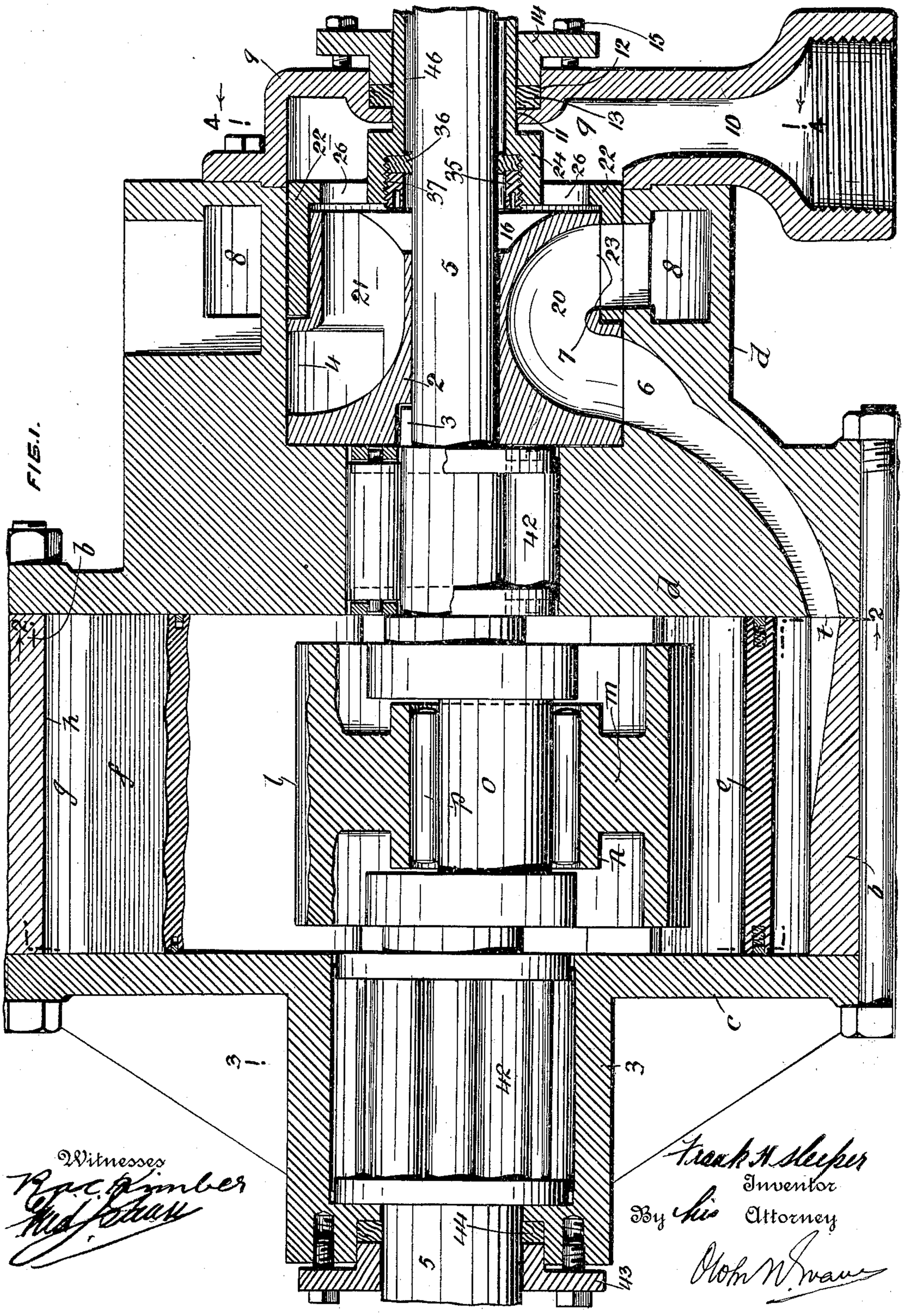
No. 696,767. Patented Apr. 1, 1902.

F. H. SLEEPER.

ENGINE.

(Application filed Jan. 2, 1901.)

(No Model.) 3 Sheets—Sheet 1.



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(No Model.) 3 Sheets—Sheet 2.

FIG. 2.

