No. 768,919. PATENTED AUG. 30, 1904.

J. A. TORRENS.

ELASTIC FLUID PRESSURE ROTARY ENGINE.

APPLICATION FILED AUG. 21, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

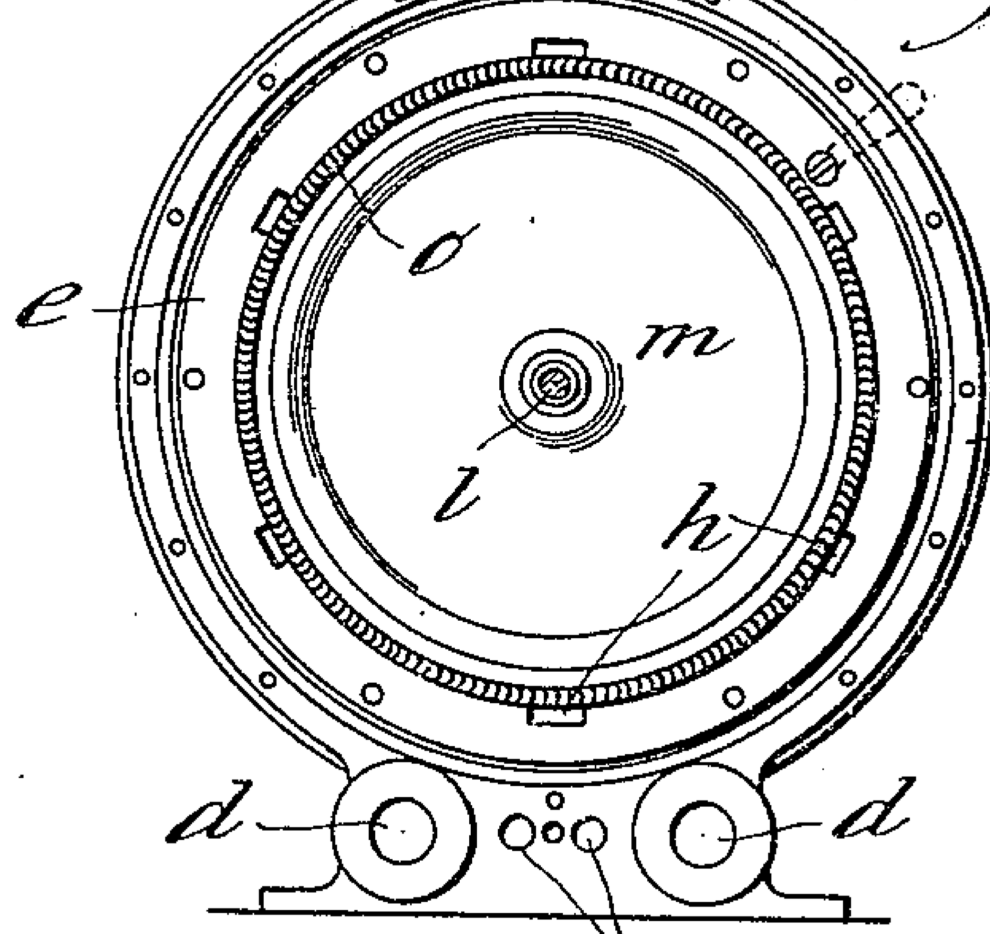



Fig. 2.

