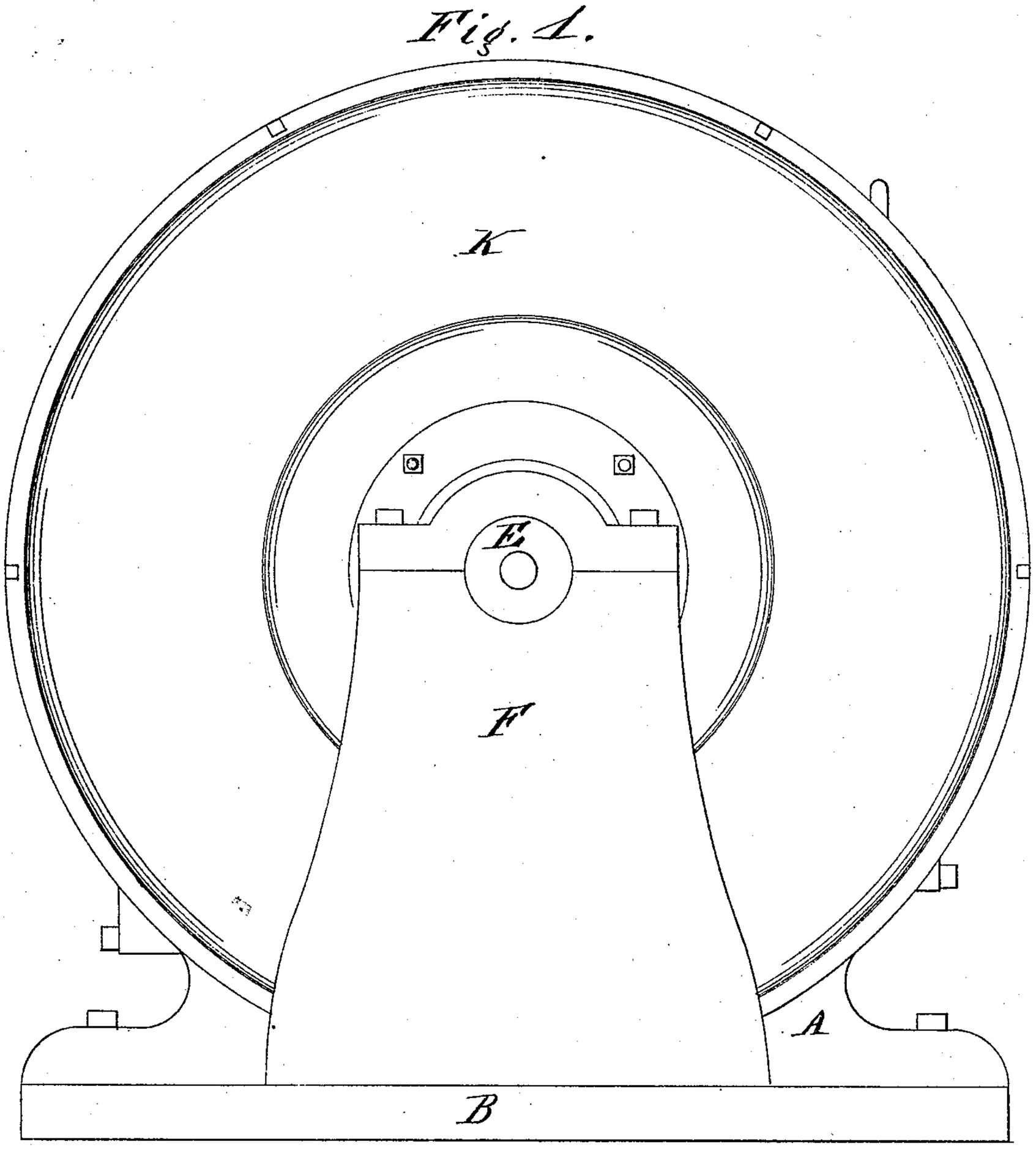
7 Sheets--Sheet 1.

W. R. MANLEY.

Rotary Engines.

No. 152,042. Patented June 16, 1874.

Fig. 1.



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Rotary Engines.

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Fig. 2.

