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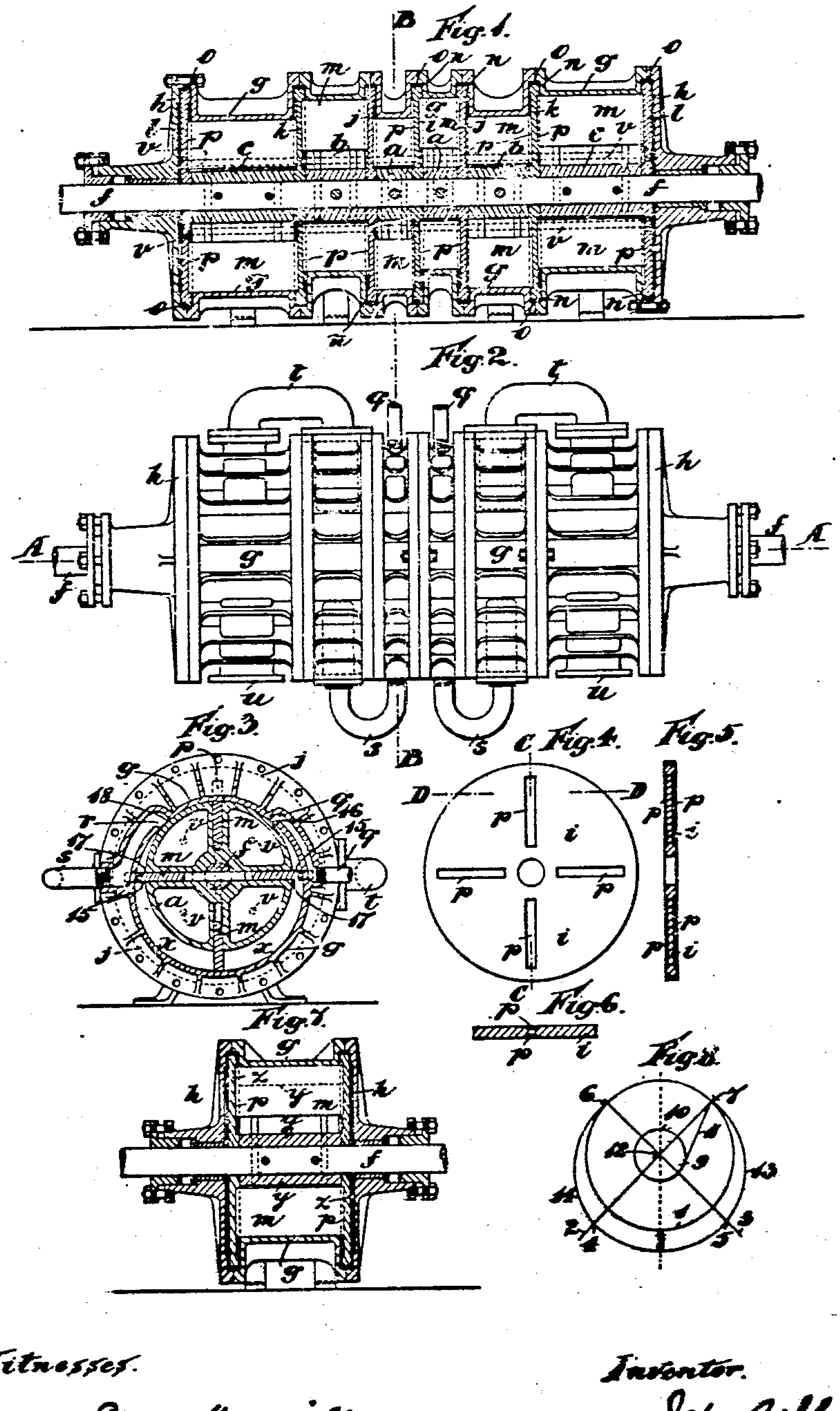
ROTARY ENGINE.

APPLICATION FILED JULY 2, 1907.

899,040. Patented Sept. 22, 1908.



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ROTARY ENGINE.

