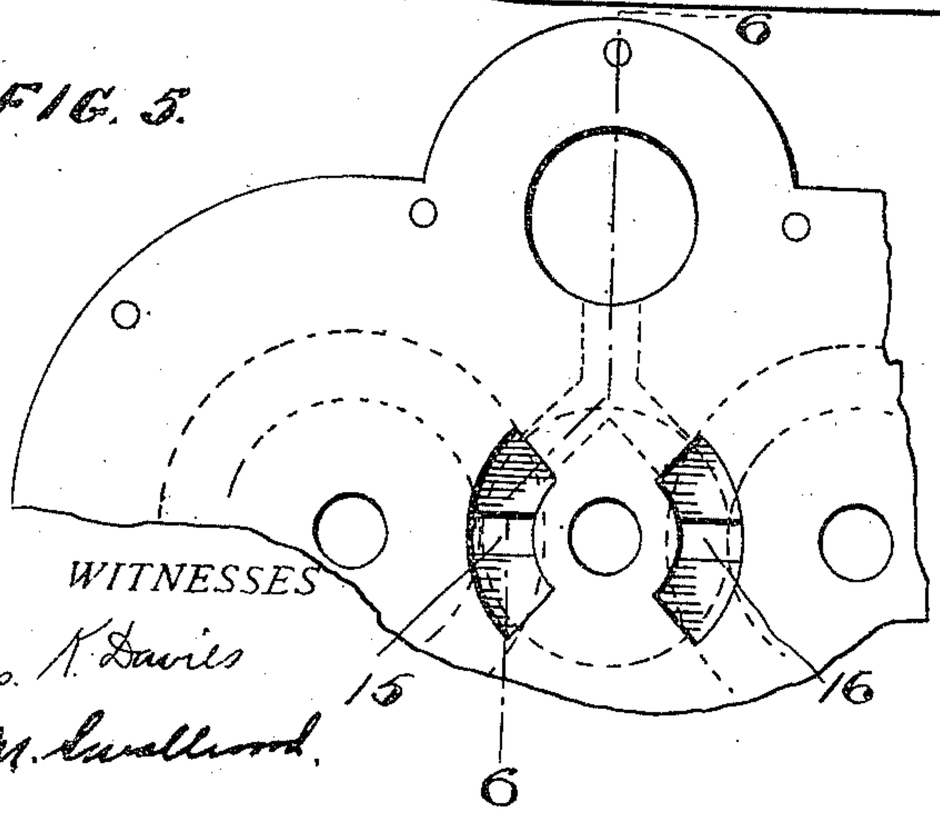
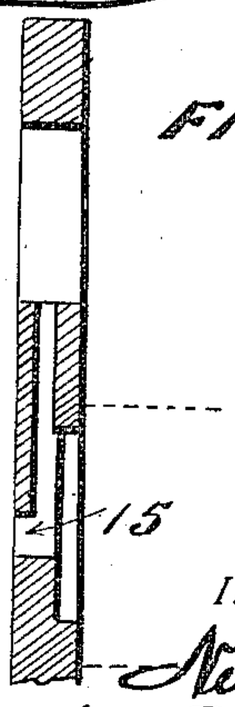


FIG. 6.



WITNESSES

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5 SHEETS—SHEET 3.

FIG. 10.

FIG. 11.

