L. P. STEVENS.

ROTARY MOTOR.

APPLICATION FILED JUNE 1, 1908.

944,581.

Patented Dec. 28, 1909.

4 SHEETS—SHEET 1.

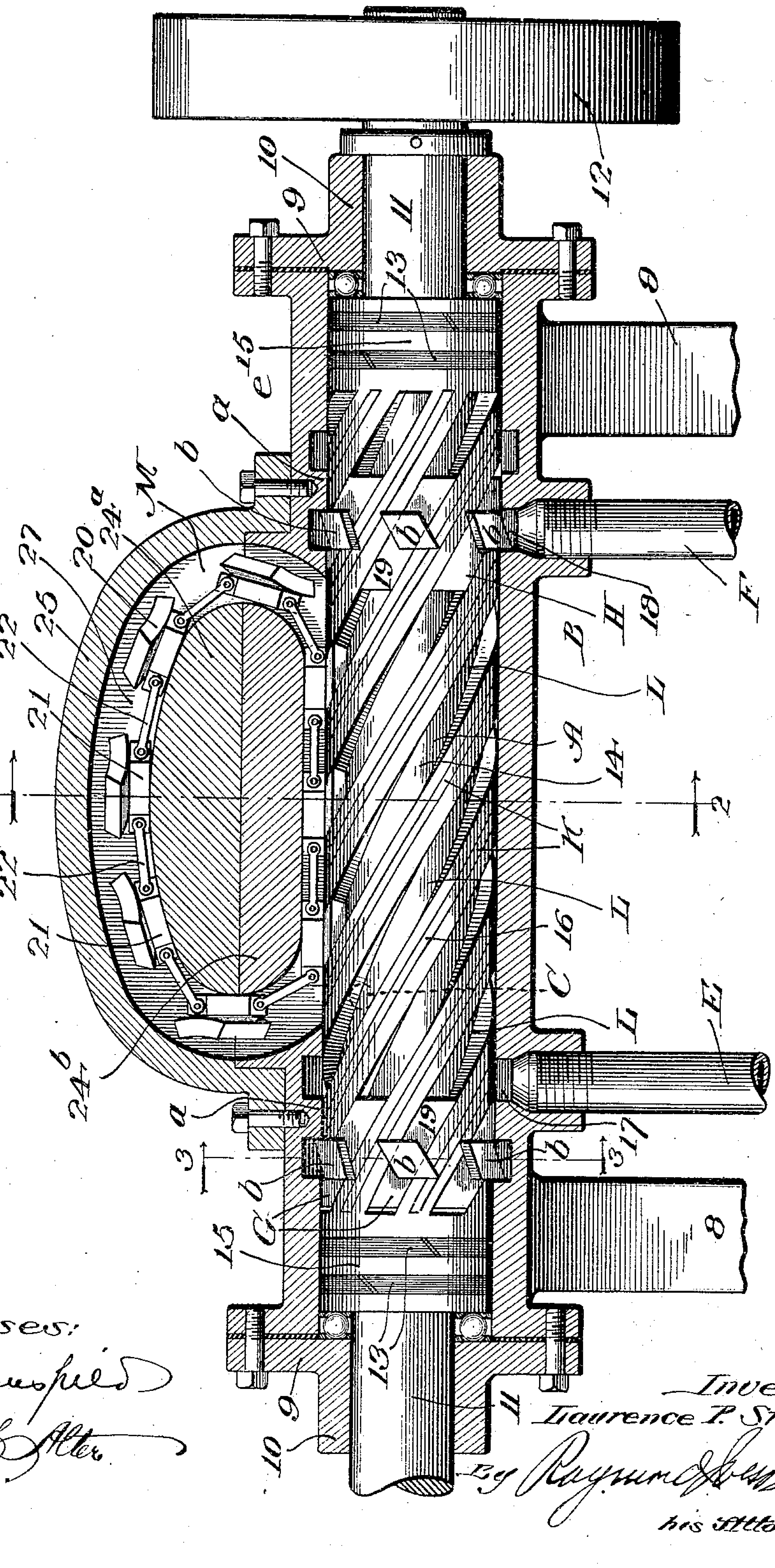

Fig. 1.

Witnesses:

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Lute S. Alter

Inventor:

Laurence P. Stevens,

By Raymond Ives Blakeslee

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4 SHEETS—SHEET 2.

Fig. 4.

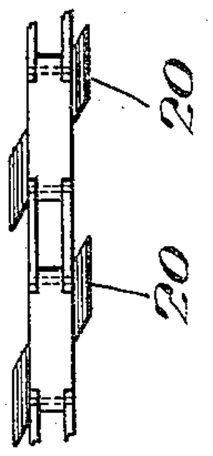


Fig. 5.

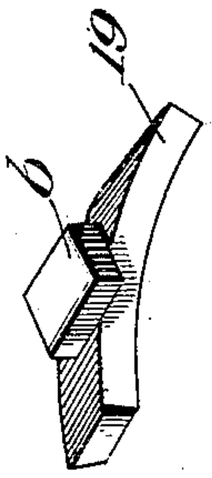


Fig. 3.