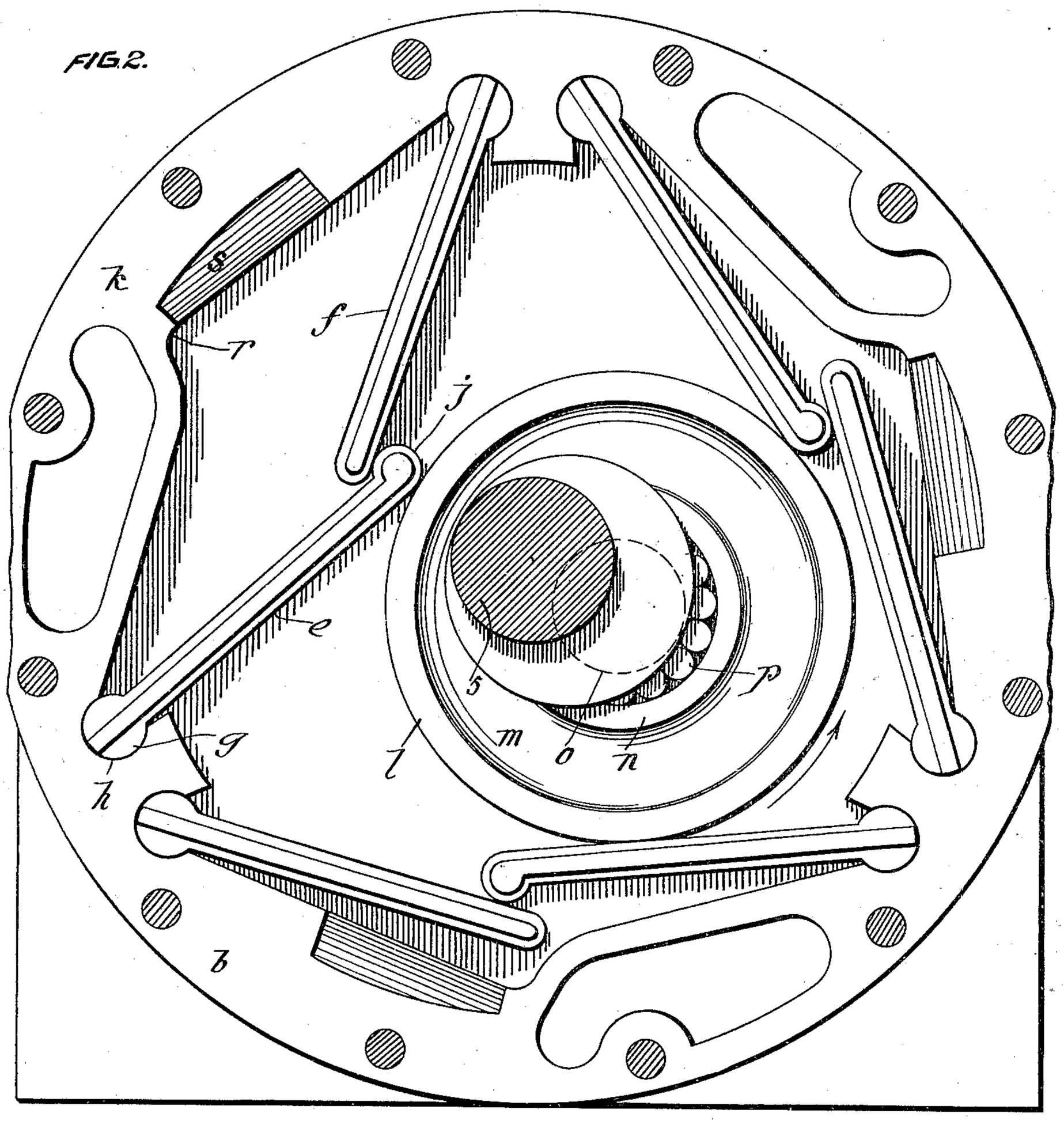
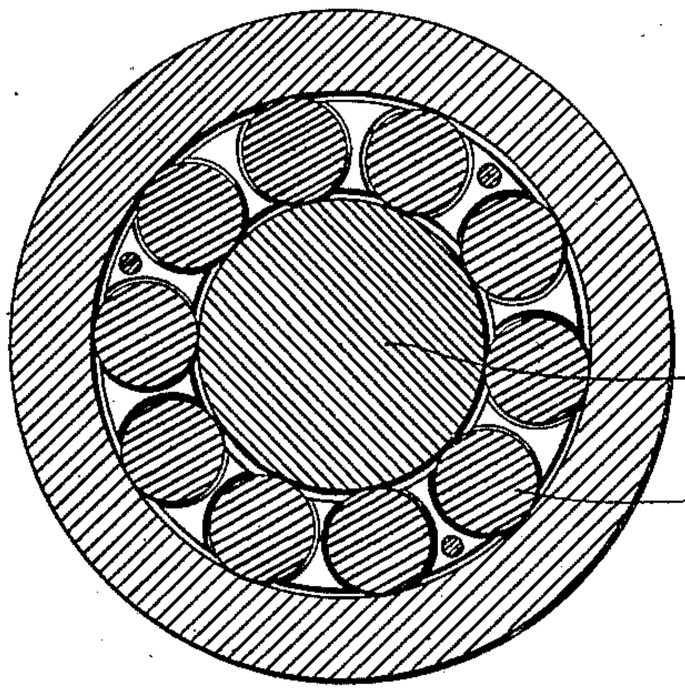