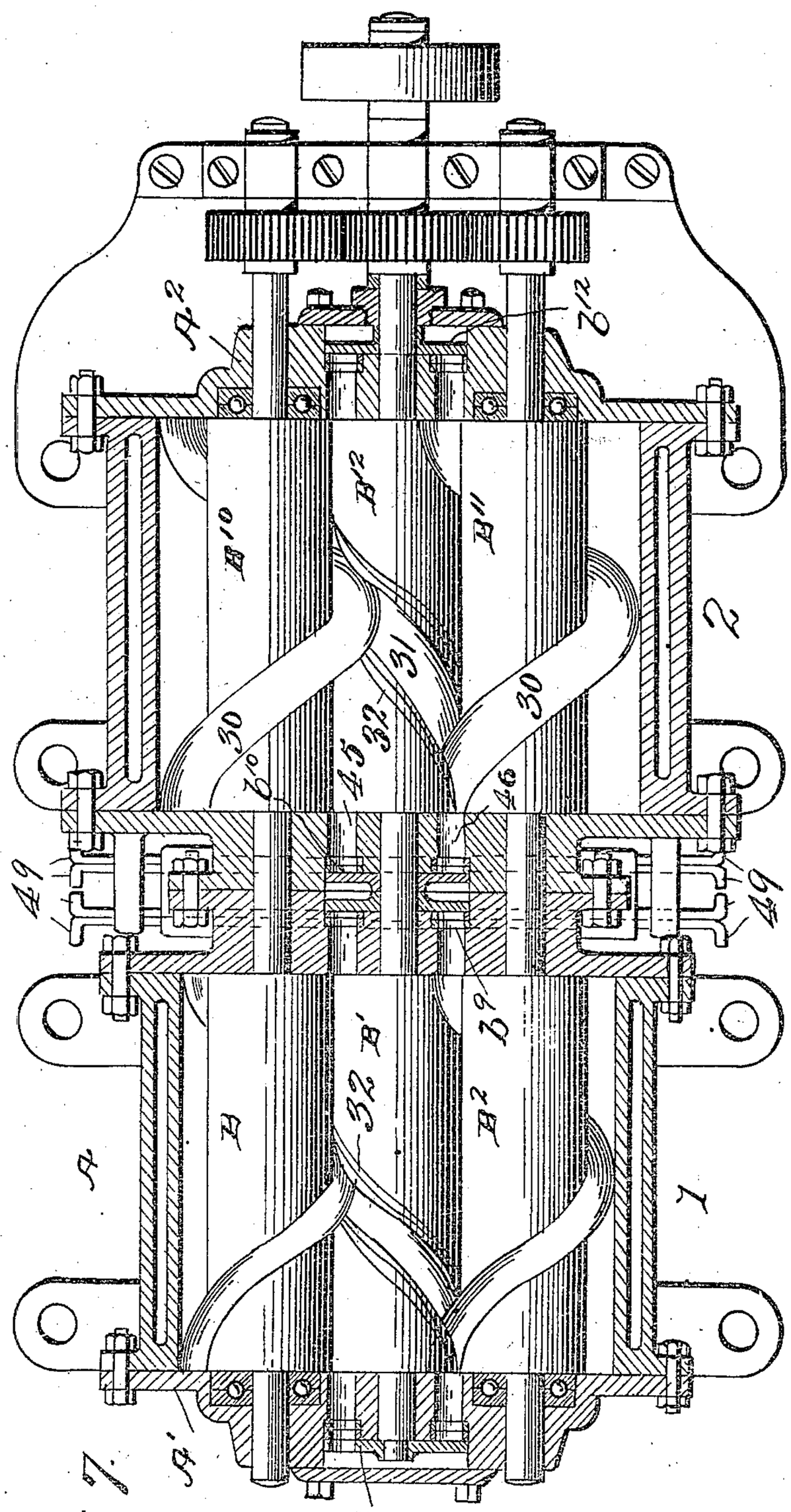

FIG. 7.

WITNESSES

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5 SHEETS—SHEET 4.

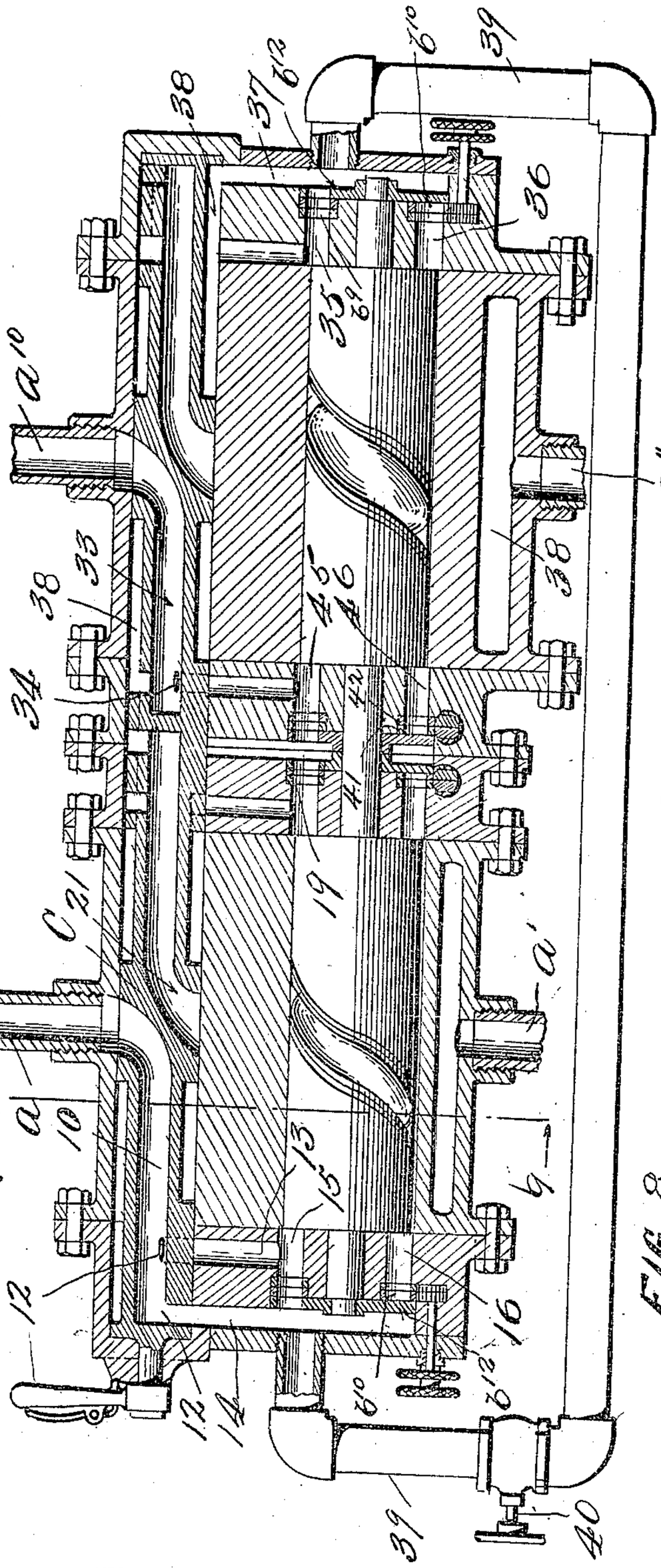

FIG. 8.

