

(No Model.)

3 Sheets—Sheet 1.

G. B. SHEPARD.
ROTARY MOTOR.

No. 586,717.

Patented July 20, 1897.

Fig. 1.



Fig. 2.

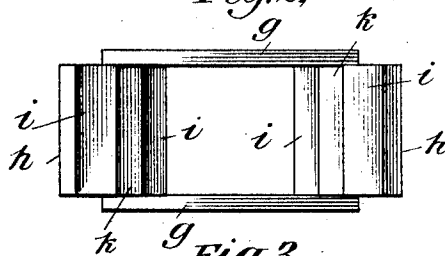


Fig. 3.

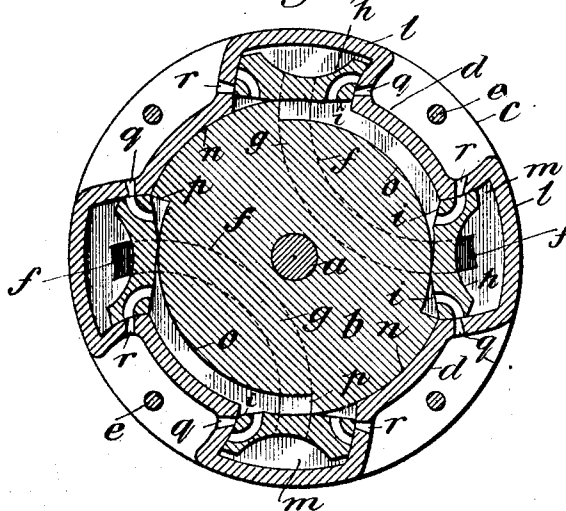
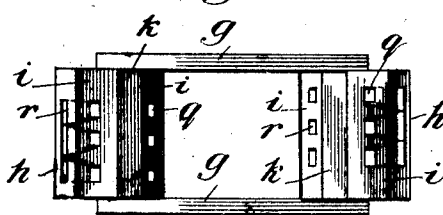


Fig. 4.



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Fig.5,

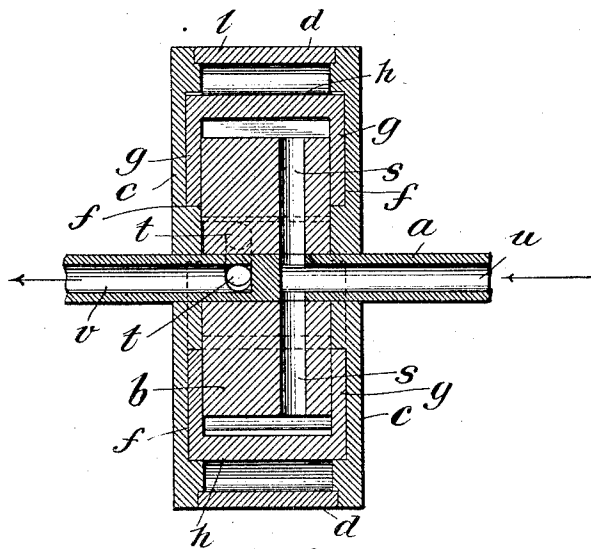
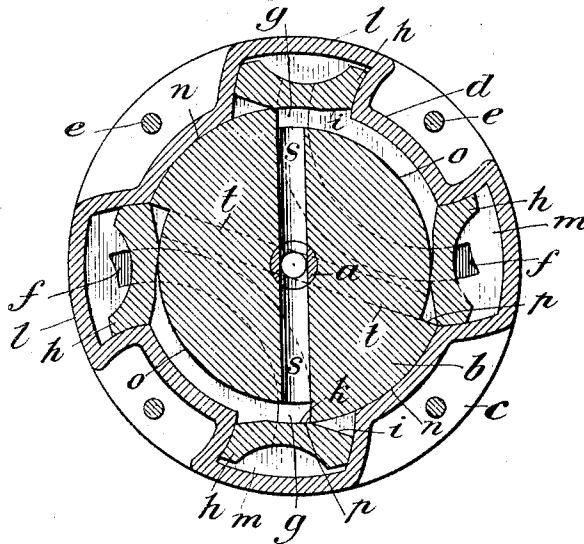


Fig. 6,



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Fig. 7.