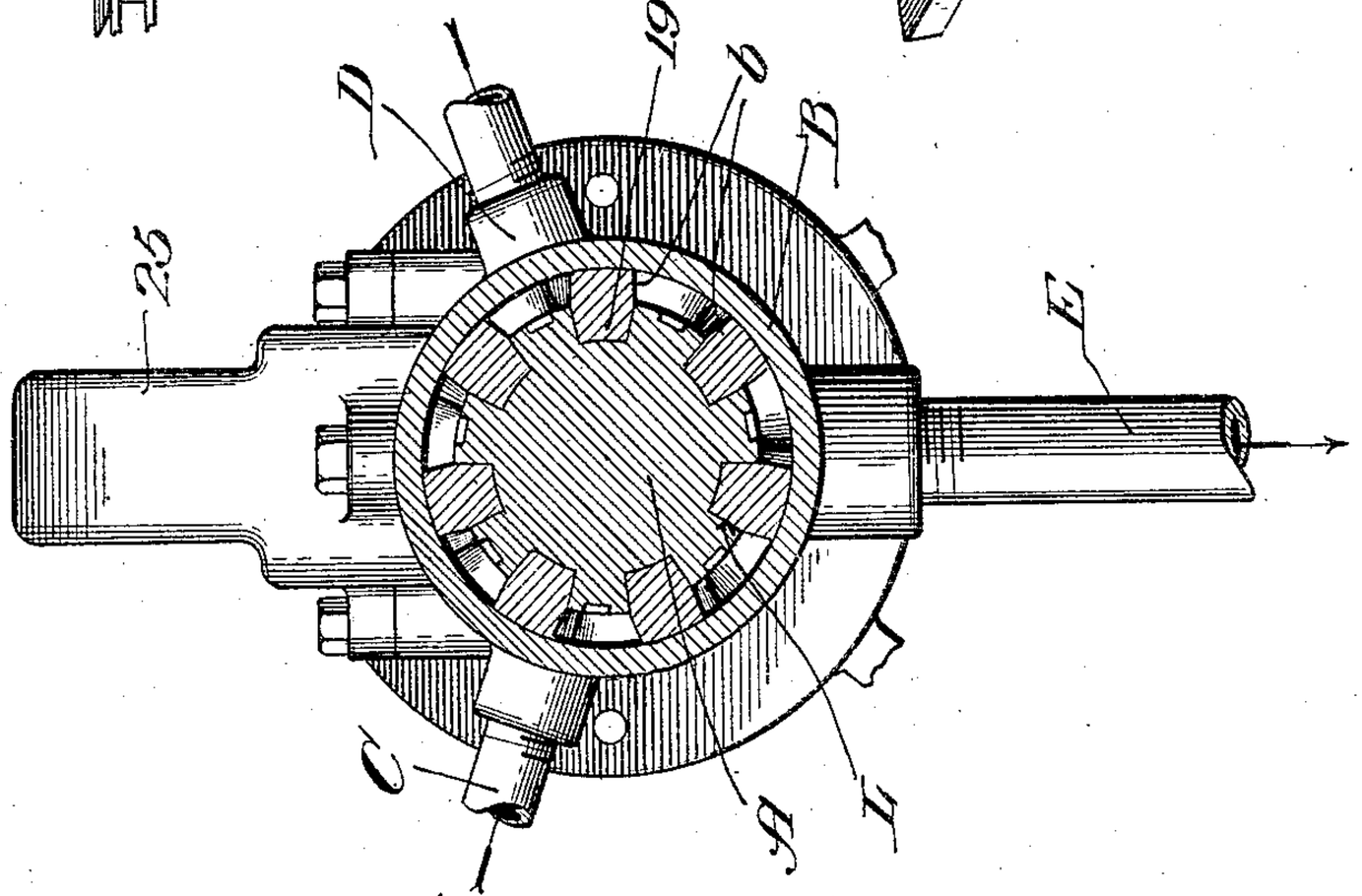
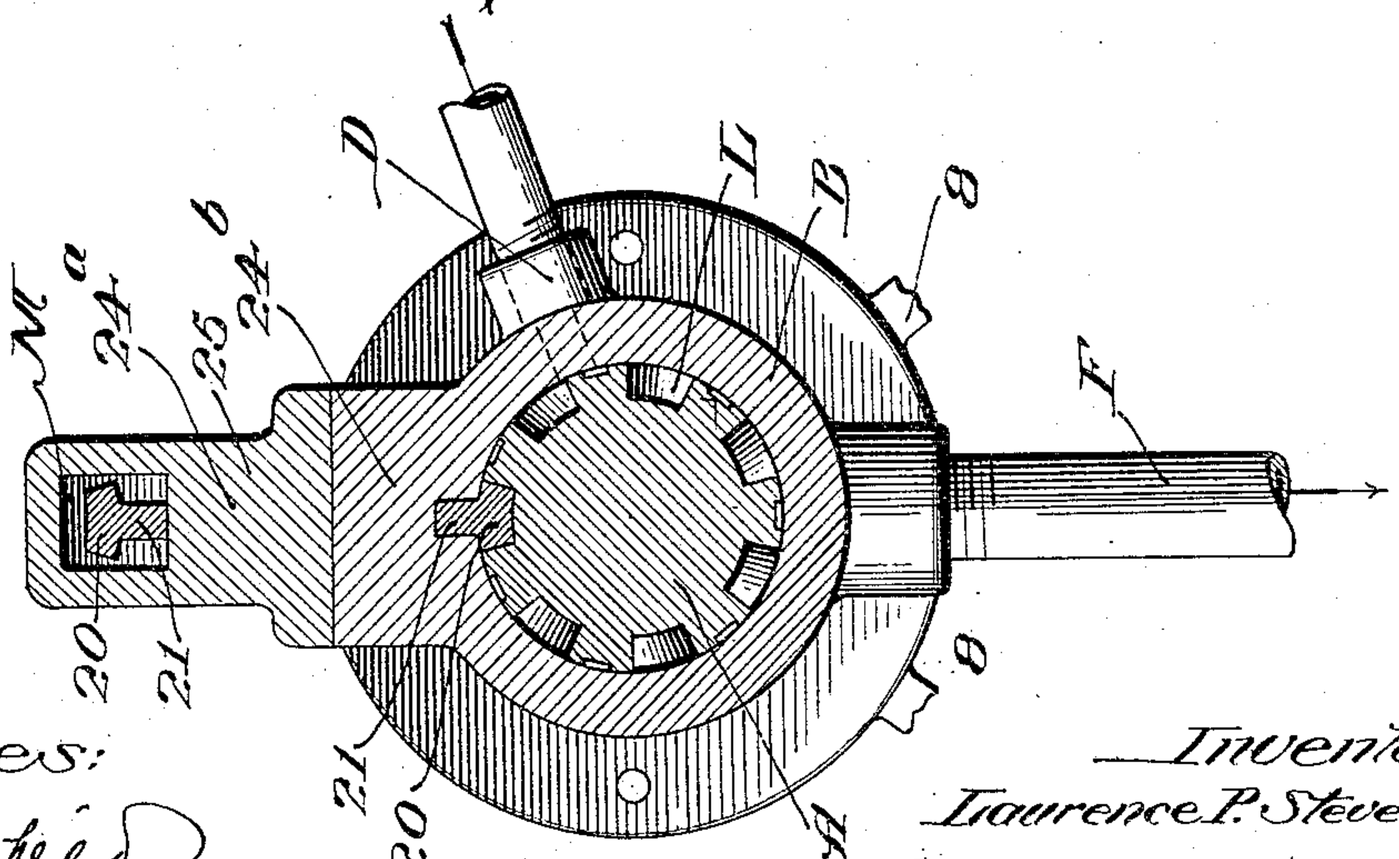