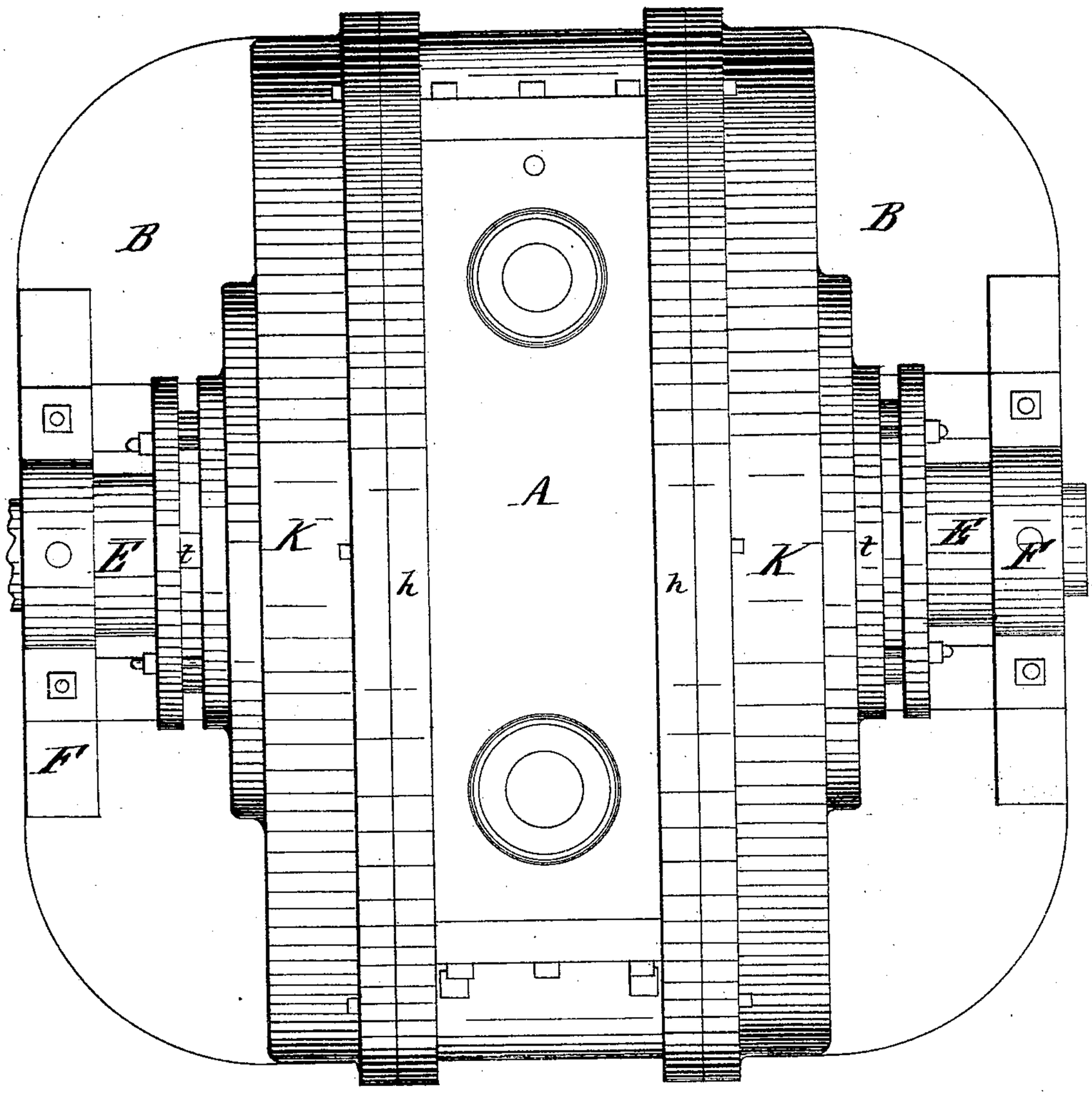

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Fig. 3.