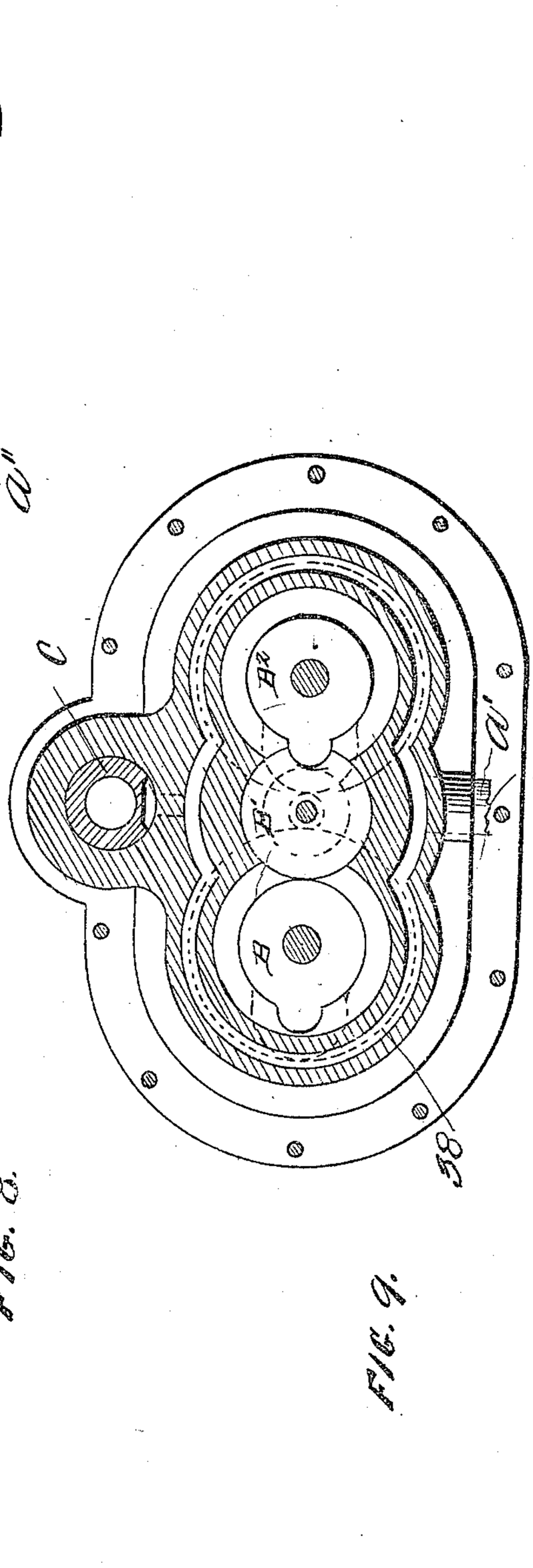

FIG. 9.