FIG. 3



Witnesses
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FIG. 6.

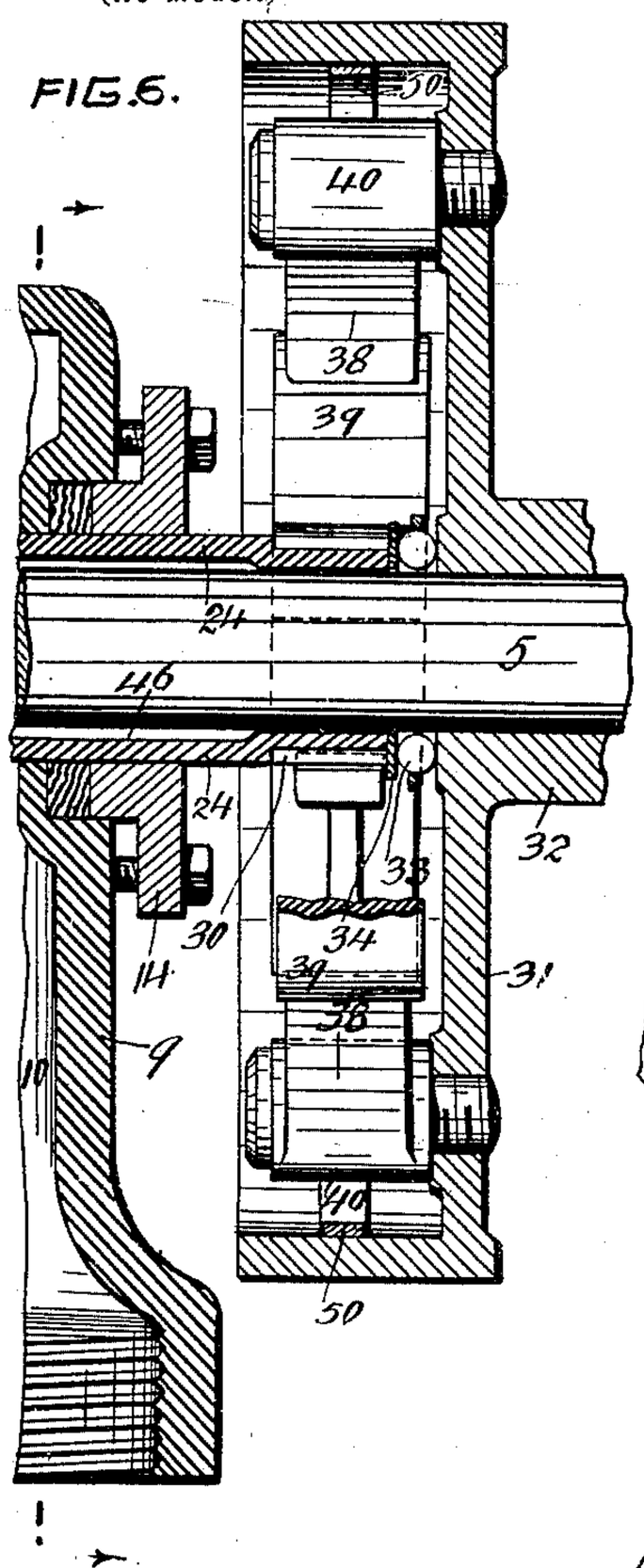
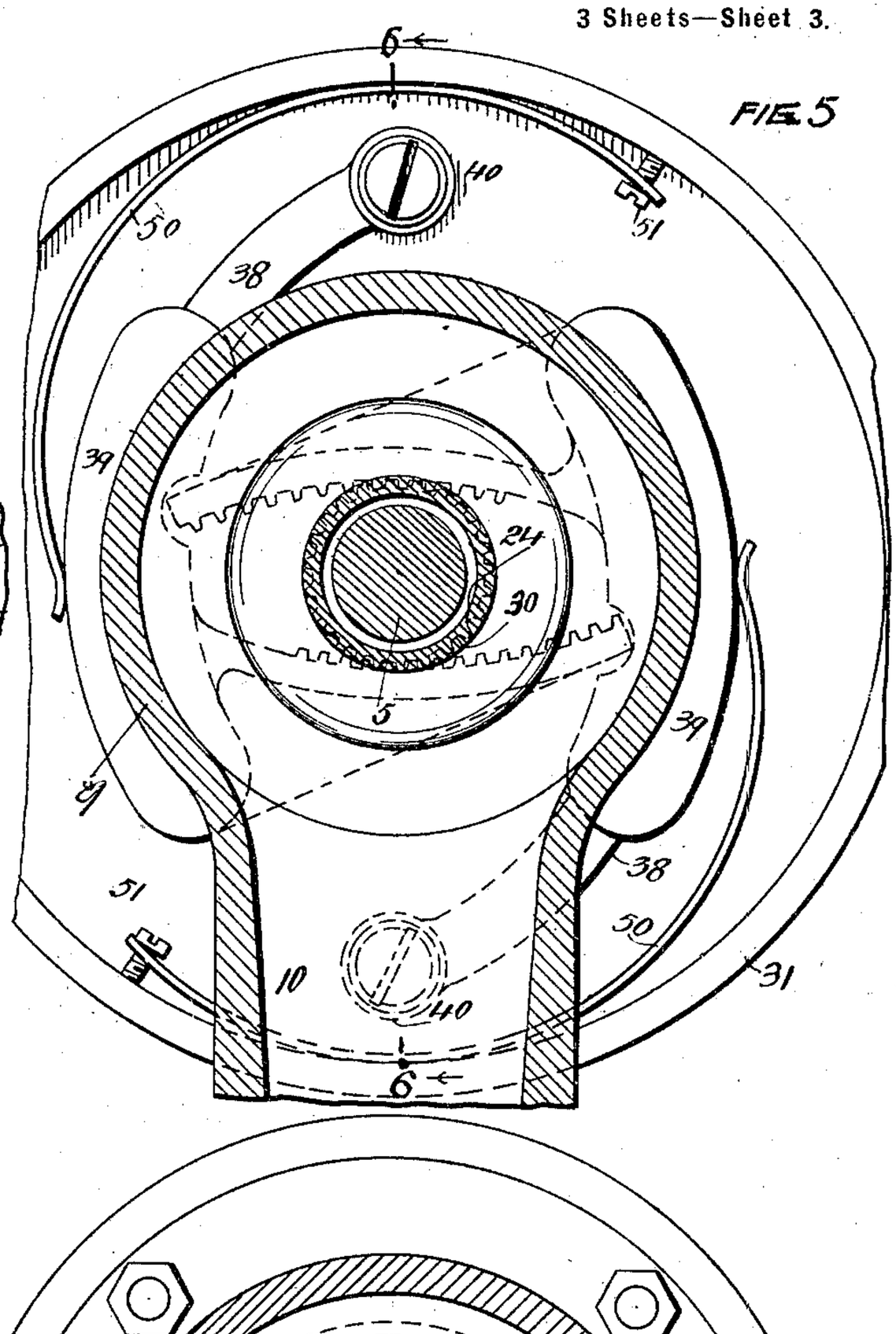