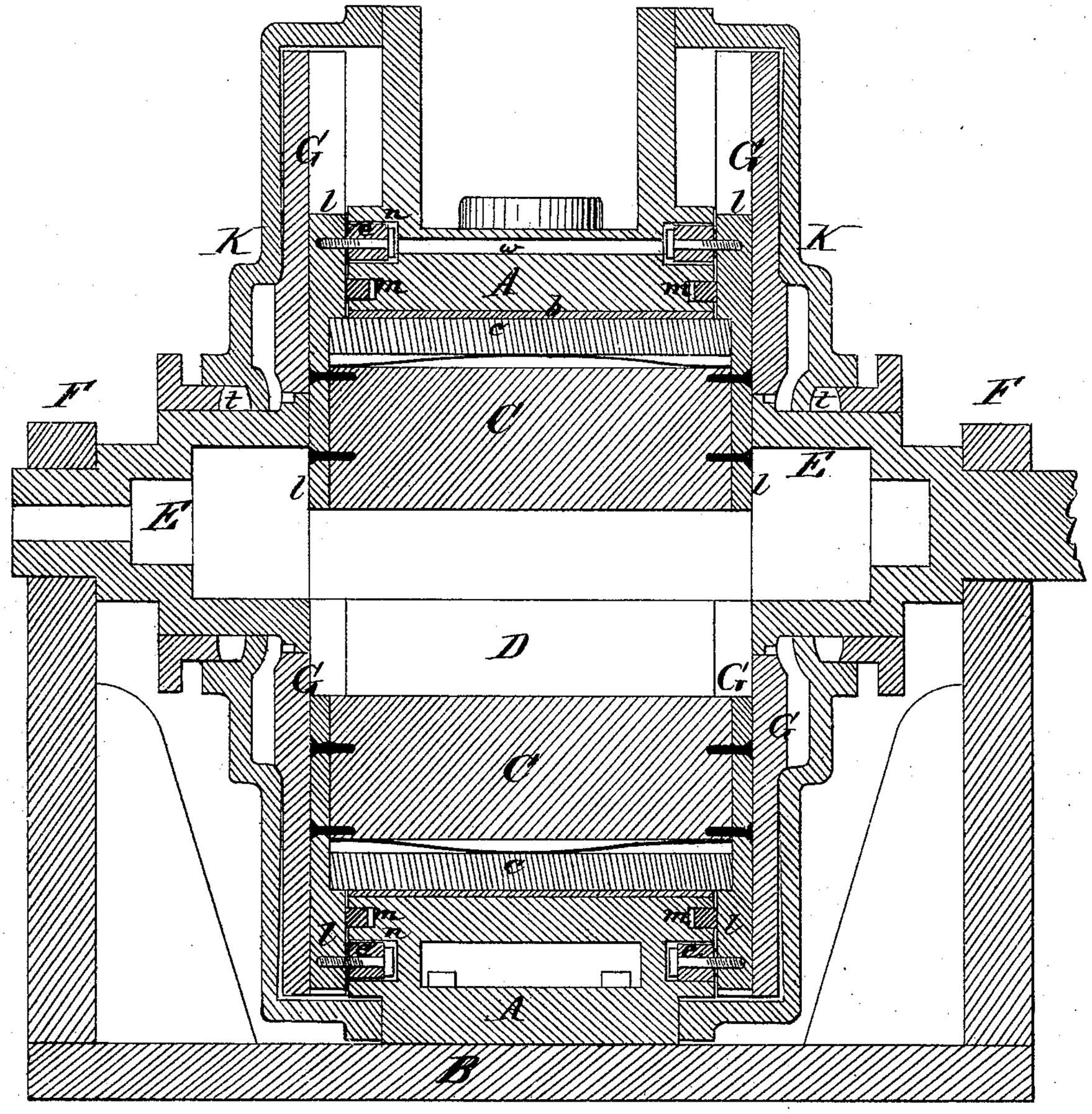

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Fig. 4.