WITNESSES

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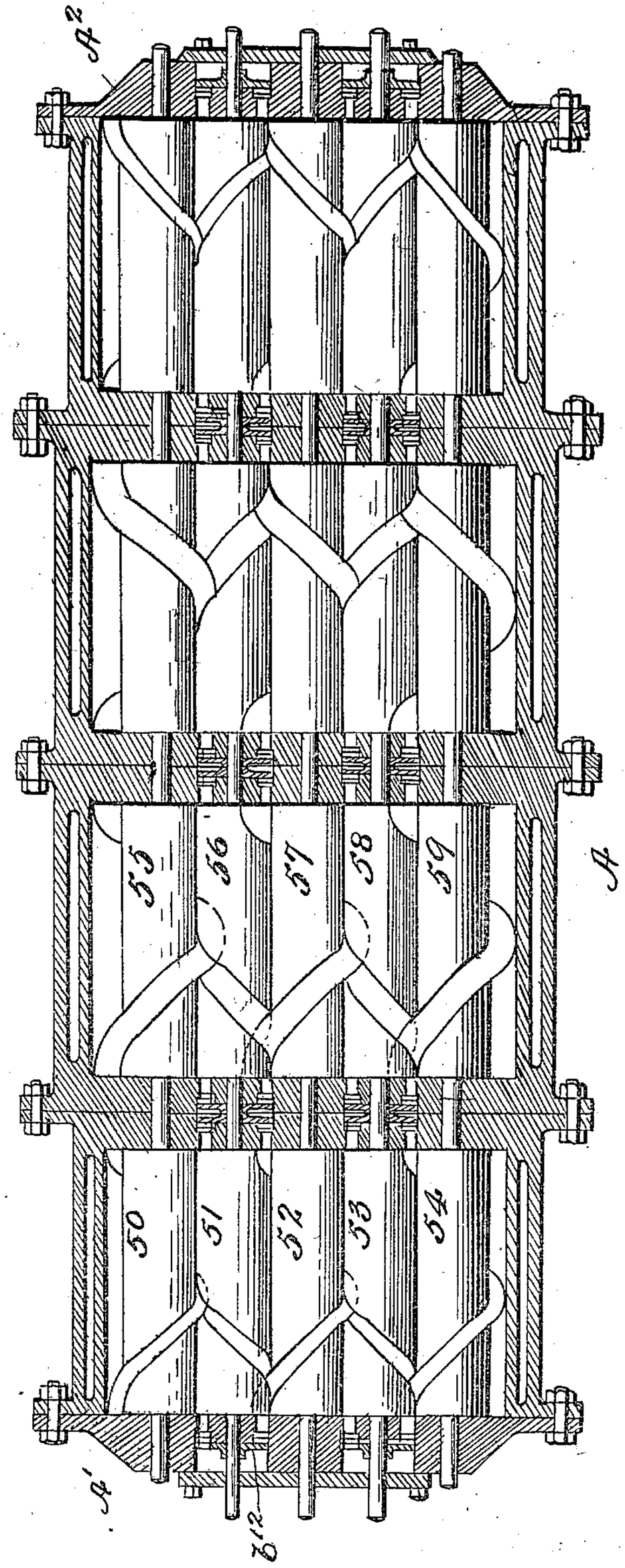
5 SHEETS—SHEET 5.

FIG. 12.



WITNESSES

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UNITED STATES PATENT OFFICE.

NEWELL H. MOTSINGER, OF GREENSBURG, PENNSYLVANIA.

ROTARY ENGINE.

960,994. Specification of Letters Patent. **Patented June 7, 1910.**

Application filed July 12, 1907, Serial No. 383,492. Renewed December 20, 1909. Serial No. 534,173.

To all whom it may concern:

Be it known that I, NEWELL H. MOTSINGER, a citizen of the United States, residing at Greensburg, in the county of Westmoreland and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My said invention consists in an improved construction of rotary engine whereby an evenly balanced structure is provided and one capable of being conveniently multiplied and of generating the maximum power with the steam pressure employed, all as will be hereinafter more fully described and claimed.

Referring to the accompanying drawings which are made a part hereof and on which similar reference characters indicate similar parts: Figure 1 is a central vertical section through a rotary engine of my improved construction on the dotted line 1—1 in Fig. 3, Fig. 2 a horizontal section of the same on the dotted line 2—2 in said figure, the cylinders being shown in both views in elevation, Fig. 3 a cross section looking in the direction indicated by the arrows from the dotted line 3—3 in Fig. 1, Fig. 4 a similar view looking in the direction indicated by the arrows from the dotted line 4—4 in the same figure, Fig. 5 an inside plan view of a portion of one of the heads, Fig. 6 a detail section on the dotted line 6—6 in Fig. 5, Fig. 7 a horizontal sectional view similar to Fig. 2 showing a compound engine embodying substantially the same construction and arrangement of parts, Fig. 8 a central longitudinal section thereof, Fig. 9 a cross section on the dotted line 9—9 in Fig. 8, Figs. 10 and 11 detail views of the valve operating mechanism, and Fig. 12 a horizontal view showing the parts arranged in a multiple or compound engine.

In said drawings the portions marked A represent the casing of the engine, B, B′, B^2 the several cylinders as seen in the views of the single engine, and C the reversing valve.

The casing A is a casting of suitable dimensions and substantially the form in cross section indicated by Fig. 9 and the end views 3 and 4 and is provided with heads A′ and A^2 containing bearings for the shafts and ports for the steam. A recess in the center of each head, communicating with the steam ports and providing seats for the operation of the valves for controlling said ports, is covered by plates A^3 and A^4, respectively. In the upper portion of said casing is provided the steam-chest with which the steam inlet pipe *a* communicates and the exhaust ports lead into a chamber surrounding the casing which chamber is provided with an exhaust pipe *a′* on its lower side.

The cylinders, or drums, B, B′, B^2 are each mounted upon shafts journaled in bearings in the heads A′ and A^2. The cylinders B and B^2 are each formed with spiral vanes extending around their periphery of substantially the form shown in my former Patent No. 726,969 and the cylinder B′ is located between said cylinders B and B^2 and is formed with a spiral groove of corresponding form with which said vanes engage, the vane of one cylinder following in the same groove in the cylinder B′ as the vane of the other cylinder, the two vanes being arranged so that their corresponding parts are substantially a half revolution apart in operation.

