No. 616,592. Patented Dec. 27, 1898.

G. SILVESTRI.

ROTARY MOTOR.

(Application filed Dec. 30, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig 1.

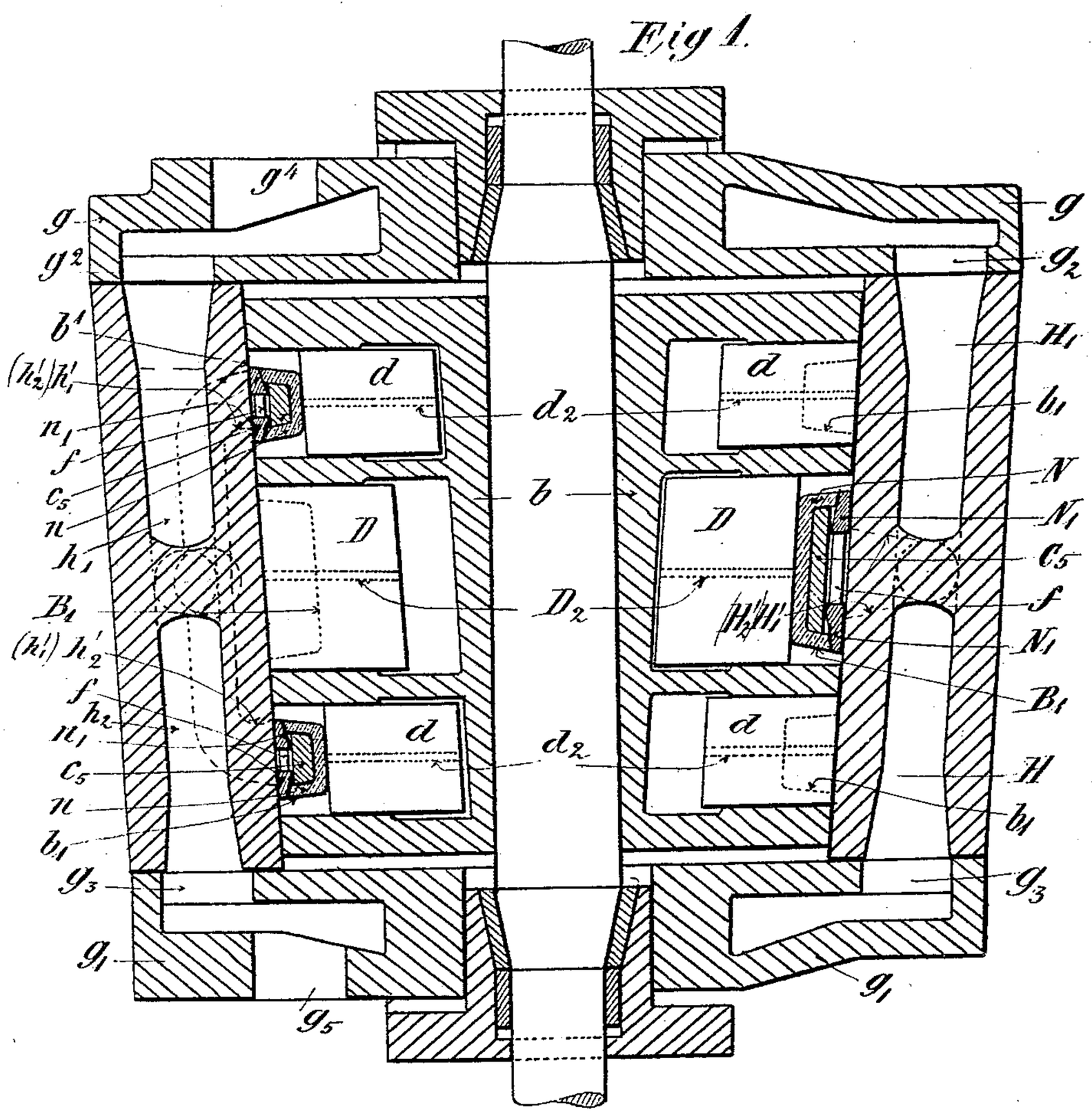
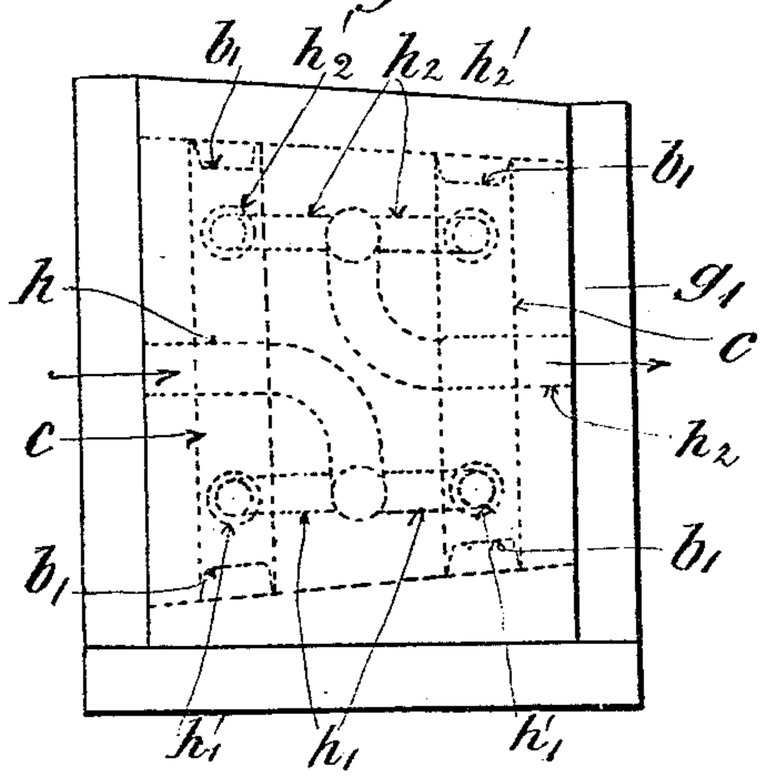


