No. 778,408. PATENTED DEC. 27, 1904.

V. FILTEAU.

ROTARY ENGINE.

APPLICATION FILED JAN. 14, 1904.

4 SHEETS—SHEET 1.

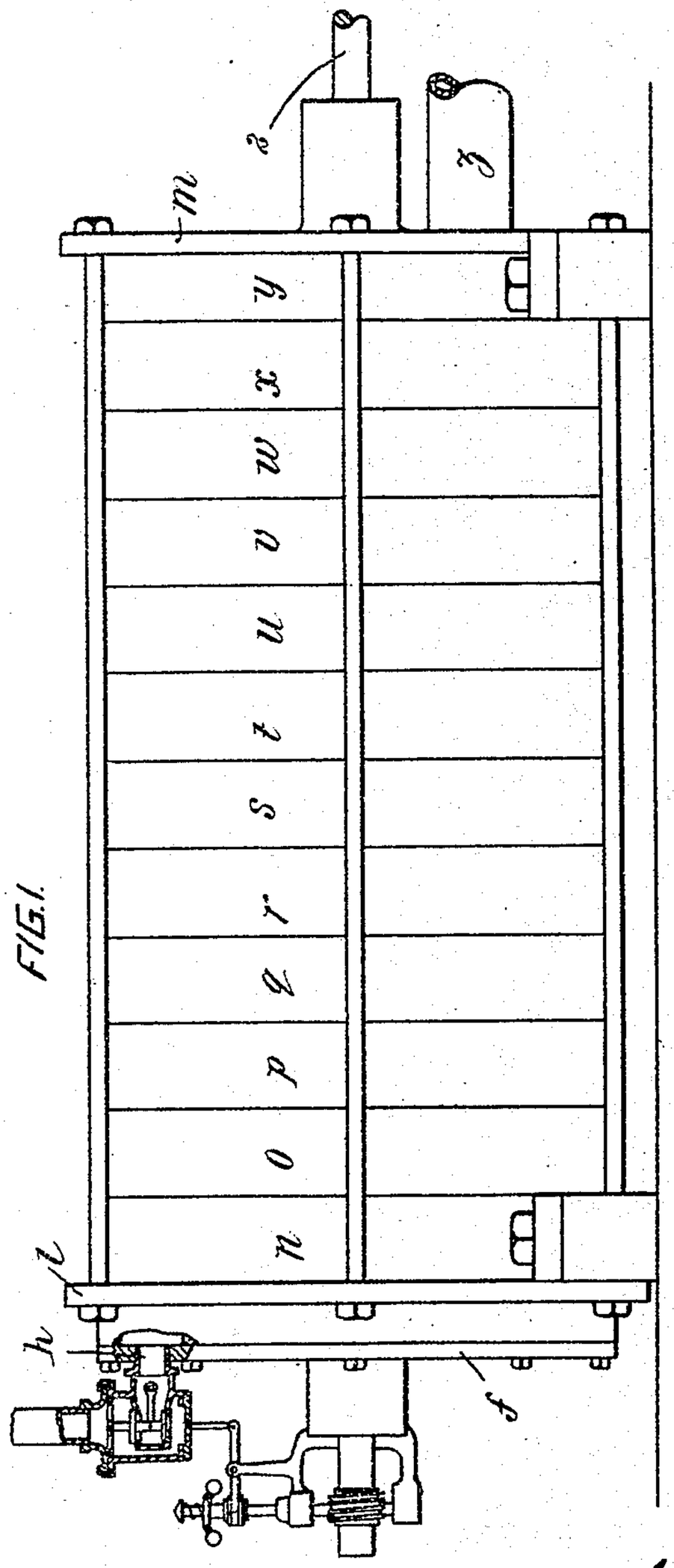

FIG. 1.