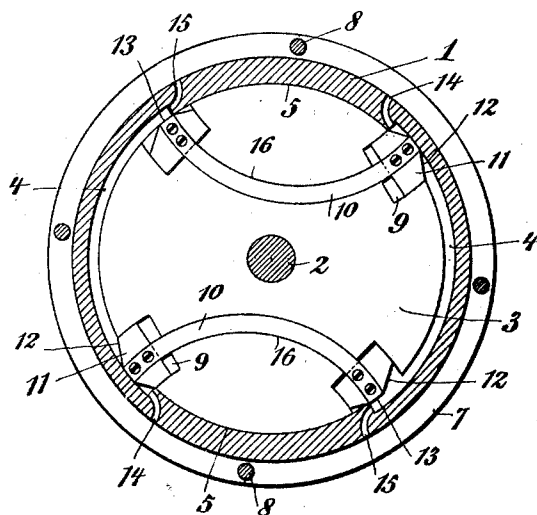
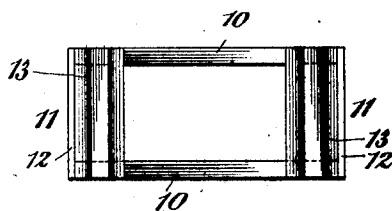


Fig. 8.



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UNITED STATES PATENT OFFICE.

GEORGE B. SHEPARD, OF OGDENSBURG, NEW YORK.

ROTARY MOTOR.

SPECIFICATION forming part of Letters Patent No. 586,717, dated July 20, 1897.

Application filed March 24, 1897. Serial No. 628,987. (No model.)

To all whom it may concern:

Be it known that I, GEORGE B. SHEPARD, a citizen of the United States, residing at Ogdensburg, in the county of St. Lawrence and State of New York, have invented a new and useful Improvement in Rotary Motors, of which the following is a full, clear, and exact specification, reference being had to the accompanying drawings, which form a part hereof.

My invention relates to that class of rotary devices adapted to be used either as a motor by the force of any fluid under pressure or when rotated by outside force as a pump (both suction and force) for air, gas, water, or any fluid, or for a meter for gas, water, or any other fluid; and the objects of my invention are to provide a motor or pump or meter that can be cheaply and easily made and repaired, run at high speed without undue wear or vibration, and readily reversed, and that will be positive in its action and economical in its operation and at the same time simple and compact in construction.

My invention consists, first, in the combination in a rotary device of two parts, one encircling the other, one of which is adapted to revolve with reference to the other, and one of which parts is provided with a surface having two or more raised portions concentric with the axis of rotation and two or more depressed portions concentric with said axis, upon which surface the bearing-surfaces at or near the ends of the gates bear and ride, and the other part having a surface in part or in whole concentric with the axis of rotation, so as to fit closely against the raised portions of the other part of the device and thus form pockets between the two parts, and a double-headed curved gate carried by one of the parts and having bearing-surfaces at or near both ends consisting of cam-surfaces and bearing-surfaces proper, the gate being so constructed and arranged that the portions of the gate at or near both ends thereof will successively constitute one of the walls of the working chamber and will be positively moved to operative position for that purpose by the action of the other part of the device upon the cam-surface at or near the other end of the gate, whereby both ends of the gate are successively brought into operation

and made to form a part of the walls of the working chamber in which the pressure is exerted which gives to the device the rotary motion when it is used as a motor.

My invention also consists in the combination, with the other parts above mentioned, of a plurality of double-headed curved gates, such as above described, whereby the rotating part is balanced on its axis and is relieved from sidewise twist or strain.

My invention also consists in arranging the gates so that they are equidistant from each other and in employing the same number of gates as there are raised concentric portions on the surface against which the gates bear at or near their ends.