No. 899,040. **Specification of Letters Patent.** **Patented Sept. 22, 1908.**

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To all whom it may concern:

Be it known that I, JOHN GILL, a subject of the King of Great Britain, residing at Edinburgh, Scotland, have invented new and useful Improvements in Rotary Motive-Power Engines Applicable also to Rotary Pumps, Air or Gas Blowers, Compressors, or Exhausters, Meters, and the Like, of which the following is a specification.

This invention relates to that class of rotary engine, pump, blower, compressor, exhauster, meter and the like which consists of an outer casing and a cylindrical drum revolving inside the said casing, and provided with one or more sliding plates let into the drum in a line or lines passing through the axis thereof, and free to slide in and out therein, so as to project from the drum at certain parts of its revolution in order to form the piston-blade or piston-blades upon which the motive fluid acts, or which acts or act upon the fluid to be set in motion, according as the apparatus is acting as a motive power engine or as a pump, blower, compressor, exhauster, meter or the like. And in order that the said invention may be fully understood I will proceed to describe the same with the aid of the accompanying sheet of drawings in which

Figure 1 is a vertical sectional elevation taken on the line A—A of Fig. 2 of a motive-power engine constructed in accordance with the invention, Fig. 2 a plan of same, Fig. 3 a cross sectional elevation of same taken on the line B—B of Figs. 1 and 2 and looking from right to left in those figures. Fig. 4 is a separate elevation of one of the parts of the machine shown in Figs. 1 and 3, Fig. 5 a sectional elevation taken on the line C—C of Fig. 4, Fig. 6 a section taken on the line D—D of Fig. 4, Fig. 7 a longitudinal sectional elevation of an engine or pump with a single piston-drum having a part of the invention applied thereto, and Fig. 8 a diagram illustrative of devices for drawing certain curves forming part of the inner surface of the outer casing.

Similar letters of reference relate to like parts in all the figures of the drawings.

According to the present invention instead of a single drum of the abovementioned description rotating in its own separate casing as heretofore practiced, there are employed several such drums as *c*, *b*, *a*, *a*, *b*, *c* in Fig. 1 of the drawings fixed side by side on the same shaft *f* and arranged to rotate in a suitably adapted casing *g*.

Between each two adjacent drums, and between each end drum and the corresponding cover *h* is secured a disk or annular plate *i*, *j*, *j*, *k*, *k*, *l*, *l* of such a diameter that it extends beyond the periphery of the drum somewhat further than the piston blades *m* project when in their outermost position as shown in Figs. 1 and 3. The peripheral parts of these disks or annular plates that project beyond the piston blades take into circumferential grooves *n* formed in the casing *g*. These disks or annular plates are fixed to and rotate with the drums and form the end walls of the spaces such as *x* in Fig. 3 between the peripheries of those drums and the internal surfaces of the casing *g* in which the piston blades *m* are acted upon by the motive-fluid, or in which the piston blades act upon the fluid to be set in motion, as the case may be.

All the drums, and the compartments formed by the drums, disks and casing may be of the same diameter, as shown in Fig. 1, or they may increase in diameter successively towards one or both ends of the machine.

By these means there is built up a compound drum which, for a motive-power engine, is preferably composed of four, six (the number illustrated in Fig. 1) eight or other even number of drum parts, forming with the casing working compartments divided from each other by the aforesaid projecting disks or annular plates which confine the steam or other motive-fluid to the compartment bounded by them; the disks or annular plates being provided, if necessary, with spring or other suitable packing rings *o* in their peripheries, or in the sides near their peripheries, to keep them fluid-tight, and prevent the leakage of motive-fluid from one compartment to another.

The ends of the piston-blades *m* are preferably guided in grooves *p* formed in the sides of the disks or annular plates as shown clearly in Figs. 4, 5 and 6 which represent one of the disks connected with one of the middle drums *a*, *a*. These grooves help to support the piston-blades *m* and keep them pointing radially from the centers of the drums, and tend to prevent the motive-fluid from passing at the sides of the piston blades, and also prevent them binding and jamming in the grooves of the latter under the tangential pressure of the motive fluid, thereby materially reducing the friction of the in and out movement of the piston blades. These grooves may, however, be omitted if desired.