Fig. 3.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 2.

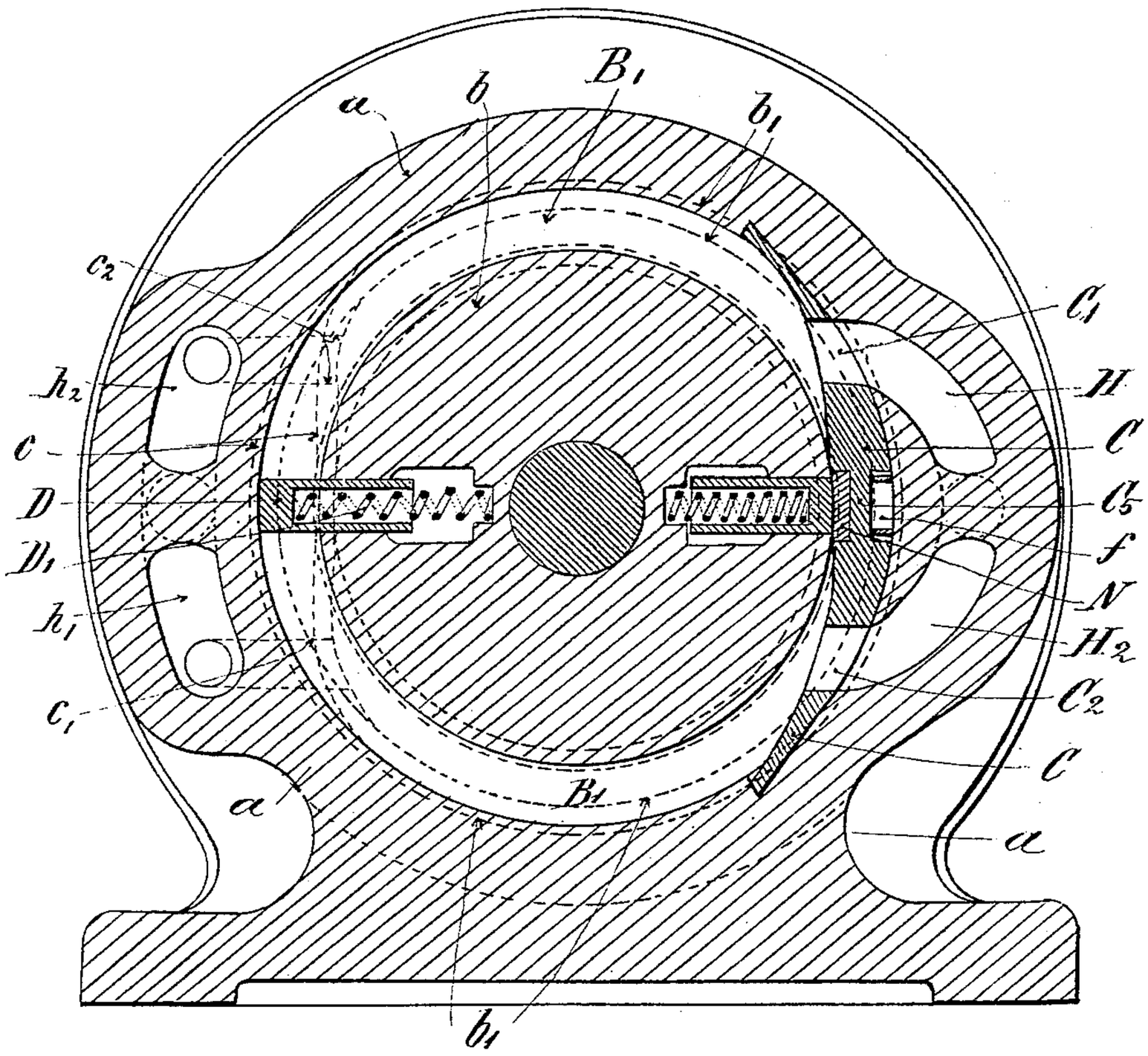
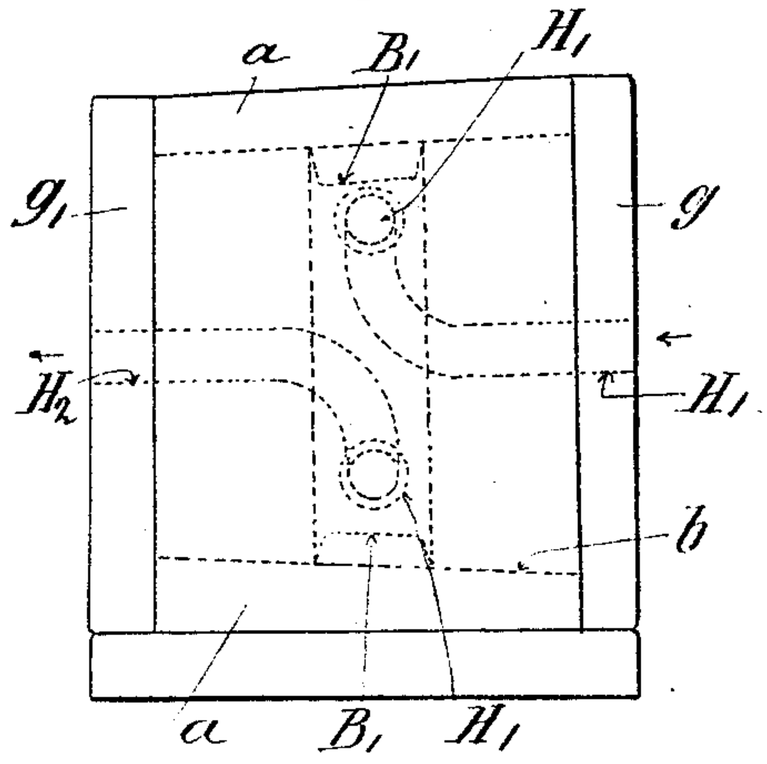