The shafts of the cylinders B and B^2 are extended through the bearings in the head A^2 and their outer ends are journaled in bearings a^2 and a^3, respectively, on supports A^5 mounted on a base A^7 connected with the head A^2. Between the bearings in the head A^2 and the bearings in the frame A^5 said shafts are formed with worms *b* and *b′*, respectively, which engage with worm gearwheels b^2 and b^3 on a transverse power shaft B^3 mounted in bearings on supports A^6 on the bed A^7 supporting the supports A^5. On each end of said shaft B^3 is mounted a pulley or gear wheel b^4 from which the power may be taken from the engine by means of a belt or other gearing to wherever it is desired to use it. The worm gear connection between the shafts of the cylinders B and B^2 and the shaft B^3 affords a longitudinal support for said cylinders against the end thrust caused by the steam pressure, as will be presently described.

The steam reversing valve C is mounted to rotate in the steam chest in the upper portion of the casing A and is formed with ports leading from opposite sides at its center toward each end to regulate the flow of steam to either end of the cylinder desired.

As shown in the drawings the port 10 communicating with the steam inlet *a* is arranged to discharge through the ports 11 and 12 into the ports 13 and 14 in the head A′ and through the ports 13 and 14 into the ports 16 and 17 leading to within the casing A at points on the opposite sides of cylinder B′ where it meets with the cylinders B and B² thus coming behind the vanes b^6 and b^7 on said cylinders and by its expansion in the chambers between said vanes and the rigid sides of the cylinder casings operating to drive said cylinders to operate the shaft B³. When the steam behind the vanes reaches the opposite end of said cylinders by following the vanes as the cylinders rotate it exhausts through the ports 17 and 18 into the port 19 in the head A² and from said port 19 into the port 20 surrounding said casing out through the exhaust pipe *a*′.

When it is desired to reverse the engine the valve C is given a half turn by means of the lever *c* to bring the port 21 into communication with the steam inlet *a* when the steam will be directed to the opposite end of the engine and pass into it through the ports in the head A² and exhaust through the ports in the head A′.

Mounted on each outer end of the shaft of the cylinder B′ is a plate b^{12} which is secured to said shaft to rotate therewith. Said plate is formed with holes, or apertures, *h* on opposite sides thereof. Underneath said plate b^{12} at each end of said cylinder are mounted two annular rings b^9 and b^{10} adapted to rotate in a suitable annular recess in the heads A′ and A² respectively. Each of said rings is formed with segmental slots *s*, *s*′, *s*², *s*³ arranged so that those of one plate may overlap those of the other and the slots in each being in line with the ports in the plates A³ and A⁴ and the heads A′ and A² respectively. Each of said rings is formed with a toothed rack on its lower edge. The toothed rack on each outer ring b^{10} engages with a pinion 25 on a sleeve 26 which is mounted in a bearing in the head and provided with a hand-wheel 27 on its outer end by which it may be turned to turn said ring as desired. The toothed rack on the lower edge of each of the inner rings b^9 engages with a pinion 28 on a shaft 29 which extends through the sleeve 26 and has a hand-wheel 30 on its outer end by which it may be turned. By this means said rings may be adjusted so as to adjust the length of the segmental slots in said rings as desired. Said rings being arranged over the ports 15, 16, 17, and 18, respectively, and the slots overlapping, the length of time required for the ports *h* in plates b^{12} to pass over said slots may be easily regulated and thus regulate the amount of steam taken into the engine at each revolution of the cylinder B′ to suit the requirements of the work.

In operation, the engine is started by the steam first coming into the ports 15 and 16, or 17 and 18, through the port 11 and the port 13 the lower end of which is in two branches, as indicated in Fig. 6, each of which leads directly into one of the ports and through the head of the cylinder. As soon as the engine is started, however, the valve is turned so that the port 11 will pass beyond the port 13 and the port 12 be brought to communicate with the port 14 and the steam admitted to the engine intermittingly through the holes *h* in the plate b^{12} as said cylinder revolves. By this arrangement of cylinders an engine of this character is provided which is evenly balanced, both of the outer cylinders B and B² meshing with the central cylinder B′ and equalizing the pressure between the parts. The coupling of the shafts of the cylinders B and B² by means of worm-gears to the transverse power shaft B³ prevents any longitudinal movement of said shafts and thus guards against undue longitudinal thrust and wear. The arrangement of the several valves and port-controlling devices enables the steam to be admitted to the engine according to the needs of the work or the speed desired.

The construction thus far described relates particularly to a single, or simple, engine. It will be understood, however, that the invention may be used in multiple and compound engines, and is of peculiar advantage in the construction of such engines.

In Figs. 7, 8 and 9 I have shown a compound engine each end of which is composed of a single engine of substantially the same construction and arrangement as above described. Some changes in the details of construction are necessary, however. It will be observed that there are ports 45 and 46 to lead through the adjacent heads of the two engines establishing communication from the casing of the first to the casing of the second. These ports are controlled by similar rotary valves in the form of rings containing slots as described for the parts b^9 and b^{10}, as shown in the principal views. The toothed racks on these rings, however, engage with racks 47 on sliding bars 48 mounted in transverse ways in the heads and provided with handles 49 on their outer ends by which they may be slid to operate said rings as may be desired. The vanes 30 on the outside cylinders B¹⁰ and B¹¹ are of a larger size in the second engine than in the first and a groove 31 in the central cylinder B¹² is of corresponding size so that the exhaust from engine 1 into engine 2 will be into larger chambers and provide for the further expansion of the steam in the second engine. In each engine I have also shown the groove in the central cylinder provided with side packing strips 32 which are spiral

and set into recesses in the sides of the main groove and adapted to secure tight joints between the parts.