Fig. 2.



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4 SHEETS—SHEET 3.

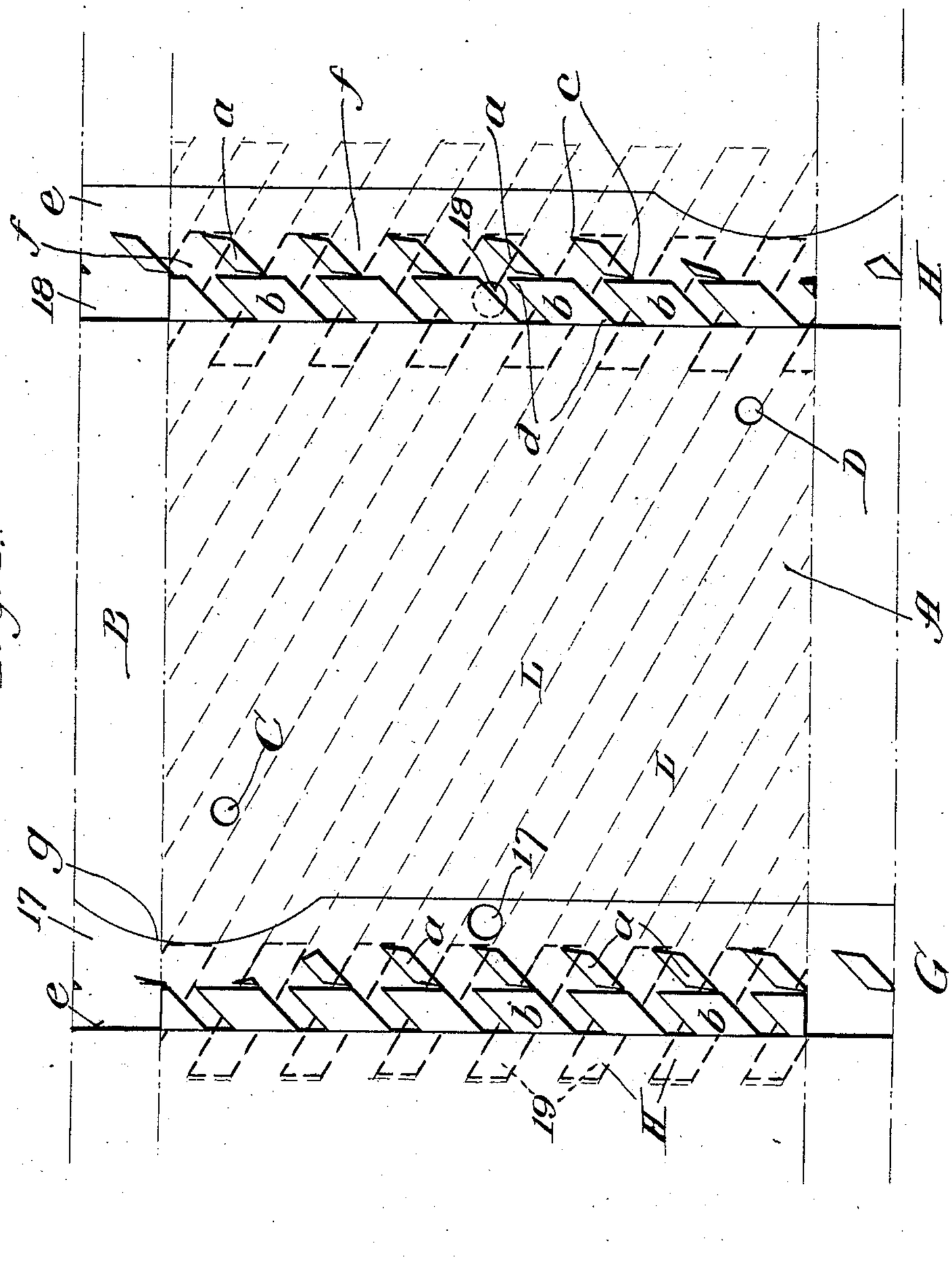

Fig. 6.

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4 SHEETS—SHEET 4.

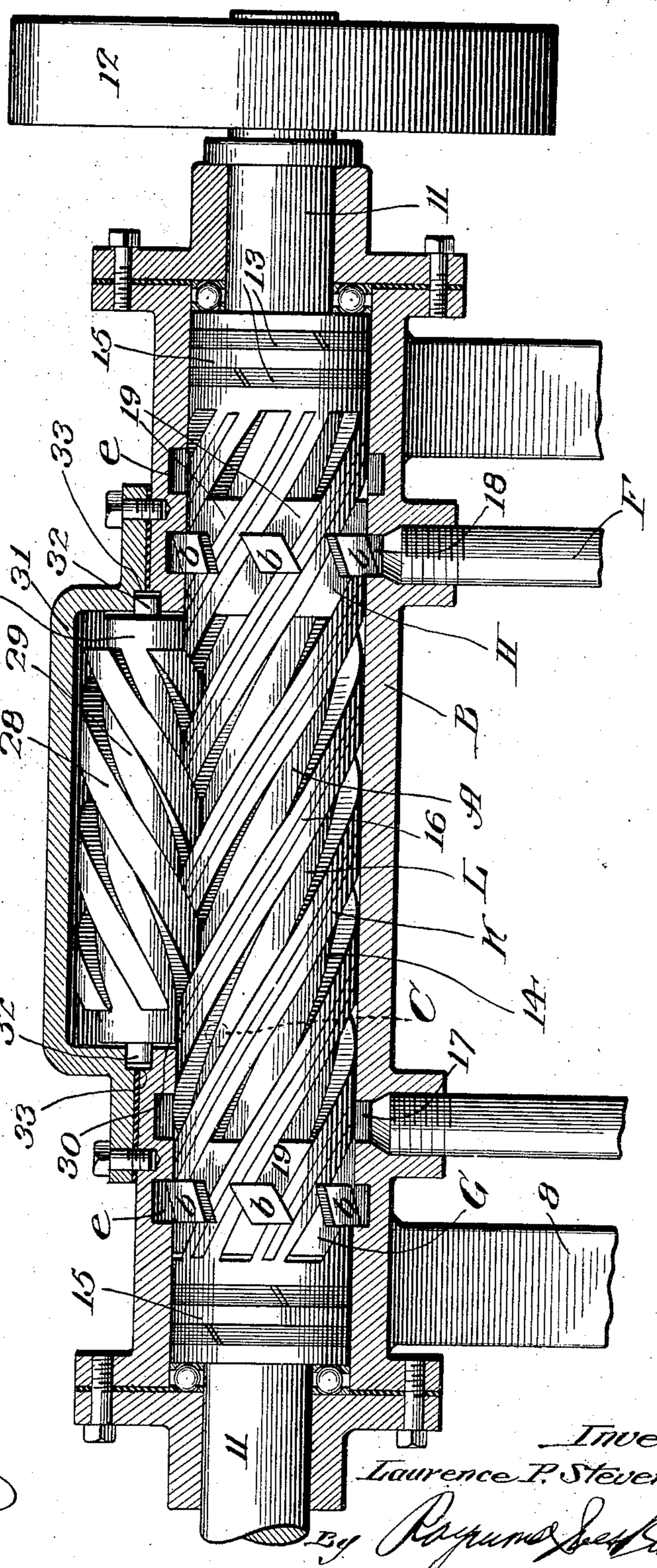

Fig. 1.

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UNITED STATES PATENT OFFICE.

LAURENCE P. STEVENS, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-THIRD TO TRUBE J. LAWRENCE, OF LOS ANGELES, CALIFORNIA.

ROTARY MOTOR.

944,581. Specification of Letters Patent. **Patented Dec. 28, 1909.**

Application filed June 1, 1908. Serial No. 436,131.

To all whom it may concern:

Be it known that I, LAURENCE P. STEVENS, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Rotary Motors, of which the following is a specification.

This invention relates to rotary motors and it has for its object to provide an improved motor of the character named, which shall be relatively simple and inexpensive in construction, positive and economical in operation, readily controlled, conveniently repaired, and generally superior in point of efficiency and adaptability to wide range of working conditions.

Particular features of the improvements constituting the invention, comprise the provision of means automatically controlling the exhaust ports and the reversal of the direction of operative movement of the motor; extended cylinder space within which the expansion of the pressure medium takes place and fewness of parts with relation to long life, perfect control and relatively frictionless operation.