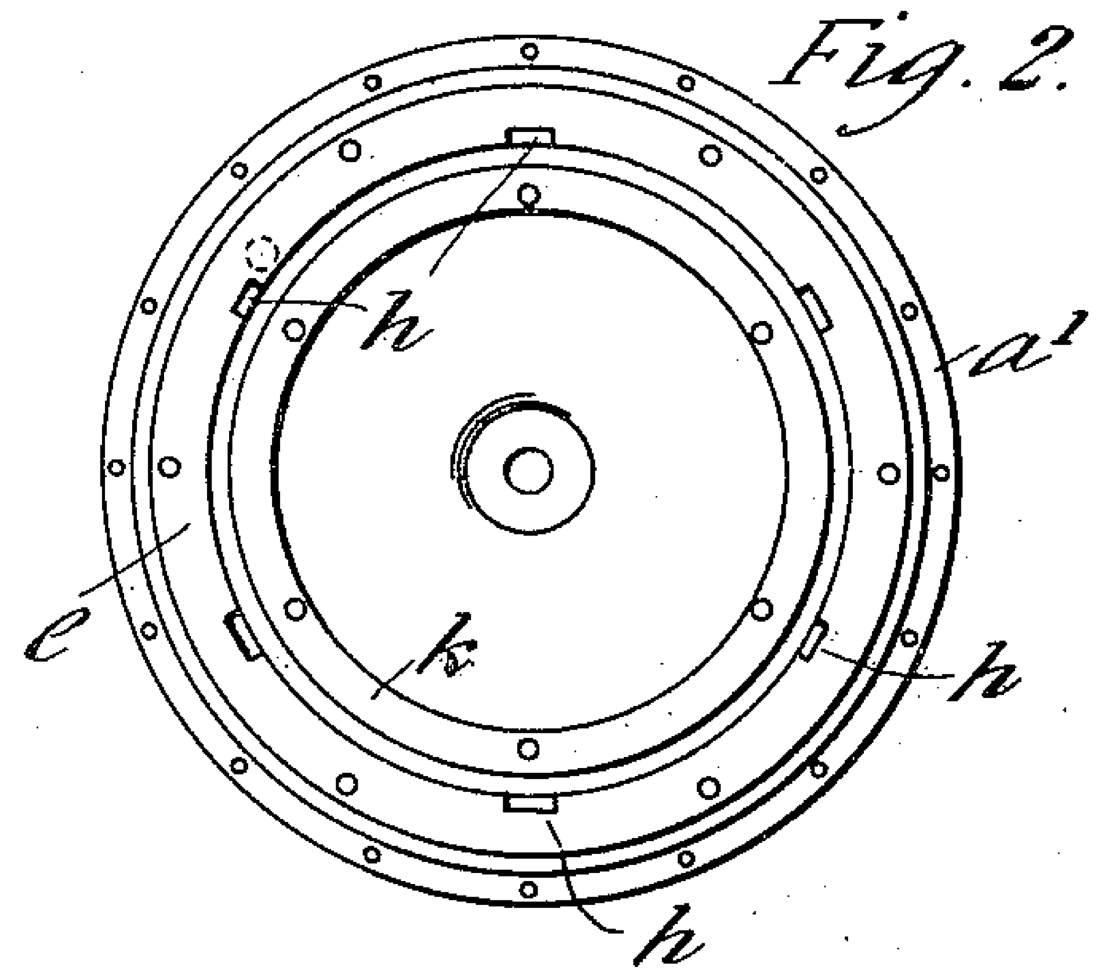



Fig. 3.