Witnesses

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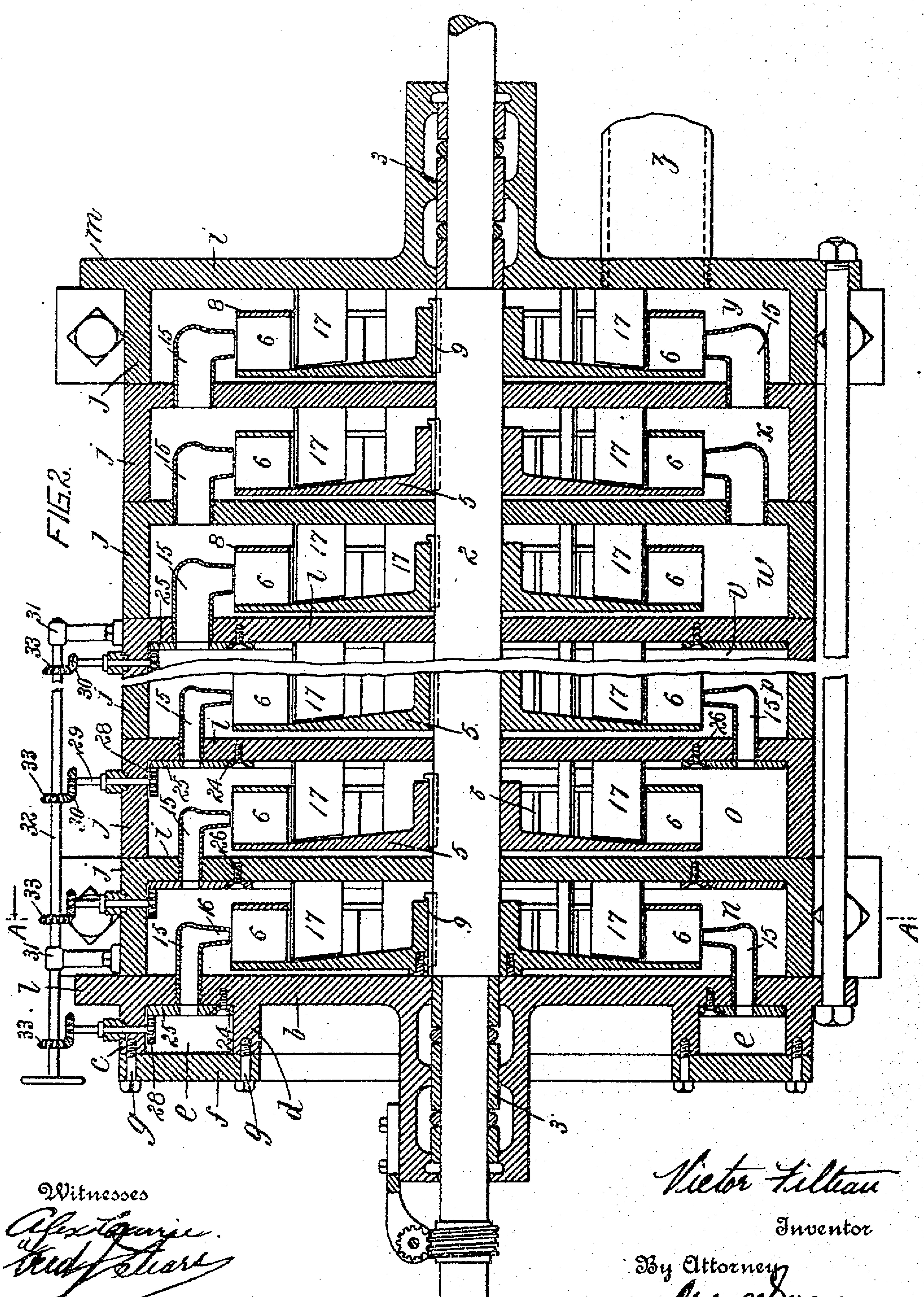
4 SHEETS—SHEET 2.



Witnesses

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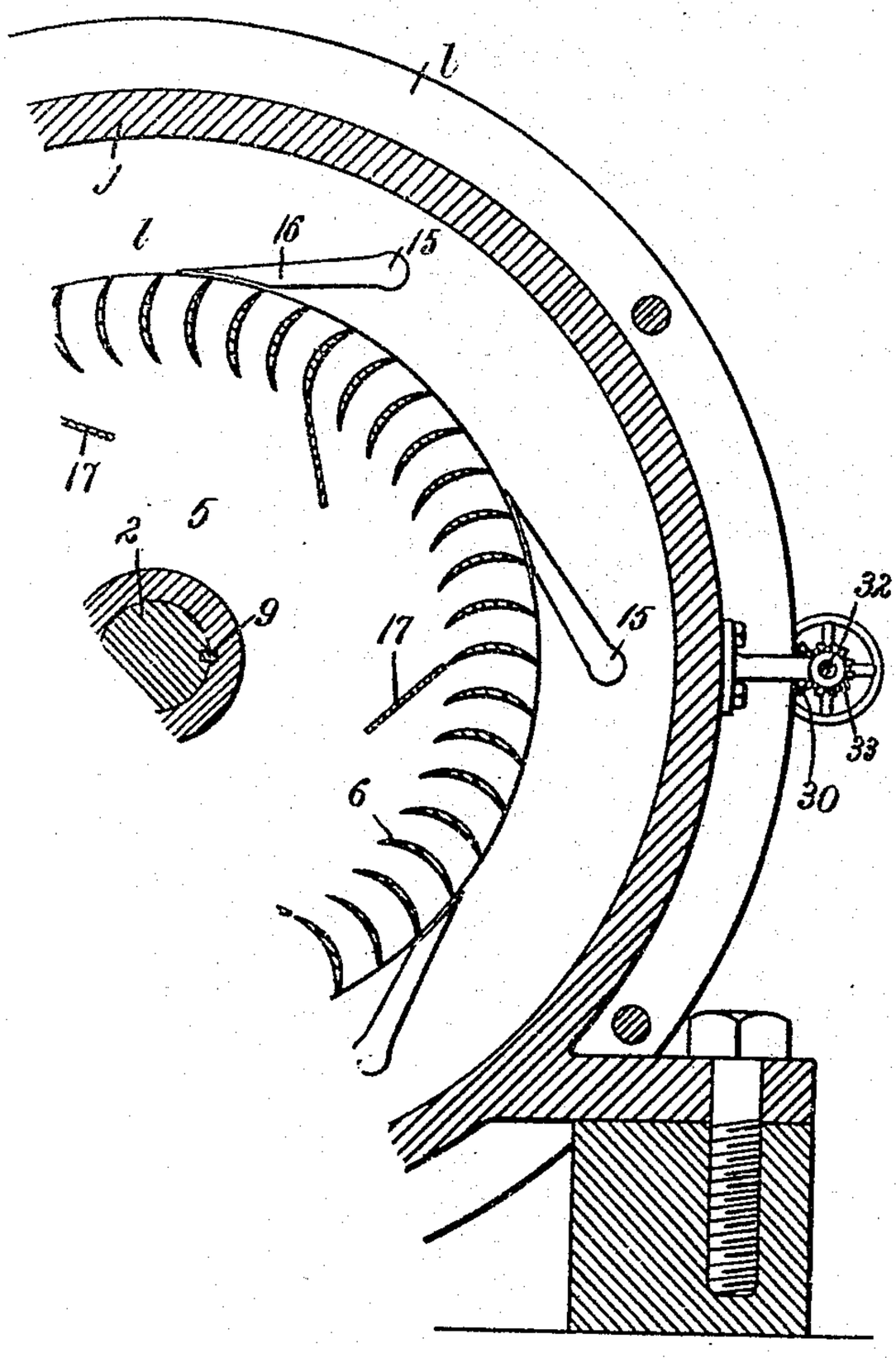
4 SHEETS—SHEET 3.