My invention also consists, broadly, in the combination of two parts, one encircling the other and one revolving with reference to the other, and a double-headed curved gate carried by one of the parts and having bearing-surfaces at or near both ends adapted to be at all times in contact with the surface of the other part of the device.

My invention also consists in certain other features of construction and combinations of parts hereinafter described and claimed.

My invention is specifically illustrated in the accompanying drawings, in which Figure 1 is a side view of the double-headed gate. Fig. 2 is a bottom or plan view of the gate shown in Fig. 1, looking from below. Fig. 3 is a vertical sectional view of the rotary device on a line perpendicular to the axis. Fig. 4 is a view similar to Fig. 2, showing the inlet and outlet ports in the gate-heads. Fig. 5 is a sectional view of the rotary device in an axial plane and showing the ports passing through the shaft and drum instead of through the shell and gate-heads, and Fig. 6 is a vertical sectional view of the form shown in Fig. 5 on a line perpendicular to the axis. Fig. 7 is a vertical sectional view of a modification of my invention in which the gates are carried by the drum, and Fig. 8 is a plan view of the form of gate shown in Fig. 7.

Similar letters and figures indicate similar parts in the different views.

Referring to Figs. 1 to 6 of the drawings, *a* represents a shaft, and *b* a drum or disk secured thereto, so as to revolve therewith; *c c*, face-plates, and *d* a ring provided with an in-

terior surface which is partly concentric with the axis of rotation. The face-plates and the ring together surround the said revolving drum, forming an encircling shell or casing therefor. The ring is fastened to the face-plates in any suitable way, as by an annular rabbet formed on the said face-plates, as clearly shown in Fig. 5, and the parts are held firmly in place by means of the through-bolts *e*, which are carried through the holes arranged in the rim of said face-plates at suitable distances apart and provided with nuts at their ends, whereby the said face-plates can be held rigidly against the ends of said ring, as shown in Fig. 5. The shaft *a* is journaled in the face-plates in any suitable manner.

On the inner face of each face-plate are cut two diametrically opposed uniformly-curved channels, as shown at *f* in Figs. 3 and 6, those cut on one face-plate being parallel, respectively, with those on the other face-plate. The said channels are connected by cross-channels *m*, extending from one face-plate to the other and formed by the projecting portions *l* of the ring *d*. These channels and cross-channels together form slots for the purpose of holding and guiding within the casing the double-headed gates, one of which is shown in Fig. 1. These slots hold and guide the gates as they are reciprocated back and forth, and the gates are in this way carried by the shell. Each gate consists of the uniformly-curved side pieces *g g* and the gate-heads *h h*. These parts are either made solid or are fastened together in any suitable manner. The gate-heads are provided with bearing-surfaces on their inner faces divided into cam-surfaces *i* and bearing-surfaces proper, *k*. The ends of the gate-head are curved, as shown, to conform to the curved surface of the wall of the cross-channel *m*, and the ends and sides of the gate-head are made to closely fit against the walls of the cross-slot *m*, so as to make a substantially fluid-tight joint therewith. The side pieces of the gate are also made to closely fit the channels *f* in the face-plates, so as to make a substantially fluid-tight joint therewith. The channels *f* and the cross-channels *m* are made long enough to give sufficient endwise play to enable either end of the gate to be retracted within the projection *l* of the shell. As already stated, the gates are formed to closely fit within the slots and have a substantially fluid-tight joint therewith and with the attaining surface of the drum, and they are of such length that their bearing-surfaces or some part thereof shall at all times bear upon the surface of the drum, as hereinafter more fully described. In the form shown in these figures the surface of the drum consists of four distinct portions. There are two raised portions *n n*, which are concentric with the axis of rotation and at such a distance therefrom that they bear against the concentric portions of the surface of the ring *d* and form a substantially fluid-tight joint