In Fig. 9 it will be observed that the casing is formed with three bores side by side, the central bore cutting into each of the side bores and being of a smaller diameter than said side bores. The central bore is of the exact diameter of the central cylinder so that said cylinder completely fills the bore and cuts off any communication between the two side bores which are of a size to accommodate the two side cylinders B and B^2 and the depth of vane formed around the surface of each. The space between the surface of the cylinders B and B^2 and the bore in which each is mounted forms a chamber in which the steam expands behind the spiral vanes. In the second engine the same relative arrangement is followed except that the side bores must be still larger to accommodate the increased size of the vanes on the side cylinders and provide larger expansion chambers for the steam which exhausts into them from the first engine. The central cylinder in each case serves as a complete cut-off between the two steam chambers and the surfaces of the three cylinders run in close contact with each other as well as the central cylinder in close contact with the central bore and the crown of each vane on the side cylinders in close contact with the side bores. In Fig. 9 the size of the bores in the casing of the second engine and the increased size of the vanes and grooves of the respective cylinders is indicated by dotted lines.

In the operation of the compound engine of this arrangement the starting of the engine is secured in the same manner as described for the simple engine, the steam coming in through the inlet pipe *a* and the port 10 and into the ports 11 and 12 through the ports 15 and 16 into the engine. Live steam also comes into the second engine at the same time through the inlet pipe a^{10}, the ports 33, 34, 45 and 46 into the second engine. After the engine has been started, however, the valve C is turned to open the port 12 into the port 14 which closes the ports 13 and 34 when the live steam will then pass through the first engine and the ports 45 and 46 into the second engine exerting its expansion power against the vanes 30 in said second engine and exhausting through the ports 35 and 36 in the outer head of said second engine into the port 37 from which it passes into the port 38 and through said port around the casing to the discharge or exhaust pipe a^{11}.

In Fig. 8 I have shown a by-pass 39 leading from the port 37 in the outer head of the second engine to the port 14 in the outer head of the first engine provided with a valve 40 by which any communication through said by-pass is prevented during the forward operation of the engine. When said engine is to be reversed, however, by the turning of the valve C so that the live steam will come through the port 21 and port 19 into the opposite end of the engine and the exhaust received into port 14 then the valve 40 is opened so that the exhaust steam will pass through said by-pass 39 into the port 37 in the outer end of the second engine through the ports 35 and 36 into said second engine exhausting through the port 34 which then communicates with the port 38 and exhausts through the exhaust pipe a^{11}. When the engine is to be reversed, therefore, the valve 40 is opened and the rings 41 and 42 in the middle head of the second engine will be adjusted by means of the sliding bars 48 to completely close the slots through them and thus close the communication through the middle ports between the two engines.

In Fig. 12 I have shown five cylinders arranged side by side the outside cylinder, 50, of the first engine being provided with a vane, the adjacent cylinder, 51, with a groove, the next cylinder, 52, with a vane, the next cylinder, 53, with a groove, and the other outside cylinder, 54, with a vane. I have also shown in this view two compound engines each single engine of which is of the five cylinder type and arranged end to end and the two compound engines being joined with their exhaust ends adjacent, in which arrangement the live steam is admitted to each end single engine with the small vanes and grooves. This multiple form is shown to indicate to what extent this construction of engine may be multiplied. It will be apparent from this illustration that an engine of this character may be built containing as many driving cylinders side by side as may be desired and as many engines arranged end to end as may be desired, one exhausting into the other and each succeeding engine being formed with larger vanes and grooves than the one exhausting into it, to provide for the further expansion of the steam. In Fig. 12 two engines with large vanes are arranged end to end and each of the engines with the small vanes are on the outer ends, the corresponding cylinders of each engine all being on a common shaft or coupled together. It is obvious, however, that this arrangement may be reversed without departing from my invention.

The construction and operation of the two engines thus shown is the same as that described for the double engine shown in Figs. 7 and 8, the exhaust from both being in the center of the engine. It will be obvious, also, that many other modifications in the details of construction may be provided and that the idea of construction thus illustrated

may be carried to any extent desired or necessary to secure the power or size of engine required for any particular work and that by the exhaust from one engine into another, all of the expansive force of the steam may be utilized until it has expanded to a point where no appreciable power is retained.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a rotary engine, the combination, of the casing, a series of rotary engines coupled together end to end with ports arranged to exhaust from one to the next, each of said engines comprising a central grooved cylinder and a cylinder with vanes to mesh therewith on each side of said grooved cylinder, said cylinders being arranged parallel and with their sides contiguous, suitable ports, and steam controlling valves, substantially as set forth.