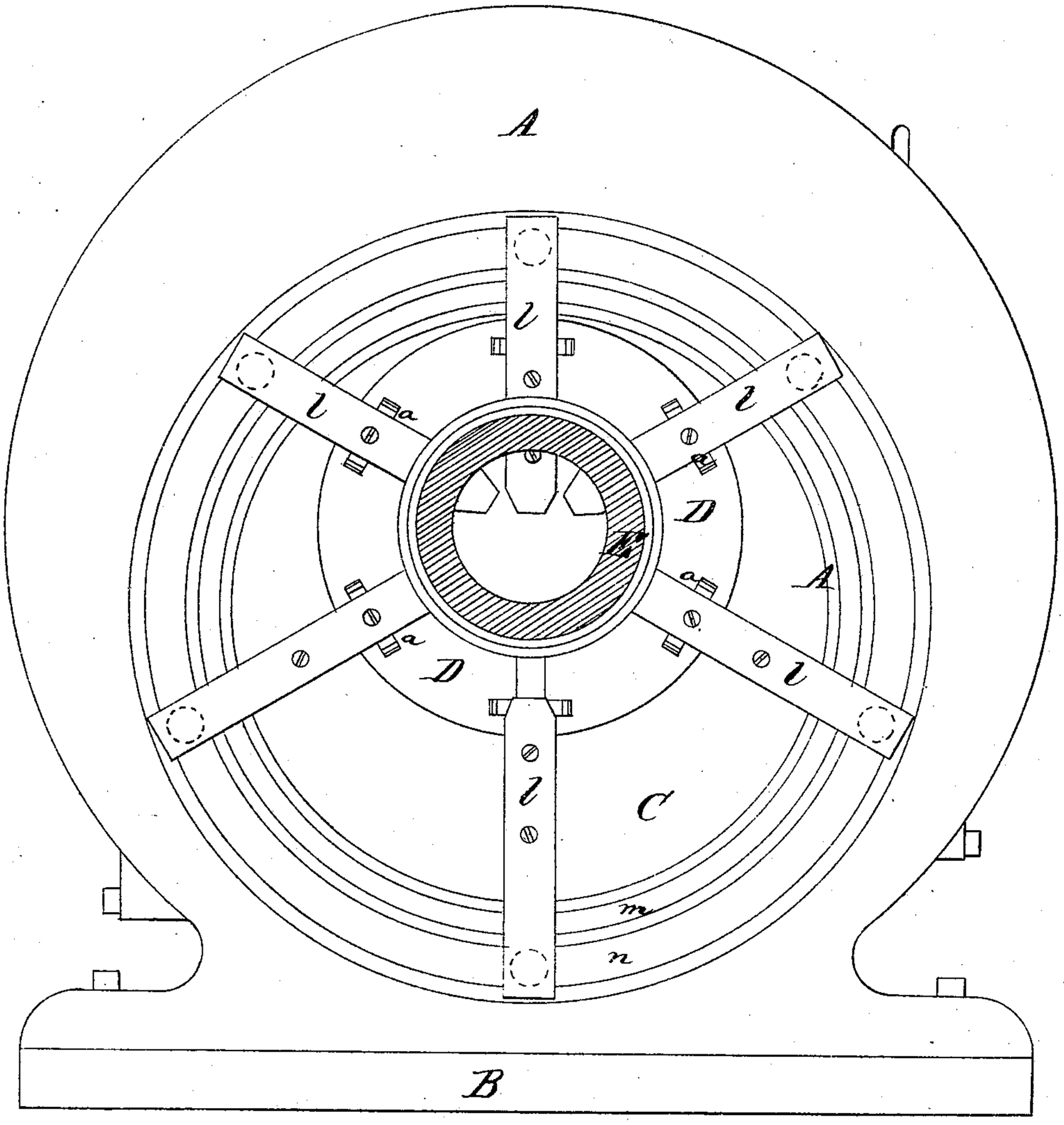

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Fig. 5.