FIG 3



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4 SHEETS—SHEET 4.

FIG. 4

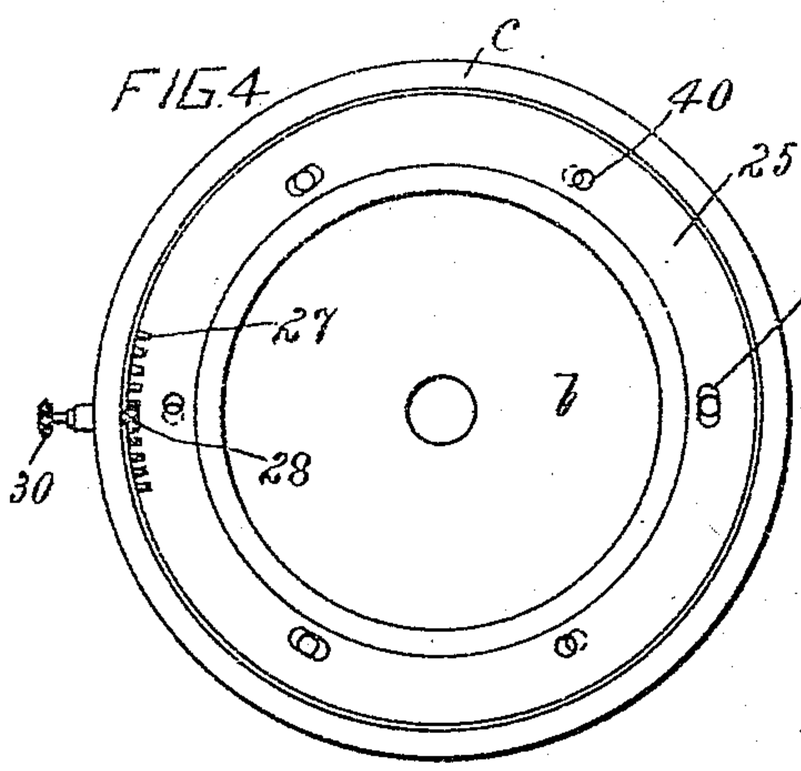


FIG. 5.

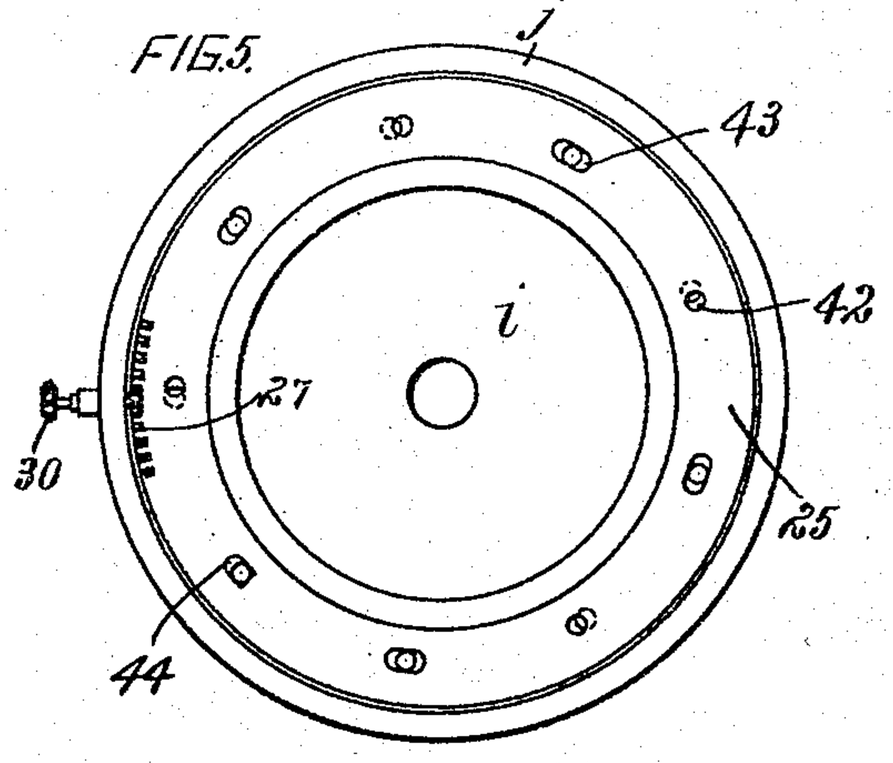


FIG. 6.