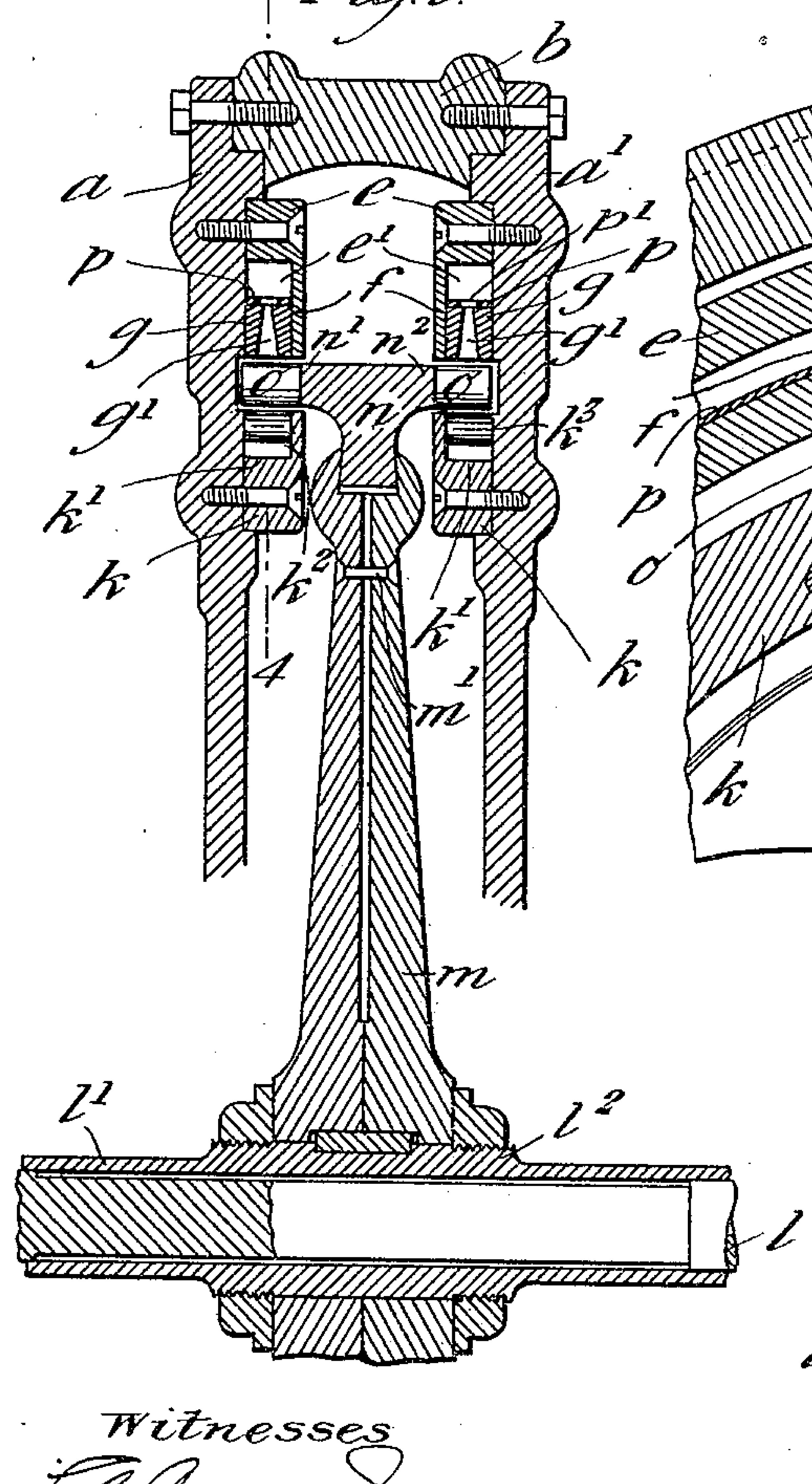



Fig. 4.