The invention consists in the novel construction, provision, combination, association and relative arrangement of parts, members and features, all as hereinafter set forth, shown in the accompanying drawings, and finally pointed out in the claims.

In the drawings:—Figure 1 is a side elevation of the essential operative parts and members of the rotary motor embodying the invention, the casing of the same being in section longitudinally, in a plane passing through the longitudinal axis of the piston member; Fig. 2 is a detail transverse sectional view of the same, taken upon the line 2—2, Fig. 1, and looking in the direction of the appended arrows; Fig. 3 is a view similar to Fig. 2, taken upon the line 3—3, Fig. 1; Fig. 4 is a detail fragmentary plan view of the particular feature of the invention; Fig. 5 is an isometric view of a further particular feature of the invention, in detached position; Fig. 6 is a diagrammatic view of the piston member of the motor and particular features of the invention associated therewith; and, Fig. 7 is a view similar to Fig. 1 of a modified form of construction, which under certain, and possibly general conditions may be found preferable thereto. Corresponding parts in all the figures are denoted by the same reference characters.

Referring with particularity to the drawings, and to all figures thereof, the invention comprises a piston member A, of cylindrical form housed within a cylinder casing B provided with inlet ports C and D and exhaust ports E and F. The exhaust ports are arranged respectively adjacent to the end portions of the cylinder casing B, and the inlet ports C and D are both arranged intermediate of the exhaust ports E and F, longitudinally of said cylinder casing, said inlet ports being relatively spaced apart. With each of the exhaust ports E and F is associated valve means, G and H, respectively, which valve means are likewise associated with the piston member A. The piston member A comprises a plurality of spaced abutments K, alternating with it are cylinder spaces L; and associated with the spaced abutments K and cylinder spaces L is a cylinder member M, (referring to Figs. 1 to 5, inclusive,) and N, (referring to Fig. 6), which cylinder member, in each instance, is movable with relation to the piston member A; each such cylinder member serving to confine the pressure medium, such as steam, within the cylinder spaces L, during effectual expansion of the former.

A particular provision, construction, combination, association and relative arrangement of parts, members and features, embodying the invention, referring now to Figs. 1 to 5, inclusive, and Fig. 6, is as follows:—The cylinder casing B may be suitably supported by standards 8, adjacent to the end portions thereof; and the open ends of said cylinder casing may be closed by detachable heads 9, comprising journals 10, for the reception of the end bearings 11, of the rotating piston member A; and one of said end bearings 11 may be provided with a flywheel or pulley 12 from which the power generated by the motor may be taken. Suitable packing rings 13 may be provided for the end portions 15 of the cylindrical body 14 of the piston member A; whereby the pressure medium is effectually confined within the cylinder casing B between said end portions 15, subject to the control of the inlet ports C and D and exhaust ports E and F.

The spaced abutments K extend longi-

tudinally of the piston member body 14 in spiral arrangement; whereby the alternating cylinder spaces L are also of spiral formation and extend longitudinally of the piston member body 14. The abutments K therefore simulate enlarged threads upon the piston member body, wound in wide pitch around the same, and terminating at their respective end portions at the end portions 15 of the cylindrical body 14; said abutments K and said end portions 15 having close rotative fit in engagement with the inner walls of the cylinder casing B. Each of the abutments K is provided with an inseat packing strip 16, maintaining effectual relative separation of the cylinder spaces L which alternate spirally with the spaced abutments K.

Where the exhaust ports E and F communicate with spaced portions of the cylinder casing B, in each instance, said cylinder casing is formed with an annular chamber 17, 18, respectively, through which annular chambers the pressure medium has egress to enter the respective exhaust ports. It is with respect to both the annular chambers 17 and 18 and the exhaust ports E and F that the valve means G and H operate in performing their functions; said valve means G and H being each mounted upon the cylinder body 14 and comprising each a plurality of valve bodies 19, each of which fits one of the cylinder spaces L between the spaced abutments K which confine the same, and having free slidable play within such cylinder space L. Each such valve body 19, serves to completely fill and occupy the cylinder space L within which it is installed, radially of the cylinder body 14, and spirally and longitudinally of the latter to an extent commensurate with the length of such valve body.

The lateral dimensions of each valve body are such that it may effectually prevent communication of the cylinder space L in which it is installed with annular chamber 17 or 18; and may likewise be accommodated in entirety between such respective annular chamber 17 or 18 and the respective end portion 15 of the piston body 14 next adjacent to the respective annular chambers 17 and 18; both as shown in Fig. 1 and in diagrammatic Fig. 6. Each of the valve bodies 19 has free slidable play within its respective cylinder space L; and there is one of such valve bodies for each such cylinder space. The valve bodies 19 are shifted, each from one to the other operative position, by heads *a* and the screw action of the spiral abutments K.

Each of the valve bodies 19 is provided with a lug or projection *b* of rectangular formation and substantially diamond-shaped. The heads *a* and lugs *b* coöperate in a shifting operation, and said heads *a* are also substantially diamond-shaped. The heads *a* are provided each with opposite noses or edge portions *c*, and the lugs *b* are correspondingly provided with opposite noses or edge portions *d*, the relative arrangement of the noses *c* and the noses *d*, of each pair, consisting of one head *a* and one lug *b*, being such, that in the initiation of the shifting operation affecting the valve bodies 19 and their respective lugs *b*, the noses *c* and *d* slightly overlap causing one face of the lug *b* to traverse one face of the head *a*, under screw action of the piston body A.