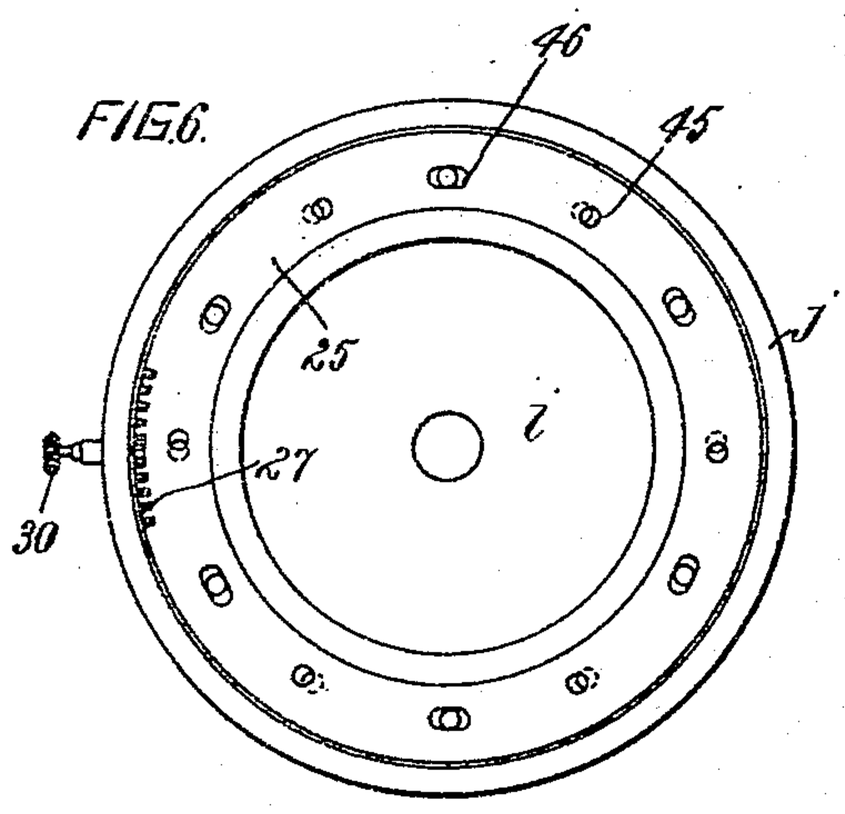


FIG. 7.

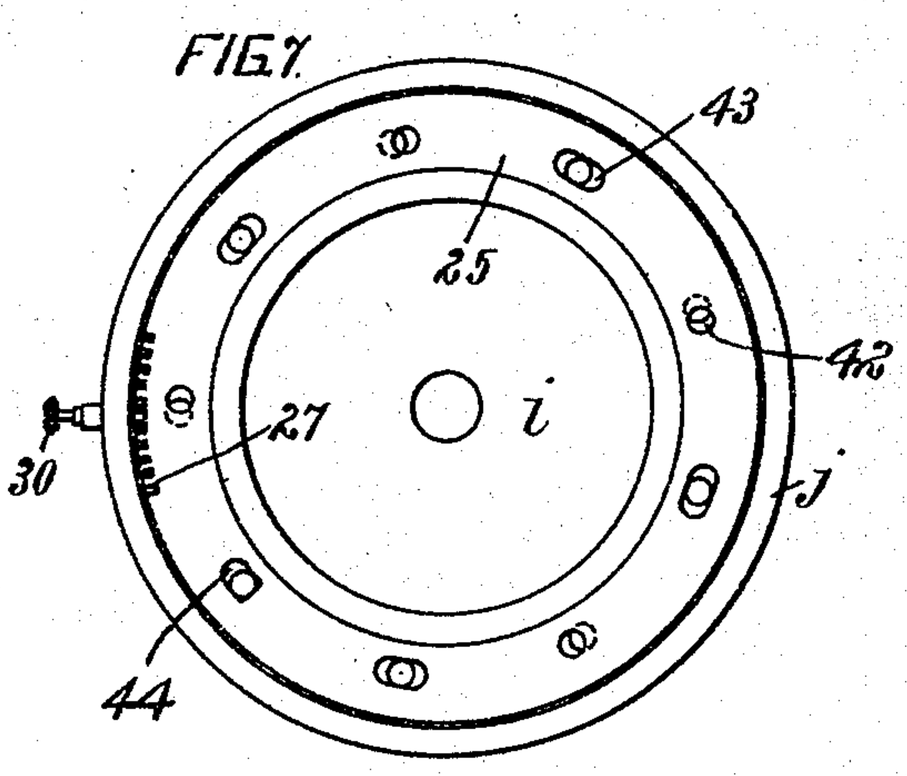


FIG. 8.