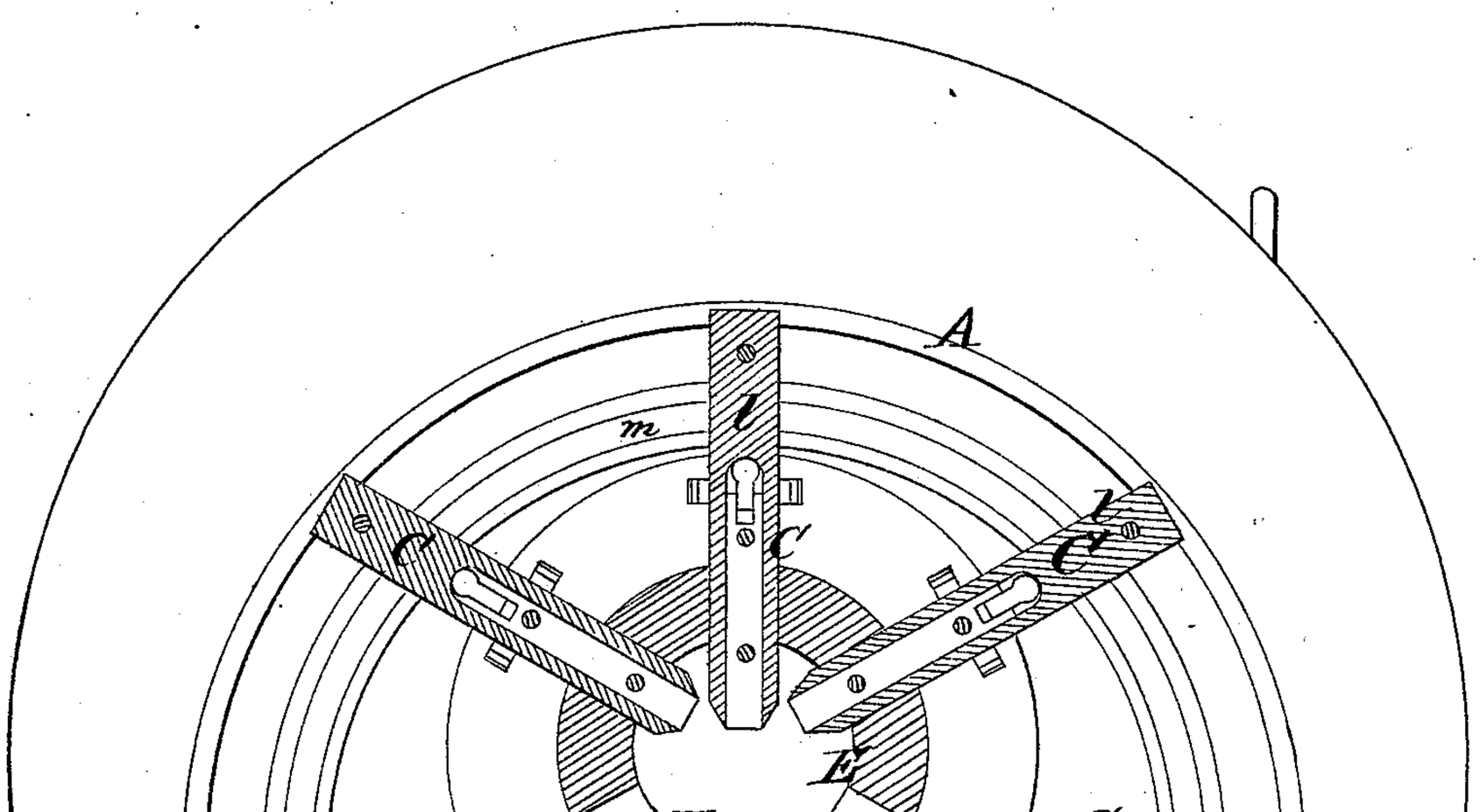

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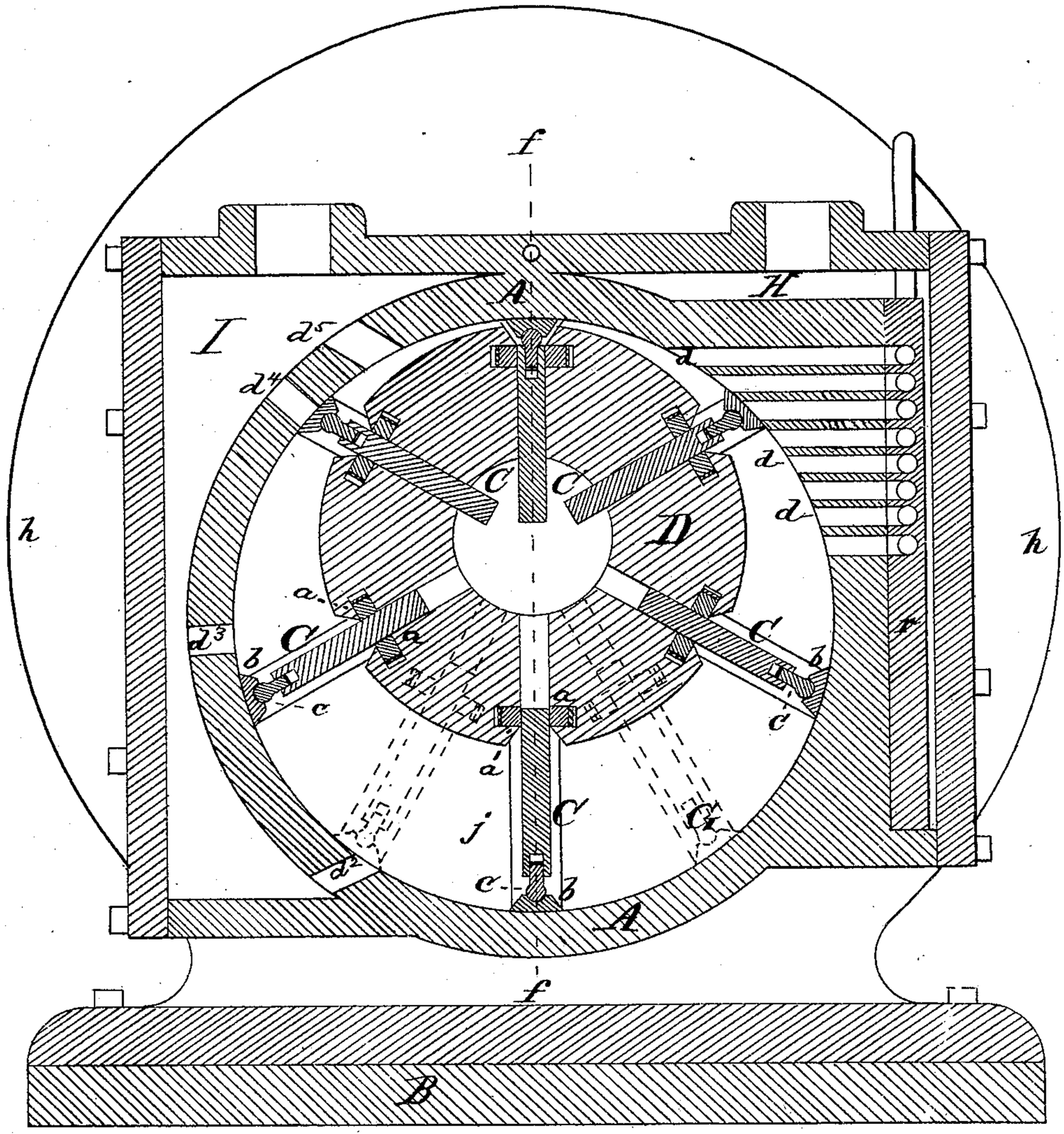
Fig. 6.



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Rotary Engines.

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Fig. 7.