In the case of a motive-power engine using an elastic fluid, whether the compound drum be of one diameter throughout, as shown in Fig. 1, or increases in diameter by steps from the middle towards the ends, the steam, for example, is preferably admitted into the middle compartments containing the drums *a*, *a* through the inlet passages *q*, *q*, and after acting upon the piston-blades *m* in those compartments is allowed to exhaust, through the outlet passages *r*, *r* by the pipes *s*, *s*, into the next compartment to the left and right. respectively containing the drums *b*, *b* in which two compartments it acts expansively upon the piston blades *m* in those compartments, and then exhausts from these two compartments through the pipes *t*, *t* respectively into the next compartments to the right and left containing the drums *c*, *c* respectively, and so on from one compartment to another (if there be more) up to the last compartment at either end of the machine, acting expansively in each compartment it passes through and finally escaping from the two end compartments into the atmosphere or into a condenser or otherwise, as the case may be, through the exhaust passages *u*, *u*. It will be understood that in this case each working compartment in succession from the middle towards each end of the machine is of larger dimensions than the preceding one. This successive enlargement of the working compartments may be effected by increasing the lengths of drums and casing axially, leaving the diameters of drums and casing uniform as shown in Figs. 1 and 2 or by enlarging the diameters of the drums and casing, or by suitably proportioning diameters and lengths as may be most suitable for given circumstances.

Instead of two central working compartments each delivering the whole of its exhaust motive-fluid to the compartment to the right or left as the case may be there may be one such central compartment only delivering its exhaust motive-fluid one half to the compartment to the right and the other half to the compartment to the left, the exhaust motive-fluid from these latter passing through the remaining compartments right and left expanding as it goes, and finally escaping from the two end compartments as before explained.

Instead of the drums and disks being mounted and fixed on a central shaft they may be fixed together side by side by means of bolts *v* or otherwise without the central shaft *f* the endmost drums being in that case provided with gudgeons which take a bearing in or pass through the end covers for the purpose of transmitting power from or to the drums, as the case may be.

The above described arrangement of disks or annular side plates may be applied with advantage to a single casing and drum as shown in Fig. 7 in which the drum is indicated by the reference letter *y* and the two disks by the letters *z*, *z*.

The casing *g* may be constructed in any suitable way to provide the necessary compartments for the respective drum parts to rotate in, but it will be found convenient to make it of a number of rings of proper shapes and sizes bolted together as shown in Figs. 1 and 2 for example.

Each part *c*, *b*, *a*, *a*, *b*, *c*, of the compound drum with its piston-blades *m* is constructed in the usual way, and the cross section of the corresponding parts of the casing *g* may be of any known suitable shape, but the inventor prefers it to be formed partly of two circular arcs and partly of two approximately involute curves described in a particular way by means of a cord, pencil or scriber and a circular disk of appropriate size as hereinafter described. The cross section of the casing so produced is such that all diametral lines drawn through the center of the axis of the drum from side to side of the casing are equal in length so that the edges of the piston-blades constantly bear against or come in contact with the internal surface of the casing at all points of their revolution without the employment of springs to press them outwards.

One of the circular arcs abovementioned is struck concentric with and to the same radius as the drum, and the latter bears closely against the said arc. The other circular arc is exactly opposite and is struck from the center of the drum with a radius equal to that of the drum plus the maximum distance of the drum from the internal surface of the casing. The approximately involute curves connect together the ends of the circular arcs and are drawn in the manner illustrated in Fig. 8 of the drawings. A circle 1 is first drawn representing the drum, and two diametral lines 2, 3, are drawn across it, preferably at right angles to one another, and projecting at one side beyond the circle 1. The second abovementioned circular arc 4, 5 is now drawn between the prolongation of these diametral lines 2, 3 from the center 12 of the drum with a radius equal to that of the drum plus the maximum distance 8 there is to be between the drum and the casing. The points where these diametral lines cut the circle 1 at the opposite side subtend between them the first abovementioned circular arc 6, 7 against which the drum is to bear. A circular disk 9 of wood or other suitable material, the proper circumference of which is to be found as hereinafter described, is fixed at the center of the circle 1 and concentric therewith. A pin 10 is fixed in the periphery of the disk 9 opposite the middle point of the arc 6, 7 and an unstretchable flexible core 11 is looped at one end to the said pin, and then wound round the periphery of the disk 9 to the left and under the disk to and round a pencil or scriber placed at 7 and is finally looped at the other end on to a pin 12 fixed at the center of the disk 9. Then on moving the pencil or scriber from the point 7 towards the point 5, while keeping the cord taut, a portion of the cord will be unwound from the circumference of the disk 9 allowing the pencil or scriber to recede from the circle 1 until it reaches the point 5 by which time it will have described a kind of involute curve 13 connecting the end 7 of the one circular arc with the end 5 of the other circular arc. By winding the cord on to the disk 9 in the reverse direction a similar curve 14 can be drawn from the point 6 at the other end of the arc 6, 7 to the point 4 at the other end of the arc 4, 5 thereby completing the inner contour of the casing.