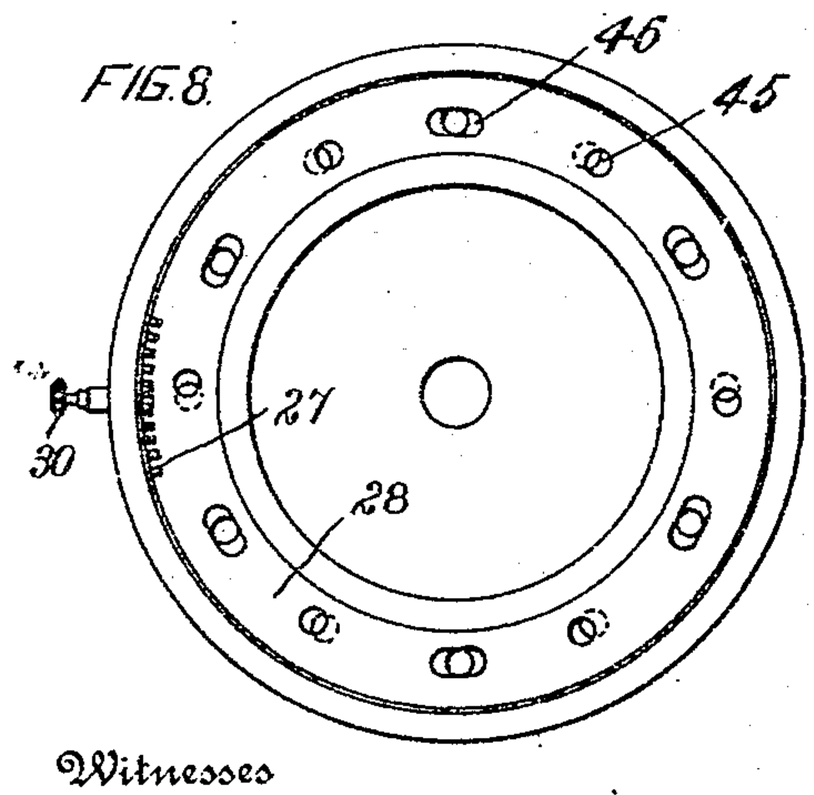
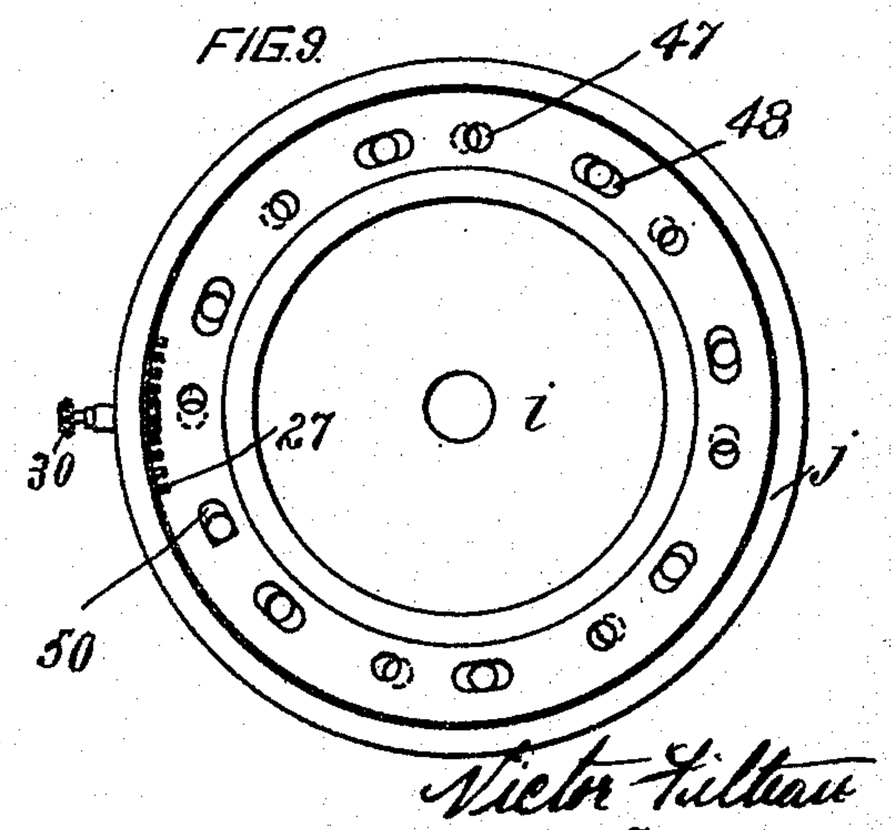


FIG. 9.



Witnesses

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No. 778,408. Patented December 27, 1904.

UNITED STATES PATENT OFFICE.