2. In a rotary engine, the combination, of the casing, a set of engines provided therein each comprising a series of parallel contiguous cylinders formed with inter-meshing vanes and grooves, a cylinder with a vane being arranged, on each side of the grooved cylinder, the casing being formed with appropriate inlet and exhaust ports, valves for controlling said ports, and means for operating said valves, substantially as set forth.

3. A rotary engine, comprising a casing and several cylinders journaled therein parallel and contiguous, alternate cylinders being provided with vanes and the others with grooves arranged to mesh therewith, each grooved cylinder being arranged between a pair of vaned cylinders, the casing being formed with suitable ports, valves for controlling said ports, and means for operating said valves, substantially as set forth.

4. A rotary engine comprising a series of single engines each composed of parallel cylinders arranged contiguous and having inter-meshing vanes and grooves mounted in a suitable casing containing inlet and exhaust ports, said engines being arranged end to end and with ports leading from one to the next and formed with expansion chambers of increasing areas from the inlet or first engine to the last engine or exhaust end, a reversing valve between the steam chest and the engine casing formed with ports to control the inlet of steam to the casings of said several single engines, other valves for controlling the inlet of steam to between the cylinders, and other valves for controlling the exhaust, substantially as set forth.

5. In a rotary engine, the combination, of the casing containing the chambers for the cylinders and the several inlet and exhaust ports, the cylinder chambers being arranged in a series arranged end to end with ports leading from one to the next, the cylinders having inter-meshing vanes and grooves mounted in said chambers, a single reversing valve between the steam supply and the inlet to said casing having ports leading to each series of chambers and adapted to control the inlet to all of them, and other valves for controlling the inlet and exhaust of steam to the cylinder chambers, substantially as set forth.

6. A rotary engine comprising a casing containing a series of chambers, a steam chest, appropriate inlet and exhaust ports leading to and from said chambers, controlling valves for said ports, and a series of rotary cylinders mounted in each of said chambers arranged in the same plane and contiguous to each other and provided with inter-meshing vanes and grooves, a grooved cylinder being arranged between two cylinders with vanes which mesh therewith, the vanes and grooves on the cylinders in one chamber being larger in cross section than those in the adjacent chamber, substantially as set forth.

7. A rotary engine comprising a casing formed with several chambers each chamber being formed with bores for containing revolving cylinders, said bores being parallel and arranged with a large bore on each side of a small bore, a grooved cylinder arranged in each of said small bores of a size to fill the same, a cylinder in each of said large bores formed with vanes extending from end to end and adapted to mesh with the grooves of said small cylinders, said several cylinders being arranged with their axes in the same plane and said vanes projecting from the surface of said large cylinders to fill the cross area of said large bores, substantially as set forth.

8. A rotary engine comprising a casing formed with appropriate inlet and exhaust ports, valves for controlling said ports, said casing being formed with seats or bores for containing rotary cylinders the intermediate one of said bores being small and the others large, the intermediate small bore cutting into said large bores, a grooved cylinder mounted in said small bore, and cylinders formed with vanes extending from end to end mounted in said large bores and arranged to mesh with said grooved cylinder, the surfaces of said large cylinders being contiguous to the adjacent surfaces of said small cylinder, substantially as set forth.

9. In a rotary engine, the combination, of the casing, containing a series of chambers each of said chambers containing a series of rotary cylinders formed with inter-meshing vanes and grooves and adapted to fill the bores in which they are mounted, a single reversing valve having ports arranged to lead into each of said chambers, ports being

formed to lead from one chamber to another, and the cylinders in each chamber arranged to receive the steam from another chamber being provided with vanes and grooves of increased depth or size, substantially as set forth.

10. A multiple rotary engine comprising several single engines arranged in series each series comprising single engines each composed of casings containing rotary cylinders formed with inter-meshing vanes and grooves, suitable inlet and exhaust ports and ports leading from one engine of the series to another the two series being arranged end to end upon common shafts and provided with suitable regulating valves, and a reversing valve extending from end to end of the casing and formed with ports leading into each of the engines, substantially as set forth.

11. In a rotary engine, the combination, of the casing, the cylinders formed with inter-meshing vanes and grooves mounted in said casing, the grooved cylinder being formed with recesses along the edges of said groove, and packing strips mounted in said recesses, said casing being formed with suitable inlet and exhaust ports, and valves for controlling said ports, substantially as set forth.

12. In a rotary engine, the combination, with the casing containing suitable ports and controlling valves, of several cylinders arranged with their sides contiguous and in the same plane, the outside cylinders being formed with vanes and the central cylinder being formed with a groove with which said vanes engage, substantially as set forth.

13. In a rotary engine, the combination, of the casing containing suitable ports and controlling valves, the rotary cylinders mounted therein comprising a central cylinder having a spiral groove and other cylinders arranged one on each side of said central cylinder each being formed with a spiral vane adapted to engage with said spiral groove, substantially as set forth.

14. In a rotary engine, the combination, of a casing containing suitable ports and controlling valves, and the rotary cylinders journaled in said casing and formed with intermeshing vanes and grooves, the shafts of said cylinders being coupled to the power shaft by means of worm-gears, substantially as set forth.