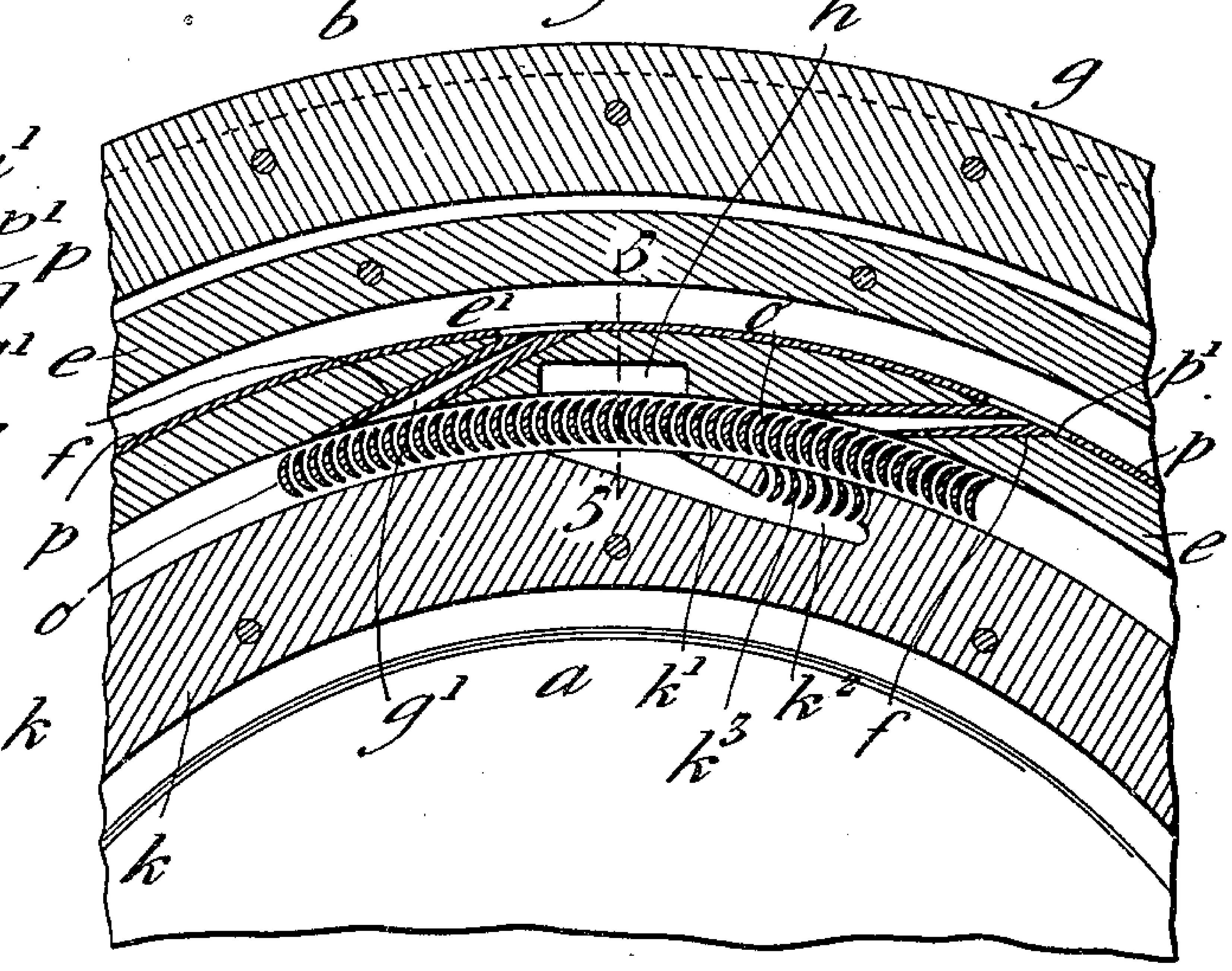



Fig. 6.

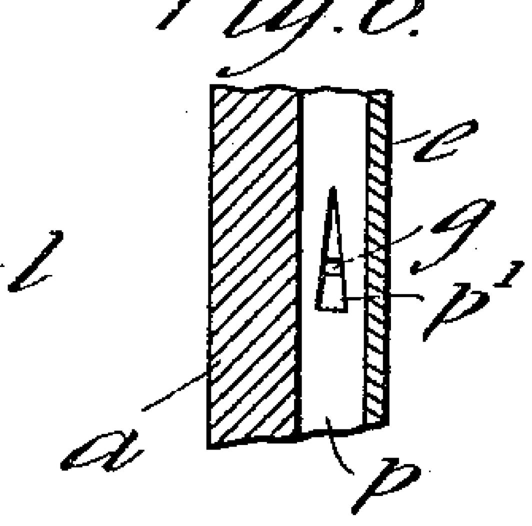
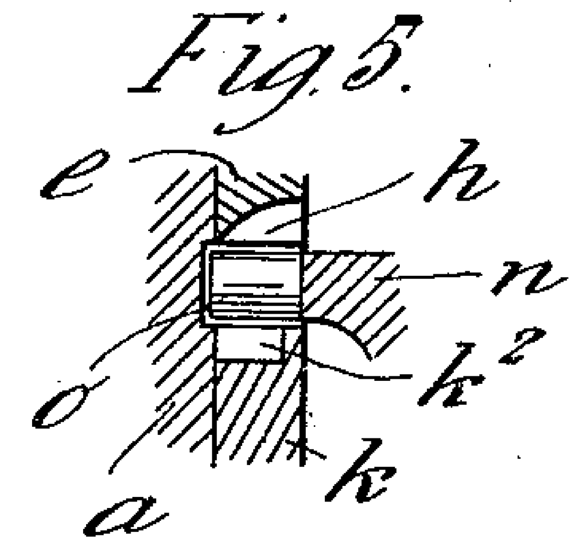



Fig. 5.




Witnesses

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ELASTIC FLUID PRESSURE ROTARY ENGINE.