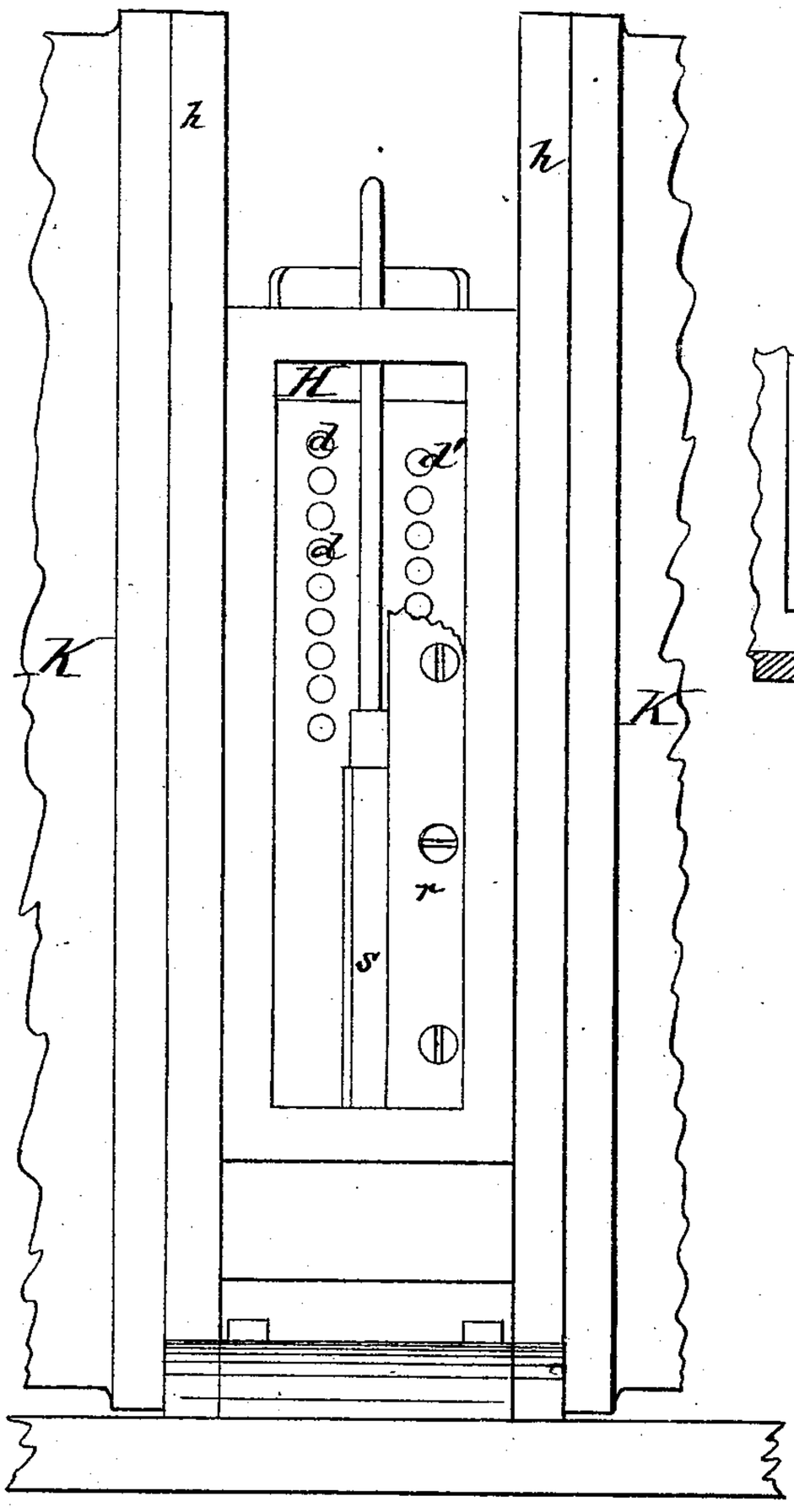
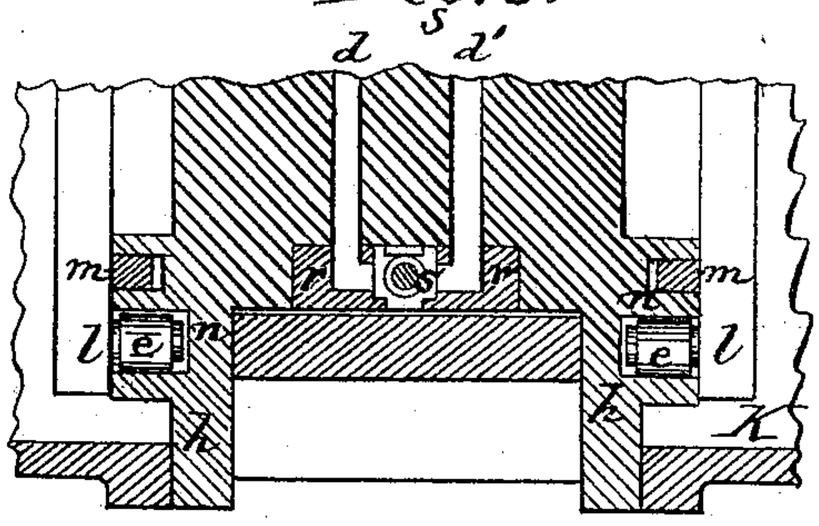


Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM R. MANLEY, OF NEW YORK, N. Y.

IMPROVEMENT IN ROTARY ENGINES.

Specification forming part of Letters Patent No. **152,042**, dated June 16, 1874; application filed September 20, 1873.

To all whom it may concern:

Be it known that I, WILLIAM ROBINSON MANLEY, of the city, county, and State of New York, have made an invention of certain new and useful Improvements in Rotary Engines; and that the following is a full, clear, and exact description and specification of the same.

These improvements have reference to that class of rotary engines in which two or more pistons are caused to revolve or rotate in a cylinder or case. The objects of the invention are, to enable such engines to work steam with a variable expansion, to reduce the friction and wear of the moving parts, and to prevent the escape of the fluid from the working cylinder. To these ends the improvements consist of certain combinations of instrumentalities, which are specified at the close of this specification.

In order that the invention may be fully understood, I have represented in the accompanying drawing, and will proceed to describe, a rotary engine embodying all the said improvements in a good practical form, it being understood that some of the said improvements may be used without others, and that the engine may be greatly varied without ceasing to employ my invention in whole or in part.

Figure 1 represents an end elevation of the said engine. Fig. 2 represents a plan of the same. Fig. 3 represents a vertical longitudinal section of the same. Figs. 4, 5, and 6 represent transverse sections of the same at the lines *x x*, *y y*, and *z z*, respectively, of Fig. 3. Figs. 7 and 8 represent views of detached parts of the engine, designated by the same letters of reference as the same parts in the other figures.