The operation of shifting the valve bodies 19 inwardly to close the exhaust ports E and F is a simple reversal of the operation, causing the valve bodies 19 to move outwardly to open said exhaust ports; it being understood that one exhaust port is opened as the other is closed. Outward of each of the annular chambers 17 and 18, and spaced therefrom sufficiently to provide proper limitations of the outward movements of the valve bodies 19 is an annular chamber *e*.

Passages *f* extend between the heads *a*, communicating each at an end with one of the annular chambers 17 and 18 and with one of the annular chamber *e;* said passages *f* being formed or cut in the inner walls of the cylinder casing B; thus producing the heads *a* which are flush with the inner walls of the cylinder casing B.

To provide for cutting off of each of the exhaust ports E and F at the point of communication of its respective annular chambers 17 and 18 with the cylinder space or cylinder spaces L into which the pressure medium is directly admitted from the respective inlet port C or D, so that an immediate exhaust of the pressure medium may be prevented, I deflect laterally the wall of each of the annular chambers 17 and 18 or of the annular chamber *e* associated with each set of valve bodies 19, as shown at *g* in Fig. 6; this deflection is formed throughout an extent sufficiently to affect one or more of the valve bodies 19 which latter operate in one or more of the cylinder spaces L into which the steam is directly admitted from the respective inlet port C or D; and as the inward and outward movements of the valve bodies 19 in the cylinder spaces L, under control of the heads *a* are limited by the engagements of the lugs *b* upon the valve bodies 19 with the walls of the annular chambers 17 and 18, and the annular chambers *e*, respectively, the valve bodies 19 are prevented from opening communication between the cylinder spaces L in which they lie and the annular chambers 17 or 18 when passing such deflected wall portions of the annular chambers 17 and 18 or annular chambers *e*.

To accommodate the lugs *b* in the shifting of the valve bodies 19 by the coöperation of the heads *a* arranged adjacent to the deflected wall portions *g*, said heads *a* are slightly cut away, as clearly shown in Fig. 6.

The cylinder member M operates in connection with the piston member A and the abutment K and cylinder spaces L of the latter and comprises a plurality of connected heads 20, each of which is formed to fit each of the cylinder spaces L between the spaced abutments K confining the former; so as to effectually fill and occupy such cylinder space in which it may be located, in the operation of the movable cylinder member N, throughout the longitudinal extent of such head 20, cutting off the passage of the pressure medium further through the respective cylinder space L at the point of such occupancy.

The heads 20 are provided with projections 21 and are alternately pivotally connected with links 22, so that the heads 20, projections 21 and links 22 constitute an endless flexible chain 23 of the units, aforesaid; said chain 23 encircling, so as to have free movement thereon, a fixed table or support 24, consisting of two members, 24^a and 24^b, respectively, which are respectively formed in connection with a detachable casing member 25 and an upper enlargement 26 of the cylinder casing B; said casing 25 fitting over said enlargement 26 and inclosing the chain 23 in its upper face of movement.

The table or support 24 is arranged transversely of the piston member A, whereby the chain 23 moves in a plane cutting the plane of the longitudinal axis of the piston member A, and at right angles to the direction of rotation of said piston member A. The member 24^b is spaced slightly above the piston member A, to permit traverse of the chain 23 beneath said member 24^b and above the piston member A. The chain 23 moves in a continuous passage 27, extending through detachable casing member 25, around both members of the fixed table or support 24, through the enlargement 26 of the cylinder casing B, and between the member 24^b of the table or support 24 and the piston member A. The heads 20 are properly spaced apart by means of links 22, so that two or more of the same, (three as shown in Fig. 1), may occupy respective cylinder spaces L at one and the same time, for the purpose aforesaid.

The cylinder M is operated, in the rotation of the piston member A, to advance the connected heads 20 and bring them successively into positions to occupy the cylinder spaces L, by the screw effect of the spiral abutments K.

The inlet ports C and D are arranged intermediate of the portions of the walls of the cylinder casing B, traversed by the sliding valve bodies 19, as well as intermediate of the annular chambers 17 and 18; and said inlet ports are controlled or throttled in any preferred and suitable manner.

Referring to the form of construction shown in Fig. 7, and diagrammatically in Fig. 6, the piston member A, the cylinder casing B, the inlet ports C and D, the exhaust ports E and F, the valve means G and H, the spaced abutments K, and the cylinder spaces L, together with the subsidiary and attendant parts and features thereof, are all the same in construction, combination and relative arrangement, as hereinabove described, and shown in Figs. 1, 2 and 3. But the cylinder member M, movable with relation to the piston member A and serving to confine the pressure medium within the cylinder spaces L during effectual expansion of the former, is of specific construction different from that of the cylinder member N, shown in said last mentioned figures and heretofore described, although operating to the same end. The cylinder member N comprises a plurality of elongated heads 28, extending longitudinally of, and spirally coiled about, a cylindrical body 29, arranged parallel with the cylindrical body 14 of the piston member A. The cylindrical body 29 engages with the abutments K, the elongated heads 28 lying within the cylinder spaces L and alternating with the abutments K, so that the elongated heads 28 substantially mesh with the abutments K, filling and occupying respectively the cylinder spaces L during predetermined portions of their extent as permitted by their spiral formation and the corresponding spiral formation of the cylinder spaces L and abutments K. The cylinder body 29 is mounted to rotate jointly with the cylindrical body 14, and to be rotated by the latter by screw action. To this end, the cylinder casing B is cut away at its top portion, as at 30, to permit engagement of the cylindrical bodies 29 and 14; and a supplemental casing 31, detachably connected with the top of the casing B housing the cylindrical body 29; said body 29 being provided with end bearings 32 accommodated in openings 33 between the supplemental casing 31 and the main casing B. The diameter of the cylindrical body 29 is in proper ratio to the diameter of the cylindrical body 14, so that the said bodies may rotate properly in unison.