The circumference of the disk 9 to be used in the above described device for drawing the approximate involute curves is dependent upon two factors namely the radial distance 8 between the drum 1 and the arc 4, 5 (Fig. 8) which distance may conveniently be called the "clearance" and the fraction of the whole circumference of the drum subtended by one of the involute curves, but is independent of the size of the drum, and the rule for finding the circumference of the disk from those data is that twice the "clearance" in inches is equal to the fraction of the circumference of the disk that corresponds to the fraction of the circumference of the drum subtended by one of the involute curves. For example assuming the "clearance" to be 3 inches, and that the involute curve is to subtend one fourth of the circumference of the drum, twice three inches will be equal to one fourth of the circumference of the disk 9 hence the whole circumference will be equal to $2\times3\times4=24$ inches. Again, assuming the "clearance" to be 3 inches and that the involute curve is to subtend three-eighths of the circumference of the drum twice three inches will be equal to three-eighths of the circumference of the disk, hence the whole circumference will be equal to

$$\frac{2\times3\times8}{3}=16 \text{ inches.}$$

The edges of the piston blades bearing against the casing are preferably so shaped that one half 15, see Fig. 3, of each bearing surface corresponds in shape as nearly as possible with the commencement at 16 of the involute curve at the steam-entering side of the casing and the other half 17 of each bearing with the commencement at 18 of the involute curve at the exhaust side of the casing. In that way as close bearings as possible are maintained between the piston blades and the casing at all points as the drum revolves.

Suitable passages are provided for the inlet to and outlet from the machine of motive-fluid or of fluid to be set in motion, as the case may be. And by means of suitable arrangements of valves and pipe connections the inlets may be converted into outlets and the outlets into inlets to enable the engine to be reversed if and when necessary, in a manner well understood in connection with engines of this kind.

In the above described arrangement of rotary engine it is preferable to place the circular arc parts of the casing against which the drums bear alternately in opposite directions as shown in Fig. 1. It is obvious however, that these circular arc bearing-parts may be all placed on one side say at the upper part of the casing if preferred.

The above described construction is applicable for utilizing the expansive force of an elastic fluid for generating power; but it is obvious that by causing the compound drum to rotate in the reverse direction by means of suitable motive power the machine may be made to act as a blower, compressor or exhauster by drawing in the elastic fluid at the two ends, as at *u u* Fig. 2 for example, and passing it from compartment to compartment through the pipes *t*, *t*, *s*, *s*, compressing it by stages until it reaches the central compartments whence it is ejected at *q q* in the required compressed condition.

An apparatus constructed in accordance with this invention can be used as a set of stage pumps for raising incompressible liquids to great heights, or for submitting them to high pressures for hydraulic purposes for example, the liquid being passed successively from compartment to compartment receiving additional pressure in each; but in this case the compartments do not vary in dimensions at each stage as in the case of expanding or compressing an elastic fluid.

Claim.

In a rotary motive-power engine, the internal surface of the casing of which is composed of two opposite concentric circular arcs and two opposite involute curves as described, a piston blade of invariable length having one half of each of its edges shaped to fit the part of the involute curve at one side of the casing, which has the shortest radius of curvature, and the other half shaped to fit the similar part of the involute curve at the other side of the casing, substantially as described.

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

JOHN GILL.

Witnesses:
SAMUEL DOW MACMILLAN,
JAMES GILL.