VICTOR FILTEAU, OF MONTREAL, CANADA, ASSIGNOR OF THREE-FIFTHS TO WILLIAM BAYLIES CHAPMAN AND LOUIS GALIBERT, OF MONTREAL, CANADA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 778,408, dated December 27, 1904.

Application filed January 14, 1904. Serial No. 189,064.

To all whom it may concern:

Be it known that I, VICTOR FILTEAU, of the city of Montreal, Province of Quebec, Canada, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates particularly to rotary engines of the turbine type. Heretofore in order to compound engines of this type it has been the practice to construct the cylinders thereof of progressively-increasing capacity, thereby necessitating an increase of the diameter of the piston-wheel for each cylinder of increased capacity. The disadvantageous result attendant upon this manner of compounding a turbine-engine is that as the motive fluid is reduced in efficiency it must overcome the increased circumferential velocity of the larger wheel in each succeeding stage before it can commence to do effective work. Consequently the energy of the motive fluid is largely wastefully exhausted in overcoming this progressively-increasing velocity.

The object of my invention is to obviate loss of efficiency in this manner and to otherwise increase the efficiency of compound engines of this type particularly and of rotary engines generally.

The invention may be said, briefly, to consist of an engine comprising a plurality of chambers of uniform interior area and each containing a piston device and means for connecting the same to the shaft or other part to be driven and the motive fluid being supplied from one to the other of said chambers through ports of progressively-increasing capacity.

The invention further consists of the specific construction of the individual chamber and the piston device therein and a particular form of cut-off.

For full comprehension, however, of my invention reference must be had to the accompanying drawings, forming a part of this specification, in which similar reference characters indicate the same parts, and wherein—

Figure 1 is a side elevation, partly in section, of an engine constructed according to my invention. Fig. 2 is a longitudinal sectional view of an engine constructed according to my invention. Fig. 3 is a transverse vertical sectional view thereof, taken on line A A, Fig. 2, and illustrating particularly the parts leading from the first to the second chamber and the cut-off device. Figs. 4, 5, 6, 7, 8, and 9 are diagrammatical views illustrating the ports effecting a communication between the cylinders.

The cylinder-head at the supply end of the engine consists of a plate or wall *b*, having upon one side thereof a pair of annular flanges *c* and *d* and a perforated flange 1 upon its periphery. The annular flange *c* is located near the periphery of such plate or wall, and the flange *d* is within and of sufficiently less diameter than *c* to provide an annular chamber *e*, which constitutes a chest to which the motive fluid is initially supplied and from which it is projected into the first chamber or cylinder. The outer side of this chamber is closed by an annular plate *f*, secured in place preferably by screws *g* and having the motive-fluid-supply pipe *h* projecting therethrough. The cylinders proper (with the exception of their ports) correspond to one another in every respect, and each consists of a plate or wall *i*, having upon the side thereof toward the supply-port an annular flange *j*, corresponding in diameter to the annular flange *c*, while the end plate or wall *i*, which constitutes the exhaust-end cylinder-head, has a perforated flange *m* upon its periphery and corresponding to the flange 1. When the plates or walls *i*, with their flanges *j*, are fitted together, they form a series of chambers *n*, *o*, *p*, *q*, *r*, *s*, *t*, *u*, *v*, *w*, *x*, and *y*, from the latter of which the exhaust-pipe *z* leads. The plates *b* and *i* have ports (to be presently described) therein, and they are centrally perforated to receive a shaft 2, which bears in automatically-lubricating bearings 3, preferably cast integrally with the outer sides of the end cylinder-heads. These self-lubricating bearings may be of any desired form and as they form no part of this invention will not be described in detail herein.

My improved piston-wheels correspond with one another, and each consists of a disk