In both of the forms of construction described, namely, both cylinder members M and N, said latter members are only effective in operation in connection with the piston member A within a zone of the latter between the zones of play of the valve means G and H, and, of course, between the exhaust ports E and F.

The operation, method of use, and advan-

tages of the improved rotary motor constituting the invention, and of both forms of the same illustrated, are as follows:—Referring to Figs. 1 to 6 inclusive, with the parts in the position illustrated, steam or other pressure medium is being admitted to the piston member A within the cylinder casing B, through the inlet port D, and after traverse of the cylinder spaces L is being exhausted through the annular chamber 17 and the exhaust port E. The valve bodies 19 of the valve means H now close the exhaust port F, being in their inward positions with relation to the piston member A, and held in such inward positions by the engagement of the lugs *b* with the wall of the annular chamber 18. The valve bodies 19 are prevented from outward movement to open the exhaust valve F by the heads *a*, which prevent such movement by obstructing the lugs *b*. The valve bodies 19 of the valve means G are in their outward positions, the exhaust valve E thus being open; and said valve bodies 19 are prevented from further outward movement by the wall of the annular chamber *e*, and are prevented from inward movement by the heads *a* which obstruct the lugs *b* upon said valve bodies 19. The annular chamber 17 is always closed at the deflected wall portion *g* thereof, and if the steam or other pressure medium be cut off from the inlet port D, it will thus be prevented from immediate exhaust through one or more of the cylinder spaces L and the annular chamber 17, and will reverse the direction of motion of the piston member A, from that indicated by the arrow in Fig. 6, and the noses *d* of the lugs *b*, upon the valve bodies 19 of the valve means G will cross the noses *c* upon the heads *a*, and the screw action of the piston member A will force the said valve bodies 19 inwardly of the piston member until said valve bodies close the annular chamber 17 and cut off the exhaust port E. The engagement of the lugs *b* with the wall of the annular chamber 17 prevents inward movement of the valve bodies 19, and the heads *a* prevent outward movement of the valve bodies 19 by obstructing the lugs *b* upon said valve bodies. Simultaneously with the above operations, the noses *d* of the lugs *b* of the valve bodies 19 of the valve means H will cross the noses *c* of the heads *a* and the said valve bodies 19 will be forced outwardly by the screw action of the piston member A, opening the exhaust port F by opening the annular chamber 18. The valve bodies 19 of said valve means H will be prevented from further outward movement by the engagement of the lugs *b* with the wall of the annular chamber *e;* and the heads *a* will prevent inward movement of said valve bodies 19 by obstructing the lugs *b* upon the latter. As described, the annular chambers 17 and 18 are always closed at their points of communication with the valve spaces L into which steam is first admitted from the inlet ports C and D, because of the inward direction of the walls of the annular chamber 17 and the annular chamber *e* at the proper predetermined points, so that the valve bodies 19 can never open the annular chambers 17 and 18 to communicate with the exhaust ports E and F, respectively, in such manner as to admit the pressure medium directly to either exhaust port from the cylinder space L into which such pressure medium is first admitted.

The cylinder member M, in the form of construction shown in Figs. 1 to 4, inclusive, operates continuously to obstruct the cylinder spaces L by means of the connected and linked heads 20, which are successively admitted to and close said cylinder spaces L throughout predetermined extents thereof, thus forming confined spaces within which the pressure medium has its full operative expansion.

In the form of construction shown in Fig. 7, the movable cylinder N operates to the same end as the cylinder member M, but is a more simple form of construction, having no relatively movable parts to get out of order; whereas its elongated heads 28 effectually confine the pressure medium within the cylinder spaces L for proper operative expansion of such pressure medium.

It is understood that the pressure medium, in both forms of construction, exhausts from the cylinder spaces L to the annular chambers 17 and 18, and thence, in accordance with the positions of the valve means G and H to the exhaust ports E and F. The lugs *b* upon the valve bodies 19 pass freely between the heads *a;* and said lugs and heads are of proper formation, preferably diamond-shaped, to effect the shifting of the valve bodies 19; and to this end there is preferably a slight inclination or lack of parallelism between the longer axes of each pair consisting of one lug *b* and one head *a*, so that the noses, *d*, and *c*, respectively, of the same, may cross or overlap in initiating the shifting movement.

The rotary motor described may readily be reversed; and in the operation of shifting the valve means G and H as above described, are freely reversed in reversing the direction of motion of the piston member A. Full expansion of the pressure medium is permitted, in the cylinder spaces L partially obstructed by the cylinder member M or N; the entire mechanism is capable of long and continuous operation without material depreciation of working efficiency.