The engine represented in the said drawings has a cylinder or case, A, which, in this example, is made fast to the bed-plate B. This cylinder forms a cylindrical cavity, in which the pistons C rotate. The pistons, in this example, are six in number, and are connected radially with a hub, D, which is arranged to revolve within the cylinder and eccentrically to the cavity thereof. The piston-hub D is supported by the gudgeons E E, which are arranged to revolve in pillow-blocks F F, secured to the bed-plate B. The ends of the cylinder are closed by heads G, which are rigidly connected with the hub D, so that the hub, heads, and radial pistons all revolve or rotate together. The rims of these heads cover the flanges *h* of the cylinder, and the joints between the two are packed, by preference, with metallic rings *m*, which are contained in ring-grooves in the cylinder, and are pressed toward the inner faces of the heads by springs inserted in the grooves behind the rings. Each piston C is constructed to slide radially in a slot in the revolving piston-hub, and the radial sides of the piston are packed (see Fig. 6) by means of metallic packing-bars, *a*, which are arranged in grooves at the opposite side of each slot, and are pressed toward the radial sides or faces of the piston by springs arranged behind the bars in the grooves. The outer edge of each piston C is provided with a rocking shoe, *b*, which is connected with the piston by a pivot-joint, *c*, and revolves in contact with the inner surface of the cylinder, to which it adapts itself by rocking. In order that a slight movement of the piston relatively to the shoe may be permitted, the pivot of the joint is constructed with a plate-shank, (see Figs. 5 and 6,) which is received in a groove in the outer side of piston, and the shank is pressed outward by springs inserted in the groove.

In order that the pistons may be sustained against the pressure of the steam, the revolving cylinder-heads are grooved radially, and each end of each piston (in the vicinity of the cylinder-heads) is connected with a slide, *l*, which is constructed to slide radially in one of the grooves of the cylinder-head, so that the pistons are guided and sustained by the heads as the pistons slide to and fro in the slots of the piston-hub D. The said piston-slides may be constructed separately from the pistons and secured to them, or may be constructed in one piece with their respective pistons, if deemed expedient. In order that the sliding pistons may be positively drawn out of the hub, the ends of the piston-slides *l* are extended beyond the circumference of the cavity of the cylinder, and their extended ends are fitted with friction-wheels *e*, which are received in guiding ring-grooves *n*, formed in the

cylinder-flanges *h*, so that the action of the sides of the said ring-grooves upon the slides *l* causes them with the pistons to move properly as the pistons rotate. If preferred, slide-blocks may be substituted for the friction-rollers *e*, each slide-block being connected with its respective slide by means of a pivot. The guiding-grooves *n* are not precisely concentric with the cavity of the cylinder, because, as the piston-hub D is eccentric to that cavity, the slides *l* are sometimes exactly radial to that cavity, and are at other times oblique to the radial lines thereof, and consequently, if the guiding-grooves were concentric with the cavity of the cylinder, the distance between the center of the sole of a piston-shoe *b* and the inner side of the guiding-groove, measured along the longitudinal center of a piston-slide when in its oblique position, would have to be greater than the distance between the same two surfaces when the piston-slide was radial to that cavity. In order that the distance between the center of the sole piston-shoe and the friction-roller of the guiding-groove measured in the line of the piston-slide may remain the same in all positions which the piston-slide assumes, the guiding-grooves are made of the requisite eccentricity to the cylinder-cavity and of an imperfect elliptic form. The precise form for this purpose is readily obtained by causing one of the pistons to revolve in the cylinder with its shoe pressed against the inner surface of the cylinder, and by marking the track described by the center of the hole in the piston-slide for the pivot of the friction-wheel. The line thus described will be the central line of the guiding-groove, from which the lines of its sides may be laid out by measurement. When the guiding-grooves are formed as described, the piston-shoes are held against the surface of the cylinder with practically equal pressure throughout their revolution. Steam is admitted to the cylinder at one side of its central diametrical line *f f*, Fig. 6, by the steam-ports *d* d^1, which communicate with the steam-chest H, and the steam is permitted to escape at the opposite side of the central diameter through the exhaust-ports d^2 d^3 d^4 d^5, which communicate with the exhaust-chest I. In order that the steam may be worked with a variable expansion, or, in other words, may be cut off at variable portions of the travel of the pistons, the steam-port is divided into a series of openings, *d*, extending in the direction in which the pistons revolve from the first place, *g*, where steam is to be admitted to the farthest place, *g'*, at which the steam is to be cut off, and a regulating-valve, *s*, Figs. 7 and 8, is applied to the outer orifices of these openings, so that more or less may be uncovered at will. The entrance of steam can take place only through the uncovered openings; consequently, as soon as any one piston passes by those openings which are uncovered, the supply of steam to the last preceding piston is cut off, and the period of cut-off may be varied by moving the cut-off-regulating valve *s*. The construction of cut-off-regulating valve and valve-openings thus described also enables the cut off valve to be used, if desired, as the throttle-valve of the engine; or it may be connected with the slide of a governor, so that the cut-off may be varied automatically. In order that the admission of steam may be continuous from the commencement to the end of the portion of the movement during which steam may be admitted to act upon a piston, two series of steam-openings, *d* d^1, of the divided steam-port are provided, and the inner orifices of one series are arranged horizontally opposite the spaces between the inner orifices of the other series, so that the orifices of the two series alternate, and that the piston passing by said orifices will receive steam continuously from an opening of one series or of the other at every part of its revolution during which cut-off may be effected. In order that the cut-off valve *s* may be moved with facility, the cut-off valve is constructed double-faced, or with faces at its opposite sides, and the outer orifices of the steam-port are arranged opposite each other, with the valve between them, as seen at Fig. 8, so that the steam-pressure at opposite sides of the valve is balanced; and in order that the seats in contact with which the cut-off valve slides may be adjusted, one or both of the series of exterior orifices of steam-ports are constructed in movable plates *r*, which are secured in place by screws. It is desirable that the steam should be permitted to exhaust as soon as it has attained the greatest expansion of which the engine admits. To this end the engine has an exhaust-port, d^2, arranged at a distance from the exhaust side of the central diameter *f* equal to half of the peripheral distance between two adjacent piston-shoes, or thereabout, so that the exhaust will commence from the space *j* between two pistons when they are at about equal distances at opposite sides of the central diameter *f*, as represented in dotted lines in Fig. 6, at which time the variable space inclosed between the pistons is greatest. In order to permit the exhaust to continue to the last moment practicable, additional exhaust-ports d^3 d^4 d^5 are used, so that the steam may exhaust through them after the exhaust through the first port d^2 is cut off by the passage of the piston over it.