5, having a plurality of concavo-convex vanes or buckets 6 carried upon the peripheral portion of the side thereof toward the exhaust end of the engine, such vanes or buckets being arranged radially to the shaft and with their piston-faces 7 in the axial plane thereof, and they are preferably braced by a flat ring 8, rigidly secured thereto. Each of these piston-wheels is secured rigidly upon the shaft by a hub formed integrally with the former and secured to the latter by a key 9 or in any other preferable manner. Any required number of chambers may be used, according to the fluid-pressure to be utilized, and as an illustration I have shown my engine and will now describe it as comprising twelve chambers. I prefer to use twelve (12) piston-chambers, as I have been able to secure the best results from such a number where a comparatively high pressure fluid is being utilized, although the number can be increased or diminished to suit requirements. The ports are cut through the portion of the plates or walls coincident with the space between the vanes or buckets and the circumferential walls constituted by the annular flanges, and these ports preferably increase numerically and in capacity from the supply to the exhaust end of the engine. In order that this feature of my invention may be clearly understood, I may point out as an instance that the first plate or wall *b*, which divides the motive-fluid chest from the first piston-chamber *n*, has, say, six ports of one-quarter ($\frac{1}{4}$) inch diameter, the plate or wall *i*, dividing chamber *n* from chamber *o*, having a series of nine (9) ports of the same diameter, and the next plate or wall, dividing chambers *o* from chamber *p*, having a series of twelve (12) ports of the same diameter. The next plate or wall, which divides chamber *p* from chamber *q*, has a series of nine ports of three-eighths ($\frac{3}{8}$) inch diameter, the wall dividing chamber *q* from chamber *r* having a series of twelve (12) ports of the same diameter as the ports in the last-mentioned wall, and the plate or wall dividing chamber *r* from chamber *s* has fifteen (15) ports of the same diameter. The next plate or wall, which divides chamber *s* from chamber *t*, has twelve (12) ports of one-half ($\frac{1}{2}$) inch diameter, the wall dividing chamber *t* from *u* having fifteen (15) ports of the same diameter as the ports in the last-mentioned wall, and the wall dividing chamber *u* from chamber *v* has eighteen (18) ports of the same diameter. The next wall, which divides chamber *v* from chamber *w*, has fifteen ports of five-eighths ($\frac{5}{8}$) inch diameter, the wall dividing chambers *w* an *x* having eighteen ports of the same diameter as the last-named port, and the wall *y* being identical with the last-mentioned wall and having the same number of ports of the same diameter. Each port is tapped to have a tapered angular nozzle 15 screwed therein, or such nozzles may be in any other suitable manner secured in place, and the end 16 of each of said nozzles is disposed to direct a jet tangentially upon the perimeter of the piston-wheels and in such a position to have the line of force thereof at substantially right angles to a plane intersecting the axis of the wheel and the bucket upon which the jet impinges, while a series of baffle-plates 17, secured rigidly upon the dividing-walls and projecting within and arranged tangentially of the piston-wheels, prevent the motive fluid after having rotatively impinged upon the vanes or buckets again impinging upon the same from the interior of the wheel and returning the rotation thereof. The ports in each dividing-wall, except the last two, are controlled by an annular valvular plate 25, rotatably mounted upon the sides of such walls, with which the intake ends of the ports communicate, such plate being held against displacement away from the wall by a series of beveled retaining-pieces 24, secured to the plate by screws 26 and adapted to have their beveled edges overlap the inner edge of the valvular plate, which is correspondingly beveled. The portion of each valvular plate contiguous to the periphery is provided with a short-toothed rack 27, with which a pinion 28 intermeshes, said pinion being mounted rigidly upon the inner end of a spindle 29, the outer end whereof has a beveled gear 30 mounted rigidly thereon. A spindle 32 is supported in bearings 31 upon the exterior of the end chambers or sections of the engine, and a series of beveled gears 33 are mounted rigidly thereon, one adjacent to and adapted to intermesh with each of the beveled gears 30. Upon rotating this spindle 32 the ports are controlled.

I prefer to arrange the valvular plate in such a manner that upon rotating spindle 32 all of the dividing-walls excepting the last two will have one-half of the number of their ports either completely or partially closed. To this end the valvular plate controlling the ports leading into chamber *n* has, say, three apertures 40 of a size corresponding to the ports they control and three other apertures, 41, double the length of the apertures they control, the valvular plates controlling the ports leading into chambers *o* and *q* having, say, four apertures corresponding in size to the ports they control, a second series of, say, four apertures 43 double the length of the ports they control, and an aperture 44 one-half longer than the port it controls, the valvular plates controlling the ports leading into chambers *p*, *r*, and *t* having, say, six apertures 45, corresponding in size to the ports they control, and a second series of six apertures 46, alternating with the series last mentioned and double the length of the ports they control, the valvular plates controlling the ports leading into chambers *s*, *u*, and *w* having, say, seven apertures 47, corre-

sponding in size to the ports they control, a second series of seven apertures 48 double the length of the ports they control, and an aperture 50 one-half longer than the port it controls, and the valvular plate controlling the ports leading into chamber *v* having, say, nine apertures corresponding in size to the ports they control and a second series of nine apertures alternating with the series last mentioned and double the length of the ports they control. Owing to the difference in diameter of the ports in the several chambers, there is a greater movement required to be given to the valvular plate controlling the larger ports than to the valvular plate controlling the smaller ports, and in order to secure a uniform control of all the ports simultaneously I provide different sized gears upon the tops of the spindles 29, the size being such as to secure a movement of each plate sufficient to control the ports in the chambers upon the side of which they are mounted to correspondingly uniform extent.

The advantageous result attendant upon the numerical reduction of the ports is that with a reduced load, and consequently (through the automatic governor) a reduced pressure in the motive-fluid chest, the efficiency of the engine is maintained under the varying load by cutting off some of the ports and allowing the remaining ports only to project the jets.

In the operation of my engine the motive fluid will be admitted in greater volume to the chambers progressively from the supply end of the series of the exhaust, and owing to the uniform diameter of the piston-wheels the motive fluid leaving one chamber after acting upon the piston-wheel therein will not need to overcome a circumferential velocity of the piston-wheel in the next chamber greater than that of the piston-wheel in the chamber last acted upon, while the fact of the jets impinging upon the piston-wheels at right angles to the axial plane of the shaft transmits the energy of said jets to the wheels in a manner to secure a maximum efficiency therefrom.