I do not desire to be understood as limiting myself to the specific construction, combination, relative arrangement, association and provision of parts, members and fea-

tures, but reserve the right to vary the same in adapting the improvements to varying conditions of use, without departing from the spirit of the invention or the terms of the following claims.

Having thus described my invention, I claim and desire to secure by Letters Patent:—

1. An improved motor of the character described, comprising a cylindrical piston member, a casing for the piston member there being cylinder spaces between the casing and the piston member, inlet ports adapted to communicate with the cylinder spaces, exhaust ports, valve means regulating communication between the cylinder spaces and the exhaust ports, and a cylinder member movable with relation to the piston member and serving to confine the pressure medium within the cylinder spaces during the expansion of the pressure medium, said cylinder member comprising a plurality of separate heads.

2. An improved motor of the character described, comprising a cylindrical piston member, a casing for the piston member, there being cylinder spaces between the casing and the piston member, inlet ports adapted to communicate with the cylinder spaces, exhaust ports, valve means regulating communication between the cylinder spaces and the exhaust ports, and a cylinder member movable with relation to the piston member and serving to confine the pressure medium within the cylinder spaces during expansion of the pressure medium; said valve means comprising a plurality of valve bodies slidably fitting said cylinder spaces.

3. An improved motor of the character described, comprising a cylindrical piston member, a casing for the piston member, there being cylinder spaces between the casing and the piston member, inlet ports adapted to communicate with the cylinder spaces, exhaust ports, valve means regulating communication between the cylinder spaces and the exhaust ports, and a cylinder member movable with relation to the piston member and serving to confine the pressure medium within the cylinder spaces during expansion of the pressure medium; said valve means comprising a plurality of valve bodies slidably fitting said cylinder spaces, and means for shifting said valve bodies in the rotation of said piston member.

4. In an improved motor of the character described, a cylindrical piston member, a casing for the piston member, there being a cylinder space between the casing and the piston member, inlet ports adapted to communicate with the cylinder space, exhaust ports, and valve means for each of the exhaust ports, comprising a valve body slidable in said cylinder space, means limiting the shift of said valve body, and means causing the shift of said valve body in the operation of said piston member.

5. In an improved motor of the character described, a cylindrical piston member, a casing for the piston member, there being a cylinder space between the casing and the piston member, inlet ports adapted to communicate with the cylinder space, exhaust ports, and valve means for each of the exhaust ports, comprising a valve body slidable in said cylinder space, means limiting the shift of said valve body, and means causing the shifting of said valve body in the operation of said piston member; said shifting means comprising a head projecting inwardly of said casing, and a lug upon said valve body with which said head coöperates.

6. In an improved motor of the character described, a cylindrical piston member, a casing for the piston member, there being a cylinder space between the casing and the piston member, inlet ports adapted to communicate with the cylinder space, exhaust ports, and valve means for each of the exhaust ports, comprising a valve body slidable in said cylinder space, means limiting the shift of said valve body, and means causing the shifting of said valve body in the operation of said piston member; said shifting means comprising a head projecting inwardly of said casing, and a lug upon said valve body with which said head coöperates, said head and said lug being each provided with noses arranged to cross each other in the initiation of the shifting means.

7. In an improved motor of the character described, a cylindrical piston member, a casing for the piston member, there being a plurality of spiral cylinder spaces between the casing and the piston member, inlet ports adapted to communicate with the cylinder spaces, an exhaust port, and valve means controlling the communication of the exhaust port with the cylinder spaces; said valve means comprising a plurality of valve bodies slidable in the cylinder spaces, means limiting the shift of the valve bodies, and means shifting the valve bodies; said shifting means comprising a plurality of spaced heads projecting inwardly from said casing, and lugs upon said valve bodies with which said heads coöperate to shift said valve bodies in combination with the screw action of said piston member and the walls of said spiral cylinder spaces.

8. In an improved motor of the character described, a cylindrical piston member, a casing for the piston member, there being a plurality of spiral cylinder spaces between the casing and the piston member, inlet ports adapted to communicate with the cylinder spaces, an exhaust port, and valve means controlling the communication of the exhaust port with the cylinder spaces; said valve means comprising a plurality of valve

bodies slidable in the cylinder spaces, means limiting the shift of the valve bodies, and means shifting the valve bodies; said shifting means comprising a plurality of spaced heads projecting inwardly from said casing, and lugs upon said valve bodies with which said heads coöperate to shift said valve bodies in combination with the screw action of said piston member and the walls of said spiral cylinder spaces; there being spaced annular chambers adapted respectively to accommodate said lugs in the shifted positions of said valve bodies.

9. In an improved motor of the character described, a cylindrical piston member, a casing for the piston member, there being a plurality of cylinder spaces between the casing and the piston member, inlet ports adapted to communicate with said cylinder spaces, an exhaust port and valve means regulating the communication of said exhaust port with said cylinder spaces; said valve means comprising a plurality of valve bodies slidable in said cylinder spaces, and traveling with said piston member, means limiting the shift of said valve bodies, shifting means for said valve bodies, and means varying the limitation of shift of said valve bodies at a predetermined point in their path of travel with said piston member.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

LAURENCE P. STEVENS.

Witnesses:
CAL. F. HUNTER,
FRED A. MANSFIELD.