therewith. They are diametrically opposite each other and are about forty-five degrees in length—that is to say, the height of each one is equal to about one-eighth part of its circle. There are two depressed portions *o o*, which are also concentric with the axis of rotation and diametrically opposite each other. Each of these depressed portions, in the form shown, is about one hundred and thirty-five degrees in length or three-eighths of its circle. The portions *n n* are at a greater distance from the axis of rotation than the portions *o o*, as a result of which pockets are formed between these portions *o o* and the ring *d*. In the form shown the portions *n n* are connected with the portions *o o* by the straight surfaces or shoulders *p*, but it will be apparent that these connecting portions *p* might be considerably changed, so as to be inclined or curved in either direction without interfering with the operation of the device. The bearing-surfaces of the gates, including the cam-surfaces and the bearing-surfaces proper, are so constructed and arranged that some part of said bearing-surfaces fits or bears closely against the surface of the drum at all points of its revolution, so as to form a substantially tight steam or fluid joint therewith. It will be observed that in this form of construction when the raised concentric portion *n* of the drum is in contact with the bearing-surface *k* of one of the heads of the gate the depressed concentric portion *o* of the drum is in contact with the bearing-surface *k* of the other head of the gate, and that when the edge formed by the intersection of the surface *n* with the surface *p* is in contact with the cam-surface *i* of one of the heads of the gate another edge formed by the intersection of a portion *n* with the adjoining surface *p* is in contact with one of the cam-surfaces *i* of the other head of the gate.

It is apparent that any desired number of pockets may be formed between the drum and the shell and that the number of the gates may be correspondingly increased if the above-described relative proportions of the parts be maintained. In the best form of my invention it is essential that such pockets shall be two or more in number and equidistant circumferentially of said drum, or otherwise when steam or other force is admitted into said pockets, as hereinafter described, the equilibrium of said drum would be destroyed and excessive friction against its rotation be caused, all of which I avoid by the construction already described. For the purpose of supplying propulsive force to rotate said drum in the form shown in Fig. 3 I provide inlet-ports *q q* through the heads of the gates and the adjoining wall of the ring, as clearly shown in Fig. 3, and outlet-ports *r r*, similarly situated on the opposite sides of the gate-heads, as shown in Fig. 3. The arrangement of these ports in the gate-head is also clearly shown in Fig. 4. These ports are so arranged that when the gate-

heads are moved into operative position, so as to constitute one of the walls of the working chamber, the ports are opened, the inlet-port being connected with the chamber on one side of the gate-head and the outlet-port being connected with the chamber on the other side of the gate-head, and when the gate-head is retreated into the cross-channel *m*, so as to be forced out of operative position, the ports will be shut. In the best form of my invention these ports are staggered with reference to each other. In the particular form shown in Figs. 3 and 4 the inlet-ports *q* of one head are staggered with reference to the inlet-ports *q* of the adjoining head, and the outlet-ports *r* of one head are similarly staggered with reference to the outlet-ports of the adjoining head. The result of this is that the intervening walls between one series of ports will be exactly opposite the port-openings of the next series. The object of this is to prevent the uneven wear upon the face of the drum which would result from having the ports opposite one another or in line with one another and the intervening walls opposite one another or in line with one another.

Instead of arranging the ports as shown in Fig. 3 they may be arranged as shown in Figs. 5 and 6—that is to say, both the inlet and the outlet ports may be made to pass through the shaft and drum. In Figs. 5 and 6, *s s* are the inlet-ports, *t t* are the outlet-ports, *u* is the main inlet or supply channel, and *v* is the main outlet or discharge channel.

It will be manifest that in either form the inlet ports or channels can be connected with any suitable source of supply in any usual way and the outlet-ports can be connected with any suitable exhaust or discharge pipe.

In operation, the parts being assembled as hereinbefore described and as shown in Fig. 3 and steam or other plenum force being admitted through the inlet-ports and being confined between the opposite surfaces of the face-plates, it fills said pockets until at one end thereof it encounters the end of the gate, with its bearing-surface bearing closely against the surface of the drum and constituting one of the walls of the said pocket or working chamber, and can go no farther in that direction, and in the opposite direction encounters the raised concentric portion *n* of the surface of the drum, so that it can go no farther in that direction except by revolving the drum, which it consequently does. Meanwhile the adjoining outlet-port just in advance of the inlet-port already described is shut off, and before the said outlet-port is opened the said inlet-port is closed by the action of the rotation of said drum and by the positive action of the next succeeding raised concentric portion *n* of the drum upon the cam-surface *i* of the gate-head containing the said inlet-port. When the outlet-port is opened, the steam or other substance filling the chamber escapes therethrough.