What I claim is as follows:

1. A compound turbine-engine comprising a series of piston-chambers of corresponding capacity, a piston-wheel in each chamber, said piston-wheels being of corresponding diameter and having corresponding circumferential piston areas, the first chamber of the series having a series of supply-ports leading thereinto and each of the succeeding chambers having a series of ports leading thereinto from the chamber preceding it, the ports leading into the succeeding chamber being progressively increasing numerically from the supply to the exhaust end of the engine, and valvular means controlling the ports leading to the first chamber.

2. A compound turbine-engine comprising a series of piston-chambers of corresponding capacity, a piston-wheel in each chamber, said piston-wheels being of corresponding diameter and having corresponding circumferential piston areas, the first chamber of the series having a series of supply-ports leading thereinto and each of the succeeding chambers having a series of ports leading thereinto from the chamber preceding it, the ports leading into the succeeding chamber being progressively increasing numerically from the supply to the exhaust end of the engine, and valvular means controlling the ports leading to said chambers.

3. A compound turbine-engine comprising a series of piston-chambers coaxially arranged and each consisting of a plate having an annular flange cast in one with the periphery thereof, means securing such chambers together with the free end of the wall of each in contact with the periphery of the plate of the chamber next to it, a cylinder-head for closing the chamber at one end of the series, a shaft extending centrally through said series of chambers, a series of piston-wheels of corresponding diameter one being located in each chamber, means rigidly securing said piston-wheels to the shaft, a series of steam-ports leading into the chamber at one end of the series, a series of ports leading from each chamber to the chamber succeeding it in the series, and an exhaust-port leading from the last chamber of the series, each series of ports being greater numerically than the series preceding it.

4. A compound turbine-engine comprising a series of piston-chambers coaxially arranged and each consisting of a plate having an annular flange cast in one with the periphery thereof, means securing such chambers together with the free end of the wall of each in contact with the periphery of the plate of the chamber next to it, a cylinder-head for closing the chamber at one end of the series, a shaft extending centrally through said series of chambers, a series of piston-wheels of corresponding diameter one being located in each chamber, means rigidly securing said piston-wheels to the shaft, a series of steam-ports leading into the chamber at one end of the series, a series of ports leading from each chamber to the chamber succeeding it in the series, and an exhaust-port leading from the last chamber of the series, each series of ports being of greater collective capacity than the series preceding it, and valvular means for simultaneously controlling all of said ports, such valvular means consisting of a series of annular valvular plates one upon the side of each chamber with which the supply end of the ports communicate and having a series of apertures registering with said ports, and means for regulating said annular plates.

5. A compound turbine-engine comprising a series of piston-chambers coaxially arranged and each consisting of a plate having an an-

nular flange cast in one with the periphery thereof, means securing such chambers together with the free end of the wall of each in contact with the periphery of the plate of the chamber next to it, a cylinder-head for closing the chamber at one end of the series, a shaft extending centrally through said series of chambers, a series of piston-wheels of corresponding diameter one being located in each chamber, means rigidly securing said piston-wheels to the shaft, a series of steam-ports leading into the chamber at one end of the series, a series of ports leading from each chamber to the chamber succeeding it in the series, and an exhaust-port leading from the last chamber of the series, each series of ports being of greater collective capacity than the series preceding it, and valvular means for simultaneously controlling all of said ports, such valvular means consisting of a series of annular valvular plates one upon the side of each chamber with which the supply end of the ports communicates and having a series of apertures of different lengths registering with said ports, and means for rotating said annular plates.

6. A compound turbine-engine comprising a series of piston-chambers coaxially arranged and each consisting of a plate having an annular flange cast in one with the periphery thereof, means securing such chambers together with the free end of the wall of each in contact with the periphery of the plate of the chamber next to it, a cylinder-head for closing the chamber at one end of the series, a shaft extending centrally through said series of chambers, a series of piston-wheels of corresponding diameter one being located in each chamber, means rigidly securing said piston-wheels to the shaft, a series of steam-ports leading into the chamber at one end of the series, a series of ports leading from each chamber to the chamber succeeding it in the series, and an exhaust-port leading from the last chamber of the series, each series of ports being of greater collective capacity than the series preceding it, and a series of tapered nozzles carried one in the exit end of each port and adapted to direct a jet tangentially upon the perimeters of the piston-wheels.

7. A compound turbine-engine comprising a series of piston-chambers coaxially arranged and each consisting of a plate having an annular flange cast in one with the periphery thereof, means securing such chambers together with the free end of the wall of each in contact with the periphery of the plate of the chamber next to it, a cylinder-head for closing the chamber at one end of the series, a shaft extending centrally through said series of chambers, a series of piston-wheels of corresponding diameter one being located in each chamber, means rigidly securing said piston-wheels to the shaft, a series of steam-ports leading into the chamber at one end of the series, a series of ports leading from each chamber to the chamber succeeding it in the series, and an exhaust-port leading from the last chamber of the series, each series of ports being of greater collective capacity than the series preceding it, a series of tapered nozzles carried one in the exit end of each port and adapted to direct a jet tangentially upon the perimeters of the piston-wheels, and valvular means for simultaneously controlling all of said ports.

In testimony whereof I have affixed my signature in presence of two witnesses.

VICTOR FILTEAU.

Witnesses:

WILLIAM P. MCFEAT,

FRED. J. SEARS.