FIG. 5



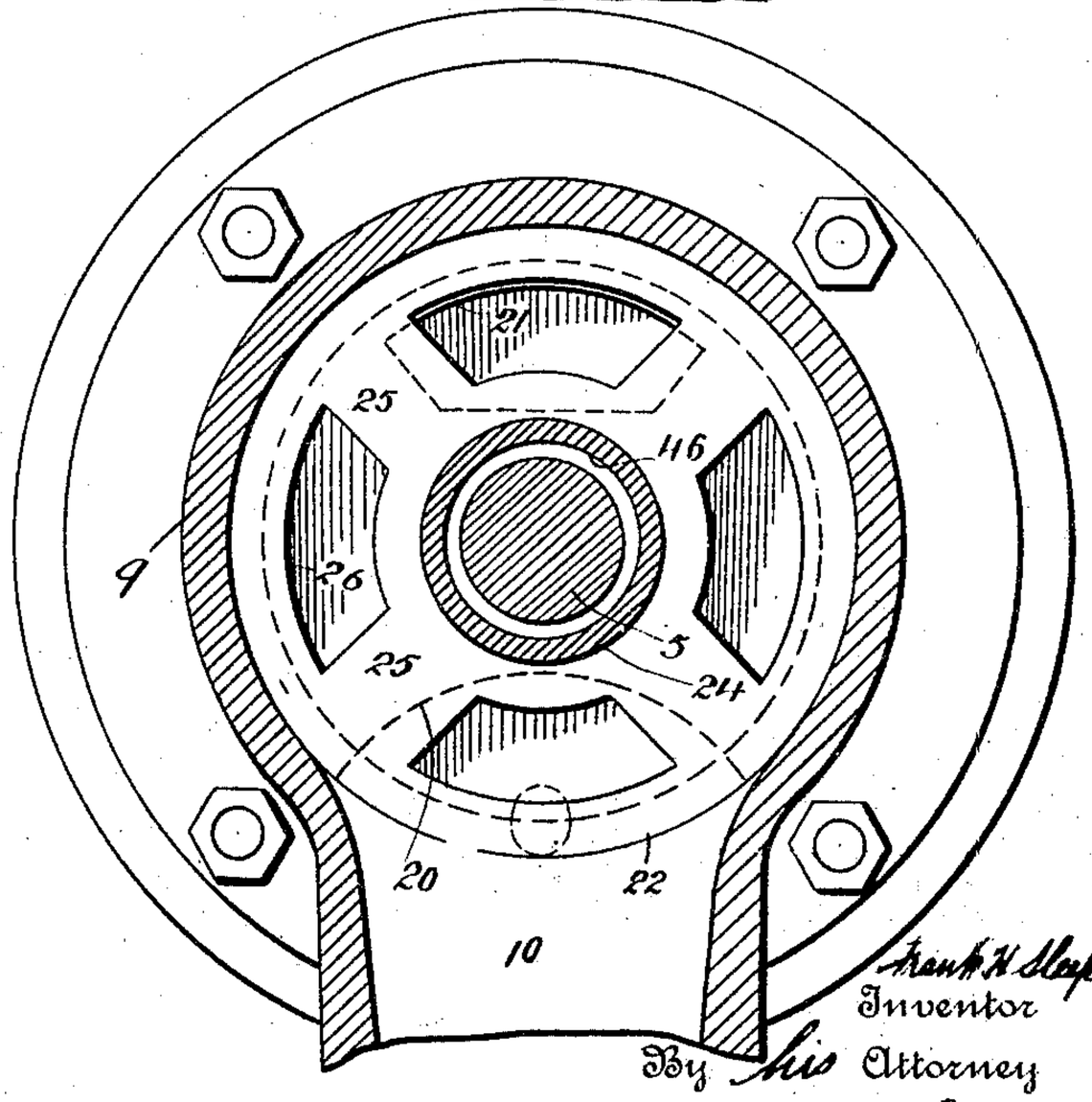


FIG. 4.

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UNITED STATES PATENT OFFICE.

FRANK HENRY SLEEPER, OF WESTMOUNT, CANADA, ASSIGNOR OF ONE-HALF TO THE NORTH WEST SHOE COMPANY, LIMITED, OF MONTREAL, CANADA, A CORPORATION.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 696,767, dated April 1, 1902.

Application filed January 2, 1901. Serial No. 41,925. (No model.)

To all whom it may concern:

Be it known that I, FRANK HENRY SLEEPER, of the town of Westmount, district of Montreal, and Province of Quebec, Canada, have invented certain new and useful Improvements in Engines; and I do hereby declare that the following is a full, clear, and exact description of the same.

My present invention relates particularly to the type of engine disclosed in my pending application filed on October 29, 1900, under Serial No. 34,772, which may be said, briefly speaking, to consist, in its broadest conception, of an engine having an expansible chamber arranged adjacent to a shaft which is preferably either cranked or provided with an eccentric, said chamber consisting of a wall stationary relatively to said shaft and a flexible wall between said stationary wall and said shaft and inclosing a portion of said stationary wall, with tight joints at the abutting edges of said stationary and flexible walls, and said chamber being adapted upon the admission of an expansile fluid thereinto to distend the flexible wall thereof toward said shaft, an intermediary being provided which is constantly free of said stationary wall and rotatively connects said shaft to said flexible wall, whereby the thrust of said flexible wall in the expansion of said chamber will be caused to rotate the shaft, valvular mechanism being provided to cause said chamber to exhaust when the distention thereof fails to exert a rotative force upon the crank, thereby leaving the wall of said chamber adjacent to the crank free to be moved back to its normal position by the crank or eccentric as it rotates by its own momentum or under the influence of another expansible chamber similarly connected, but arranged at a different angular position relatively to the shaft. I prefer to utilize, and the engine disclosed in said pending application comprises, a series of such chambers and valvular means to cause an expansile fluid to be supplied to said chambers successively.