For the sake of clearness in the drawing, the piston-hub D is represented as separated from the surface of the cylinder at the nearest point between the last exhaust-port and the first steam-port by a considerable space; but in practice the piston-hub is made so large that it just clears the surface of the cylinder, so that the dead space between the last exhaust-port and the first steam-port may be a minimum.

In order that the eccentric heads of the steam-cylinder may be kept warm head-jackets K K are provided. These are secured steam-tight to the flanges of the cylinder, and

they have packing-boxes *t t* at their central openings for the piston-shaft or gudgeons E, so that the escape of steam or water from the jackets is prevented, unless it is drawn off by a cock. Consequently, the steam which may leak past the packings of the revolving eccentric cylinder-heads is caught and retained in the jackets, and the water produced by the condensation of such steam acts as a lubricator for the working parts.

In order to equalize the pressure upon the exteriors of the two cylinder-heads at opposite ends of the cylinders, the spaces within the jackets are combined by a transverse equalizing-passage, *w*, through which steam can pass from one jacket to the other.

In the engine thus described the cylinder is fixed to the bed-plate, and the piston-hub, pistons, and cylinder-heads revolve relatively to the said cylinder; but, if deemed expedient, this arrangement may be reversed without avoiding my invention by constructing the cylinder to revolve relatively to the other members above named, which, in that case, may be fixed to the bed-plate, or by constructing the cylinder to revolve in one direction, and the other members above recited to revolve in the opposite direction.

The piston-hub D of the engine above described is, by preference, made hollow, and one of the gudgeons is made tubular, so that a pipe with a stop-cock may be connected with this gudgeon by a stuffing-box, for the purpose of permitting condensed water to escape, if desired.

When the cylinder is fixed, the power developed by the engine is transmitted by one or more cog-wheels secured to one or both of the gudgeons, or one or both of the gudgeons may be connected with a shaft or shafts.

Some of the improvements are applicable to rotary pumps and blowing-engines.

What I claim as my invention is—

1. The combination, substantially as before set forth, of the cylinder, the piston-hub arranged eccentrically to said cylinder, the revolving cylinder-heads, the sliding piston, the rocking shoe at the outer edge of said piston, and the bar-packing between the radial face of the piston and the piston-hub.

2. The combination, substantially as before set forth, of the fixed cylinder and the cylinder-heads, arranged to revolve eccentrically to the said cylinder, and provided with radial grooves for guiding and sustaining the pistons.

3. The combination and arrangement, substantially as before set forth, of the cylinder, the piston-hub arranged eccentrically to said cylinder, the sliding pistons, the grooved cylinder-heads, and the piston-slides.

4. The combination, substantially as before set forth, of the cylinder, the piston-hub arranged eccentrically to said cylinder, the sliding piston, the revolving cylinder-heads, the piston-slides, and the friction-wheels for the said piston-slides.

5. The combination, substantially as before set forth, of the cylinder, the revolving pistons, the divided steam-port, and the cut-off valve.

6. The combination and arrangement, substantially as before set forth, of the cylinder, the piston-hub arranged to revolve eccentrically to said cylinder, the pistons and cylinder-heads arranged to revolve with the said hub, and the head-jackets inclosing the eccentric cylinder-heads.

7. The combination, substantially as before set forth, of the cylinder, the piston-hub, the revolving pistons, the revolving cylinder-heads, the head-jackets, and the equalizing-passage connecting the said jackets.

8. The combination, substantially as before set forth, of the cylinder, the revolving pistons, the divided steam-port having its orifices arranged in two alternating series in the direction in which the pistons revolve, and the cut-off-regulating valve.

9. The combination, substantially as before set forth, of the cylinder, the revolving pistons, the divided steam-port having two series of outer orifices arranged oppositely, and in the direction in which the pistons revolve, and the double-faced cut-off-regulating valve arranged between the said two series of opposite orifices.

Witness my hand.

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