15. In a rotary engine, the combination, of the casing containing suitable ports, the controlling valves, means for operating said valves, the several cylinders journaled in said casing, the central cylinder being grooved and the outer cylinders being provided with vanes to engage therewith, the shafts of said cylinders being extended beyond the head of the casing and formed with worm-gears thereon, and a power shaft journaled in bearings and provided with worm gear wheels engaging with said worms on said cylinder shafts, substantially as set forth.

16. In a rotary engine, the combination, of the casing formed with suitable inlet and exhaust ports, valves for controlling said ports, means for operating said valves to adjust the length of the steam inlet ports, and a rotary part containing openings mounted between the steam chest and the port leading into the engine proper, and the rotary cylinders mounted in said casing formed with inter-meshing vanes and grooves, substantially as set forth.

17. In a rotary engine, the combination, of the casing, rotary cylinders mounted therein and provided with inter-meshing vanes and grooves, a steam chest on the top of said casing, ports leading from said steam chest into said casing through one head thereof, exhaust ports leading through the other head to an exhaust pipe leading from said casing, a rotary valve on the shaft of one of said cylinders containing ports for intermittently opening and closing communication between the steam chest and the interior of the casing, and adjustable rings containing slots mounted beneath said rotary valve for adjusting the length of the opening into said ports, substantially as set forth.

18. In a rotary engine, the combination, of the casing formed with steam inlet and exhaust ports, inter-meshing grooved and ribbed cylinders mounted in said casing, valves for controlling the ports in said casing comprising a reversing valve mounted in the steam chest and rotary valves mounted in recesses in the heads of the casing, and means for operating and adjusting said valves, substantially as set forth.

19. In a rotary engine, the combination, of the casing formed with steam inlet and exhaust ports and with a series of parallel bores for containing the rotary cylinders, each of said bores being of a diameter to closely contain said cylinders, ports leading through the heads of the casing to points between said cylinders, said cylinders mounted in said casing and formed with inter-meshing vanes and grooves, a rotary plate mounted on the shaft of the central cylinder formed with ports, an adjustable valve with slots under said plate and arranged to register with the ports in said plate, and means for adjusting said valve, substantially as set forth.

20. In a rotary engine, the combination, of the casing formed with steam inlet and exhaust ports and containing parallel chambers or bores for receiving rotary cylinders, the steam chest on the top of said casing containing a rotary reversing valve and said reversing valve formed with ports leading from opposite sides thereof toward each end

and arranged to discharge into the ports leading through the heads of the casing into the cylinder chambers, and valves for controlling the ports in said heads, substantially as set forth.

21. In a rotary engine, the combination, of the casing, the cylinders mounted in said casing formed with inter-meshing vanes and grooves, the steam chest on said casing, said casing being formed with ports leading to within chambers containing the rotary cylinders, a reversing valve mounted to rotate in said steam chest and formed with an inlet port leading each way from opposite sides toward each end and adapted to communicate with the ports in the heads of the casing, and valves for controlling said ports, substantially as set forth.

22. In a rotary engine, the combination, of the casing, the cylinders mounted therein and formed with inter-meshing vanes and grooves, said casing being provided with suitable inlet and exhaust ports comprising ports through the heads of said casing leading to within the chambers between the cylinders, and valves for controlling said ports comprising a rotary plate adapted to rotate with one of said cylinders and containing ports, and a pair of rotary rings mounted underneath said plate and containing elongated slots each of which is arranged to register with the ports in said rotary plate, and means for adjusting said rings in relation to each other and in relation to the ports in the heads, substantially as set forth.

23. In a rotary engine, the combination, of the casing formed with a series of parallel and alternately arranged large and small bores, a series of rotary cylinders mounted in said bores provided with inter-meshing vanes and grooves, the grooved cylinders being mounted in the small bores and the cylinders with vanes in the large bores on each side thereof, said bores being of a size to closely fit their respective cylinders, said casing being also formed with suitable inlet and exhaust ports, and valves for controlling said ports, substantially as set forth.

24. A rotary engine comprising a casing formed with a series of cylinder chambers of different diameters arranged parallel and with the large and small chambers alternating, a small chamber being arranged between each pair of large chambers, a series of cylinders of uniform diameter mounted in said chambers and formed with inter-meshing vanes and grooves, the vanes on the alternate cylinders projecting from the surface of said cylinders to fill their respective chambers, the casing being provided with suitable inlet and exhaust ports, and valves for controlling said ports, substantially as set forth.

25. A rotary engine comprising a casing containing a series of cylinders formed with inter-meshing vanes and grooves, a grooved cylinder being mounted between two cylinders with vanes, the casing being formed with suitable inlet and exhaust ports, and suitable valves for controlling said ports, substantially as set forth.

In witness whereof, I, have hereunto set my hand and seal at Washington D. C. this 3rd day of July, A. D. nineteen hundred and seven.

NEWELL H. MOTSINGER. [L. S.]

Witnesses:
E. W. BRADFORD,
A. M. PARKINS.