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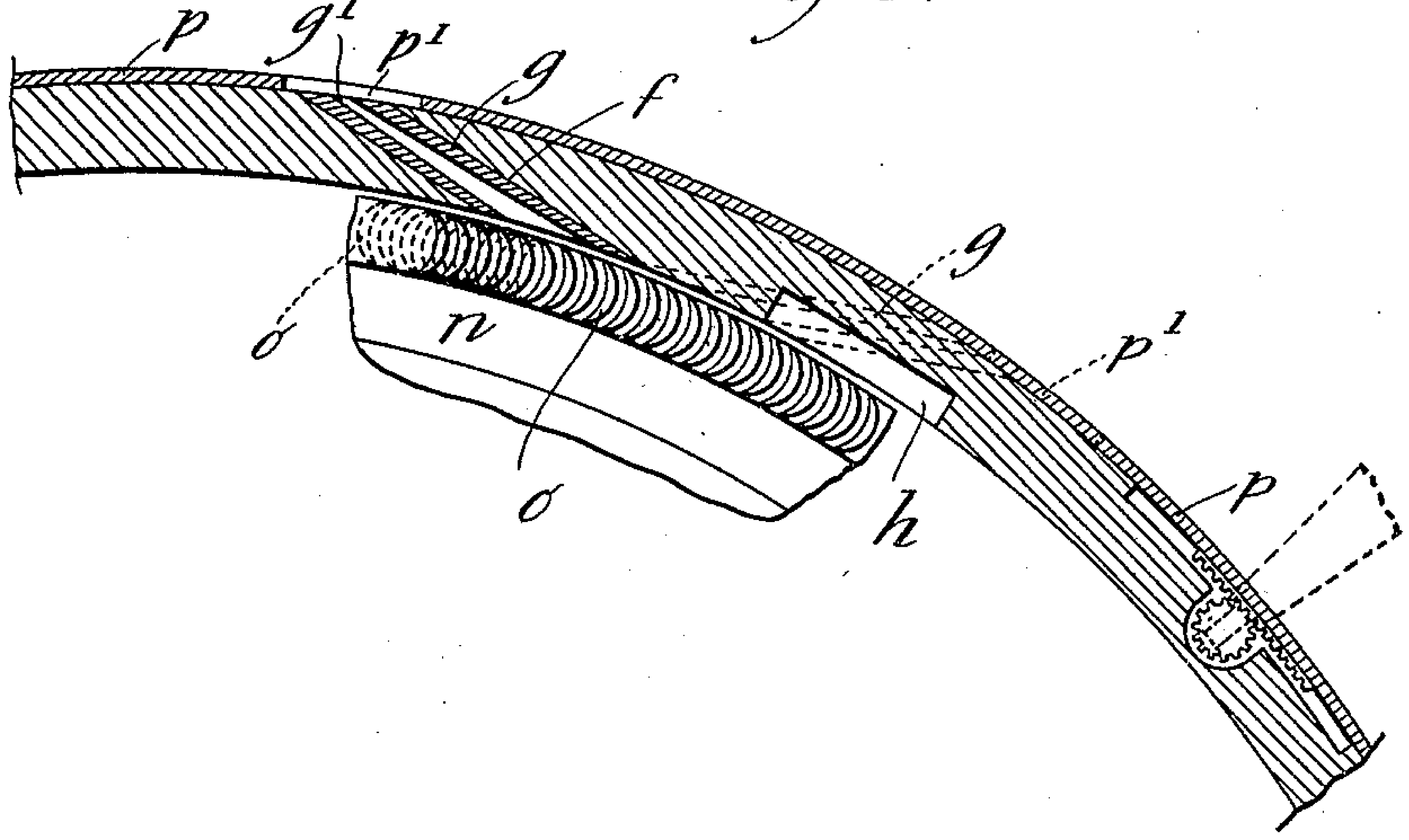
NO MODEL. 2 SHEETS—SHEET 2.

Fig. 7.

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# UNITED STATES PATENT OFFICE.

JOHN ARTHUR TORRENS, OF SOMERSET, COLERAINE, IRELAND.

## ELASTIC-FLUID-PRESSURE ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 768,919, dated August 30, 1904.

Application filed August 21, 1903. Serial No. 170,261. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN ARTHUR TORRENS, a subject of the King of Great Britain and Ireland, residing at Somerset, Coleraine, in the county of Londonderry, Ireland, have invented certain new and useful Improvements in Elastic-Fluid-Pressure Rotary Engines, of which the following is a specification, for which I have applied for a patent in Great Britain, dated January 6, 1903, No. 362.

This invention relates to rotary engines of the type in which the potential energy of steam or other elastic fluid under pressure after being converted into kinetic energy in suitable expansion-chambers is utilized for driving a wheel by direct impact and by reaction on a series of vanes fixed on the wheel. This type of engine is well known; and the present invention consists in improvements in construction, which will be hereinafter described, and illustrated in the accompanying drawings, of which—

Figure 1 is an elevation of an engine constructed according to this invention with one of the cylinder ends removed. Fig. 2 is an elevation of the inside of a cylinder end. Fig. 3 is a part transverse vertical section through the center of the shaft, drawn to a larger scale. Fig. 4 is a longitudinal vertical section on line 4 4 of Fig. 3. Fig. 5 is a section on line 5 5 of Fig. 4. Fig. 6 is a detail showing the method of regulating the supply of pressure fluid to the high-pressure ports, and Fig. 7 is a partial section on the line IV IV of Fig. 3 looking in the opposite direction to that of Fig. 4 and on a larger scale.