My invention has for its object to provide an engine that will use up in friction less of the power of the motive fluid and have less area of rubbing surfaces to pack and fewer points of possible leakage, thereby materially increasing the efficiency of the engine.

The invention may be said, briefly, to consist in forming the flexible or thrust walls of the expansible chambers intact, in that the component parts of each of said thrust-walls bear one upon the other with steam-tight relation and bear collectively at one point upon the eccentric, thereby in conjunction with a portion of the frame of the engine and said intact inner wall forming a chamber complete in itself. This construction of the chambers obviates the necessity of forming the eccentric of as great width as the said thrust-walls of the chambers. I also provide a novel form of cut-off valve applicable particularly to this type of engine and adapted to automatically control the motive-fluid supply to the chambers and regulate the power of the engine to the load to be overcome. I further improve this type of engine by constructing same to utilize roller-bearings to receive the side load upon the shaft and the thrust upon one of the valves thereof and to overcome the unnecessary friction between the crank and the intermediary therebetween and the thrust-walls of the chambers.

Other features of novelty are embraced; but for full comprehension thereof and of my invention in its entirety reference must be had to the accompanying drawings, forming a part of this specification, in which like reference characters indicate the same parts, and wherein—

Figure 1 is a longitudinal vertical sectional view of an engine constructed according to my present invention. Fig. 2 is a transverse vertical sectional view taken on line 2 2, Fig. 1, and illustrating particularly my improved expansible chambers. Fig. 3 is a similar view to Fig. 2, but taken on line 3 3, Fig. 1, and illustrating particularly one of the shaft-bearings. Fig. 4 is also a transverse vertical sectional view, but taken on line 4 4, Fig. 1, and illustrating particularly my improved automatic cut-off valve. Fig. 5 is a right-hand side elevation looking at Fig. 1 of my improved engine, partly in section, and illus-

trating particularly the means for automatically regulating the supply-port of my improved cut-off valve; Fig. 6, a vertical sectional view taken on line 6 6, Fig. 5.

In the present embodiment of my invention I construct the casing of my engine, as formerly, with a central circular portion or body *b* and two end portions or heads *c* and *d*. The central portion *b* embodies three expansible chambers, preferably arranged equidistant apart, and to that end the interior of said body is cored out in hexagonal form with a pair of blades *e* and *f*, respectively, pivoted by a ball-and-socket joint adjacent to one another at each alternate angle by having their said pivoted ends enlarged and rounded, as at *g*, and taking into sockets *h*. Each of the blades *e* is enlarged and rounded at its free end to form a bead *j*, upon which the blade *f* of the next adjacent pair bears, and thereby with the portion *k* of the casing between the points at which said blades *e* and *f* are pivoted forming a chamber complete in itself. The blades *e* bear upon the crank of the shaft through the medium of an antifriction intermediary comprising an annular bearing part *l*, which receives the thrust of the yielding wall constituted by the blades *e* and *f*, while a web *m* connects said annular bearing part to a hub *n*, which encircles the wrist *o* of the crank, between which and the interior of said hub a roller-bearing *p* is located, the annular bearing part being less in width than the space between the heads *c* and *d* to avoid the friction that would exist if it bore at its side edges upon said heads. The portions *k* of the casing are recessed, as at *r*, to receive the blades *f* and the beaded ends of the blades *e*, and the inner end *s* of what serves alternately as a supply and exhaust port *t* leads into each of said recesses *r* and leads with diminishment of depth to a point about midway of the width of the casing *b*, while these ports *t* are under the control of an automatic cut off of novel construction. This automatic cut-off consists of a main cylindrical valve 2, connected to the shaft by a feather 3 and located in a valve-chamber 4, through which the shaft 5 projects. This valve-chamber communicates with the expansible chambers of the engine by means of the series of ports *t*, the outer ends 6 whereof are cut in the wall of said valve-chamber near the inner end thereof, while a series of ports 7 in the wall of said cylindrical valve-chamber near the outer end thereof and in axial line with said ports 6 effect a communication between said valve-chamber and an annular steam-chest 8.