This operation is repeated and the drum continues to revolve.

In the form shown in Figs. 5 and 6 the operation is substantially the same, except that the ports are never shut off, but the inlet-ports are separated from the outlet-ports, except for a very brief interval during the revolution of the drum by the intervention of the gate-heads bearing upon the depressed concentric portions *o* of the drum.

It will be seen that the double-headed gate is so arranged that the portions of the gate at or near both ends successively constitute one of the walls of the working pocket or chamber and are positively moved into operative position for that purpose by the action of the surface of the drum upon the cam-surface at or near the other end of the gate.

In Figs. 7 and 8 a modification of my invention is shown. The construction and operation of this form of device are substantially the same as already described, except that the gates instead of being carried by the shell are carried by the drum and the inner surface of the shell is provided with the raised concentric portions and the depressed concentric portions and the surface of the drum is made in part or in whole concentric with the axis of rotation. In other words, these parts are merely reversed. In these two figures, 1 is the ring, 2 is the shaft, 3 is the drum, 4 is the depressed concentric portion on the ring, 5 is the raised concentric portion on the ring, 7 is the face-plate of the shell, 8 8 are the through-bolts, 9 9 are the cross-channels in which the gate-heads move, 10 10 are the curved side pieces of the gate, 11 11 are the gate-heads, 12 12 are the cam-surfaces on the gate-heads, 13 13 are the bearing-surfaces proper on the gate-heads, 14 14 are the inlet-ports, 15 15 are the outlet-ports, and 16 16 are the curved channels in the ends of the drum, forming with the cross-channels 9 9 the slots in which the gates are reciprocated.

It is apparent that if it is desired to operate my improved device by vacuum that can be done by opening the supply pipe or ports to the air and attaching the exhaust pipe or ports to exhausting apparatus, when the operation of the device would be similar to that above described, or if the supply pipe or ports be attached to any fluid-supply and the outlet pipe or ports be attached to a reservoir and the said shaft or drum rotated by outside force it is apparent that my device will act as a lifting or force pump for any fluid desired.

My invention may also be used as a meter for measuring gas or any other fluid by providing it with suitable registering devices to record the number of revolutions, the size of the pockets being known and it being therefore possible to accurately estimate the amount of gas or fluid passing through it if the number of revolutions is known.

I wish to call attention to the fact that my rotary device above described takes its pro-

pulling power simultaneously at opposing equidistant points of its circumference, so that there is caused no sidewise strain or twist upon the shaft.

5 If my device is used as a steam-motor, the exhaust can be condensed, if desired, or a vacuum-pump can be used.

It will be apparent that many of the details of my invention can be varied or altered and that certain features or elements can be used independently of other features or elements or in other combinations.

10 It will be manifest that instead of making the depressed concentric portions of the drum surface longer than the raised concentric portions they can be made of equal length therewith, and the portions now constituting the ends of the depressed concentric portions could be cut away or differently shaped; as the ends of these depressed concentric portions perform no useful or necessary function.

Both the shell and the drum may revolve, or one may be revolved and the other may be stationary.

25 The number of gates and the number of concentric portions on the part of the device that does not carry the gates may be varied according to circumstances.

Some of the advantages secured by my invention are simplicity of construction, certainty and uniformity of operation, positive action of the reciprocating gates, protection of the different parts from wear and injury, resulting in part from the fact that the operating parts of the engine are all contained within the shell, an accurate balancing of the device relieving it from sidewise twist or strain, reduction of friction, and economy in the production of power.