The cylinder consists of two end plates *a a'*, of iron, secured by set-screws to a cylindrical cover *b*, provided with an inlet *c* and an exhaust-opening *d*. Secured by set-bolts to the inside of each cylinder end is a ring *e* of iron, the central part of which is cut away, leaving an annular recess *e'*, which communicates with the inlet *c*. This recess forms a reservoir for the high-pressure elastic fluid. A number of slots *f* are cut slantingly from the recess *e'* to the inner periphery of the ring *e*, and into these are driven gun-metal blocks *g*, in which are formed suitably-shaped passages *g'*, which form expansion-nozzles for the high-pressure fluid. In the rings *e* in rear of each nozzle is formed a recess *h*, opening into the central space of the cylinder and thence to the exhaust-outlet.

A second pair of iron rings *k*, concentric with the first pair, are similarly fixed to the cylinder ends, so as to leave an annular space on either side between the inner periphery of the ring *e* and the outer periphery of the ring *k*. At intervals along the outer periphery of the ring *k* are a number of slotted recesses *k'*, each of which is situated opposite and extends from a nozzle *g'* to the next succeeding recess *h*. In these recesses *k'* are fixed gun-metal blocks, in which are formed longitudinally-extending passages $k^2$, flaring outward and opening to the periphery of the ring *k*, and at the closed end of these passages there are a number of small curved channels $k^3$, extending more or less radially from the passage to the periphery.

Rigidly mounted on a shaft *l*, the axis of which is coincident with the axis of the cylinder, is a light steel sleeve *l'*, having a central boss $l^2$, on which is keyed a steel fly-wheel *m*. The central part of the shaft *l* is turned down to a slightly-smaller diameter than the parts over which the ends of the sleeve closely fit, thus providing a flexible mounting for the fly-wheel. This flexibility of the mounting supplies the play required in a wheel running at a very high speed, and the amplitude of this play can be accurately limited to any required extent by the clearance allowed between the shaft and the sleeve.

Dovetailed into a recess in the periphery of the wheel *m* is a rim *n*, preferably of gun-metal, having flanges *n'* $n^2$, which project into and fill up the annular spaces between the pairs of concentric rings, so as to leave a bare clearance. In the flanges are narrow radial channels *o*, closely and regularly spaced round the periphery and curved in the opposite sense to the channels $k^3$. The steel wheel *m* may conveniently be made in two halves longitudinally, which when the outer rim *n* has been placed in position are fastened together by rivets *m'*, as shown in Fig. 3, thus securing the rim.

The disposition of the various channels and passages described above is such that the high-pressure fluid from the reservoir $e'$ on acquiring velocity during expansion in the nozzles $g'$ is directed tangentially, or nearly so, into the outer ends of the vanes $o$, changes its direction while traversing them, so that on leaving them it is directed tangentially, but in the opposite direction, into the oppositely-curving fixed vanes $k^3$, in which its direction is again changed, so that on leaving the low-pressure expansion-nozzles $k^2$ it is directed into the moving vanes in the same direction tangentially, but in the opposite radially to that in the first instance, its direction being again changed as it traverses the moving vanes, from which it is discharged tangentially into the exhausting-recesses $h$.

A ring $p$ in each recess $e'$, which fits closely over the high-pressure nozzles, is provided with triangular holes $p'$, corresponding in number to the nozzles. These rings are coupled together and arranged so that they may be rotated by means of an external handle and the admission of the pressure fluid to the reservoirs thereby controlled.

If the arrangement of passages and vanes is identical on the two sides of the cylinder, the ring-valves would be coupled so as to admit pressure fluid simultaneously to the two reservoirs; but if the passages on the two sides of the cylinder are arranged for the purpose of causing rotation of the wheel in one direction or the other, according to which side of the cylinder is being used, the rings would in that case be coupled, so that pressure fluid would be cut off on one side by rotation of the valve-handle and further rotation would cause it to be admitted at the other side. In the former case also the triangular slots would taper in similar senses and in the latter case in opposite senses.