An exhaust-cap 9 is secured by screws to the outside face of the head *d* and is of a size to inclose the end of the valve-chamber. This cap has a lateral exhaust-passage 10, cast in one therewith, and a shaft-passage 11 centrally thereof, the outer end of said shaft-passage being increased in diameter to form a packing-recess 12, in which packing 13 is held against the shaft by a gland 14, secured by screws 15 to the outside of the cap 9.

The valve 2 above mentioned is similar to the valve disclosed in my said pending application in that it has a semicircular port 20 in its perimeter to effect at times a communication between the corresponding ports 6 and 7 and also has a curved port 21 to at times and successively effect a communication between each of the ports 6 and the exhaust-passage of the engine. The outer end of the port 20 is in width preferably about eighty-five degrees of the circumference of the valve 2. I augment in my present invention the functions of this automatic cut-off valve by providing means for automatically controlling the amount of steam supplied therethrough to the engine, and to this end I diminish the outer half of the valve 2 and core out said outer end to form a flared recess 16. An annular slide 22 is inserted between this diminished portion of the valve 2 and the portion of the wall of the valve-chamber having the ports 7 therein and has a port 23, which communicates with the outer end of port 20 of the valve. A sleeve 24 is connected to this annular slide by a series of bridge-pieces 25, thus providing a series of ports 26, effecting a communication between the flared recess 16 and the exhaust-cap. The sleeve 24, which is loose upon the shaft, projects through the passage 11 and has the exterior of its outer end formed with gear-teeth 30. A circular box 31 is formed centrally thereof with a hub 32, by means of which it is keyed to the shaft adjacent to the end of this sleeve, while a thrust ball-bearing 33 is located between the inner end of said hub and said sleeve, and a steel washer 34 prevents the balls being tripped upon by the ends of the teeth 30. This sleeve is recessed at its end adjacent to the slide-valve to receive a gland 35, between which and the inner wall of said recess a packing 36 is located, said gland being held in place by screws 37 and the function of this packing being to prevent leakage at this point during exhaust. A pair of interiorly-gear-toothed quadrants 38, weighted, as at 39, are pivotally mounted upon the interior of the vertical side of said box 31 at diametrically opposite points, as at 40, and the gear-teeth thereof intermeshing with the gear-teeth 30 upon the sleeve of the slide-valve.

The shaft 5 is supported in a roller-bearing 42 in each of the heads *c* and *d*, and the outer end of the bearing in the head *c* receives a packing-gland 43 and packing 44. The slight vibration of the shaft in its roller-bearings is accommodated and the annular slide-valve prevented from binding in its seat by the feather-and-groove connection, hereinbefore described, between the valve 2 and the shaft and by increasing the internal diameter of the sleeve, as at 46, from within a short distance of its toothed outer end to its inner end.

As the speed of the engine exceeds that required to overcome its load, the weighted sides of the gear-toothed quadrants will be caused by centrifugal force to move away from the shaft and in so doing turn the sleeve and slide the annular valve over the valve 2, and thereby diminish the supply-port 20.

By constructing an engine according to the foregoing a minimum quantity of the power of the motive fluid will be consumed by friction, because there will be no rubbing of the intermediary, which receives the thrust of the expansible chambers and transmits it to the crank at its edges upon the heads *c* and *d*, as it runs perfectly free. For the same reason there will be a minimum area of rubbing surfaces to pack, and, furthermore, the only points of possible leakage from the expansible chambers are along the straight edges of the thrust-walls, and as these points call for straight-line packing, which is the most effective, the maximum efficiency from a motive fluid of given pressure is secured. A pair of elliptical springs 50 bear upon said weighted quadrants and keep them yieldingly in their position near the shaft. These springs are of less circumference than the interior of the box and are each held adjustably at one end to the box by a screw 51, whereby the tension of said springs is varied. The supply-port of the valve is timed relatively to the ports *t*, leading to the expansible chambers, to cause the motive fluid to be supplied to each chamber a short time before the crank reaches the dead-center, thereby cushioning the blades and preventing them from rattling.

What I claim is as follows:

1. In an engine the combination with a shaft of an expansible chamber consisting of a wall stationary relatively to said shaft, a flexible intact wall between said stationary wall and said shaft and hinged at two of its opposite sides to said stationary wall, means for closing the space between the stationary wall and the other side edges of said flexible wall, an expansile-fluid supply to and exhaust from said expansible chamber and means for rotatively connecting said flexible wall to said shaft, substantially as described.