40 What I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary device, the combination of two parts, one encircling the other, one adapted to revolve with reference to the other, one being provided with a surface having raised portions concentric with the axis of rotation and depressed portions concentric with said axis, and the other having a surface in part or in whole concentric with the axis of rotation, and a double-headed curved gate carried by one of the parts and having cam and bearing surfaces at or near both ends, so arranged that the portions of the gate at or near both ends successively constitute one of the walls of the working chamber and are positively moved to operative position for that purpose by the action of the other part of the device upon the cam-surface of the other end of the gate and suitable inlet and outlet ports, substantially as set forth.

2. In a rotary device, the combination of two parts, one encircling the other, one adapted to revolve with reference to the other, one being provided with a surface having raised portions concentric with the axis of rotation and depressed portions concentric with said axis, and the other having a surface in part

or in whole concentric with the axis of rotation, and double-headed curved gates carried by one of the parts and having cam and bearing surfaces at or near both ends, so arranged that the portions of each gate at or near both ends successively constitute one of the walls of the working chamber and are positively moved to operative position for that purpose by the action of the other part of the device upon the cam-surface of the other end of the gate, and suitable inlet and outlet ports, substantially as set forth.

3. In a rotary device, the combination of two parts, one encircling the other, one adapted to revolve with reference to the other, one being provided with a surface having raised portions concentric with the axis of rotation and depressed portions concentric with said axis, and the other having a surface in part or in whole concentric with the axis of rotation, and double-headed curved gates carried by one of the parts equidistant from each other and equal in number to the number of raised concentric portions on the other part, and having cam and bearing surfaces at or near both ends, so arranged that the portions of each gate at or near both ends successively constitute one of the walls of the working chamber and are positively moved to operative position for that purpose by the action of the other part of the device upon the cam-surface of the other end of the gate, and suitable inlet and outlet ports, substantially as set forth.

4. In a rotary device, the combination of a drum and an encircling shell, one adapted to revolve with reference to the other, the drum being provided with a surface having raised portions concentric with the axis of rotation, and depressed portions concentric with said axis, and the shell having a surface in part or in whole concentric with the axis of rotation, and provided with uniformly-curved slots to hold and guide the gates and double-headed uniformly-curved gates sliding in said slots and having cam and bearing surfaces at or near both ends so arranged that the portions of each gate at or near both ends successively constitute one of the walls of the working chamber and are positively moved to operative position for that purpose by the action of the surface of the drum upon the cam-surface of the other end of the gate and suitable inlet and outlet ports, substantially as set forth.

5. In a rotary device, the combination of two parts, one encircling the other, one adapted to revolve with reference to the other, and a double-headed curved gate carried by one of the parts, and having bearing-surfaces at or near both ends adapted to be at all times in contact with the surface of the other part, and suitable inlet and outlet ports, substantially as set forth.

6. In a rotary device, the combination of the shell *c*, *e*, *d*, having a surface partly concentric with the axis of rotation, the drum *b*

having the raised concentric portions *nn*, and the depressed concentric portions *oo*, and the curved gates *g, h*, having the cam-surfaces *i i*, and the bearing-surfaces *k k*, adapted to bear constantly at both ends against the surface of the drum, and suitable inlet and outlet ports, substantially as set forth.

7. In a rotary device, the combination of the shell *c, c, d*, having a surface partly concentric with the axis of rotation, the drum *b* having the raised concentric portions *nn*, and the depressed concentric portions *oo*, and the curved gates *g, h*, having the cam-surfaces *i i*, and the bearing-surfaces *k k*, adapted to bear constantly at both ends against the surface of the drum, the staggered inlet-ports *q* and the staggered outlet-ports *r*, substantially as set forth.

8. In a rotary device, the combination of two parts, one encircling the other, one adapted to revolve with reference to the other, and a double-headed curved gate carried by one of the parts and having bearing-surfaces at or near both ends adapted to be at all times in contact with the surface of the other part, and suitable inlet and outlet ports staggered with reference to one another, substantially as set forth.

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

GEORGE B. SHEPARD.

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CHARLES G. IDLER.