The working fluid would in the engine described be expanded from the pressure of the reservoir to atmospheric pressure in two stages. Obviously the expansion could be carried farther by connecting the exhaust-passage to a condenser. Also the number of stages in which the expansion is completed could be increased in a variety of ways. For example, alternate sets of nozzles could be used as low-pressure sets, in which case the exhaust from the preceding high-pressure set would be connected to the high-pressure nozzle of the low-pressure set. The expansion would then be carried out in four stages, or all the sets of nozzles on each side or on both sides of the cylinder might be connected in series, in which case the number of expansion stages would be equal to twice the number of sets connected in series. In every case the kinetic energy developed during expansion in each stage must be in excess of the energy theoretically necessary by an amount sufficient to overcome friction losses, counteract back pressure due to eddy-currents, and secure an efficient circulation of working fluid. It is obvious that in order that these losses should not be excessive the cross-sectional area of the path of the working fluid should increase along its length in inverse proportion to the pressure of the fluid, and therefore in cases where the nozzle sets are connected in series of two or more the lower-pressure sets must be dimensioned in correspondence with this law. Another method of increasing the expansion stages, and therefore diminishing the speed of the engine for a given initial pressure of working fluid, would be to couple two or more similar engines on the same shaft, the exhaust from the higher-pressure cylinders being discharged into the pressure-reservoirs of the next succeeding cylinders. Similarly, to increase the power the cylinders of two or more wheels coupled on the same shaft may be connected in parallel.

Many constructional modifications might be substituted by any one skilled in the art without departing from this invention, which is not to be considered to be limited by the special construction herein described.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. A rotary engine comprising a wheel rotatably mounted on a shaft, flanges on either side of the rim of the wheel, curved channels extending through the flanges, high-pressure-fluid reservoirs, expansion-nozzles leading from said reservoirs and directed tangentially toward the wheel-flanges, and a second set of expansion-nozzles on the other side of the said flanges adapted to receive the pressure fluid on its first passage through the curved channels and to redirect it tangentially thereto, substantially as described.

2. A rotary engine comprising two high-pressure-fluid reservoirs, expansion-nozzles leading from the reservoirs and directed tangentially toward flanges on either side of the rim of a wheel rotatably mounted on a shaft, curved channels extending through each of the said flanges, the channels in one flange being curved in the opposite direction to those in the other flange and the nozzles directed toward one flange leading in the opposite direction from its communicating reservoir to that of the other nozzles, and means for cutting off and establishing communication between either set of nozzles and its corresponding reservoir, substantially as and for the purpose set forth.

3. A rotary engine comprising high-pressure-fluid reservoirs, expansion-nozzles leading from the reservoirs and directed tangentially toward flanges on either side of the rim of a fly-wheel, curved channels extending through each of the said flanges, a second set of expansion-nozzles having at one end chan-

nels curved oppositely to the channels in the flanges, the said second set of expansion-nozzles being directed tangentially toward the rim-flanges on the opposite side thereof to the first set of nozzles, substantially as described.

4. A rotary engine comprising a fly-wheel having a double-flanged rim and rotatably mounted on a shaft so that the said flanges project into and traverse during rotation an annular space in an inclosed chamber, curved channels extending through each of the said flanges, expansion-nozzles tangentially directed toward one end of the curved channels and communicating at their other ends with high-pressure-fluid reservoirs, expansion-nozzles on the other side of the channeled rims from the first nozzles and directed tangentially toward the said rims, curved passages leading from the other end of the second nozzles and directed toward the channels in the flanges, the said passages being curved in the opposite direction to the said curved channels, ports on the opposite side of the flanges to the second nozzles, and means for establishing and cutting off communication between the first nozzles and the reservoirs substantially as and for the purpose set forth.

5. In rotary engines of the kind herein described, a ring valve for establishing communication between an annular reservoir and a concentric ring of expansion-nozzles, provided with triangular notches equal in number and similarly disposed to the said nozzles, substantially as described.

6. In rotary engines of the kind herein described, a shaft with a central part slightly smaller in diameter than the end parts, a light steel sleeve having a central boss rigidly mounted on the shaft so as to inclose the central part thereof, and a fly-wheel keyed on the sleeve and having a flanged gun-metal rim fixed in a slot round its periphery, substantially as and for the purpose set forth.

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

JOHN ARTHUR TORRENS.

Witnesses:

CHARLES HUNT,

THOMAS S. HYDE.