2. In an engine the combination with a shaft of an expansible chamber consisting of a wall stationary relatively to said shaft, a flexible intact wall between said stationary wall and said shaft and hinged at two of its opposite sides to said stationary wall, means for closing the space between the stationary wall and the other side edges of said flexible wall an expansile-fluid supply to and exhaust from said expansible chamber and an eccentric carried by said shaft to receive from said flexible wall and transmit to said shaft the thrust due to the expansion of said expansible chamber substantially as described.

3. An engine comprising a casing; a pair of heads closing the ends of said casing; a shaft extending through said casing; a portion of the shaft within said casing being offset; a series of pairs of blades pivotally connected at one side edge of each to the interior of said casing, the opposite side edges of the blades of each pair overlapping one another; and the other side edges of said blades being in contact with said heads; an intermediary between the offset portion of said shaft and each pair of blades, and an expansile-fluid supply to and exhaust from the space between each pair of blades and the portion of the casing covered thereby, substantially as described.

4. An engine comprising a casing of interior hexagonal form and recessed at its alternate angles and a pair of heads closing the ends of said casing; a shaft extending through said casing; a portion of the shaft within said casing being offset; a series of pairs of blades pivotally connected at one side edge of each to the interior of said casing at the other angles, the opposite side edges of the blades of each pair overlapping one another and the other side edges of said blades being in contact with said heads; the blades adjacent to the shaft being each formed with a bead projecting toward the overlapping blade; an intermediary between the offset portion of said shaft and each pair of blades, and an expansile-fluid supply to and exhaust from the space between each pair of blades and the portion of the casing covered thereby, substantially as described.

5. An engine comprising a casing, a shaft extending through said casing, roller-bearings for said shaft in the walls of said casing, a motive-fluid supply to and exhaust from said casing, an automatic cut-off valve carried by the shaft for controlling the supply of said motive fluid, means for yieldingly connecting said cut-off valve to said shaft to accommodate the vibration of said shaft in its roller-bearings, means for causing said motive fluid to rotate said shaft, substantially as described.

6. In an engine the combination with the frame thereof, a shaft extending through said frame, roller-bearings for said shaft in said frame, a steam-chest, a cylindrical valve having a steam-port and mounted loosely upon said shaft for controlling the supply of steam from said steam-chest to said engine, and a feather connecting said valve to said shaft, substantially as described, and for the purpose set forth.

7. In an engine the combination with the frame thereof, a shaft extending through said frame, roller-bearings for said shaft in said frame, a steam-chest, a cylindrical valve having a steam-port leading at one end from the perimeter thereof and mounted loosely upon said shaft for controlling the supply of steam from said steam-chest to said engine, a feather connecting said valve to said shaft, an annular slide-valve having a port to register with and control the port in said cylindrical valve, a sleeve fitting over said shaft adjacent to said cylindrical valve and having its interior of increased diameter from the end thereof

adjacent to said cylindrical valve to within a short distance of the other end thereof, means for connecting said sleeve to said slide-valve, and means connected to the shaft and to said sleeve and actuated by centrifugal force to rotate said sleeve upon said shaft, substantially as described and for the purpose set forth.

8. In an engine the combination with the steam-chest and a cylindrical valve having a port therein leading from the perimeter thereof for controlling the steam-supply from said steam-chest to said engine of an annular slide-valve encircling the portion of said valve having said port therein, said annular slide-valve having a port to register with and control said supply-port, and means under the control of a rotating part of said engine for causing said annular slide-valve to slide over the surface of said cylindrical valve, substantially as described and for the purpose set forth.

9. In an engine the combination with the frame thereof, a shaft extending through said frame, a steam-chest, a cylindrical valve having a steam-port leading at one end from the perimeter thereof and an exhaust-port leading from the engine side to the opposite end thereof, said valve being mounted upon said shaft for controlling the supply of steam from said steam-chest to said engine, an annular slide-valve having a port to register with and control the steam-port in said cylindrical valve, a sleeve fitting over said shaft adjacent to said cylindrical valve, a series of bridge-pieces connecting said sleeve to said slide-valve, a cap for closing the outer end of the valve-chamber containing said cylindrical valve and slide-valve and having an exhaust-passage leading therefrom, and means connected to the shaft and to said sleeve and actuated by centrifugal force to rotate said sleeve upon said shaft, substantially as described and for the purpose set forth.

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

FRANK HENRY SLEEPER.

Witnesses:
WILLIAM P. MCFEAT,
FRED. J. SEARS.