Fig. 4.



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UNITED STATES PATENT OFFICE.

GIULIO SILVESTRI, OF VIENNA, AUSTRIA-HUNGARY.

ROTARY MOTOR.

SPECIFICATION forming part of Letters Patent No. 616,592, dated December 27, 1898.

Application filed December 30, 1897. Serial No. 664,631. (No model.)

To all whom it may concern:

Be it known that I, GIULIO SILVESTRI, engineer, a subject of the Emperor of Austria-Hungary, residing in the city of Vienna, in the Province of Lower Austria, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Rotary Motors, of which the following is a specification.

All the rotary motors with cylindrical pistons heretofore employed possess the deficiency of being difficult to tighten. Besides, they work with too great a friction. These two factors and the relief of the piston, however, are the main conditions for a practical rotary motor.

My invention relates to the construction of a rotary motor which differs from others of this kind in possessing a conical piston instead of a cylindrical one, and its steam-channels are in constant connection with the steam-admitting device. This connection is in my improved motor not broken by a subsequent taking up for wear of the piston. The steam-channels are so proportioned and arranged on the piston that the latter one is perfectly relieved both in respect to the pressure exerted upon the projection surfaces of the channels as well as regarding the existing turning moments. Further, the conical form of the piston and cylinder enables an exact tightening up of the piston in accordance with its wear.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 illustrates my rotary motor in horizontal section. Fig. 2 is a vertical section of the same. Figs. 3 and 4 are two side views of the motor on a reduced scale.

The main part of the motor is the rotating piston *b*, of conical form, which rotates steam-tight in a conical case *a*. The conical piston has for its object to fit tightly from the beginning and to make it possible to tighten up the piston according to wear.

The piston *b* is provided on its mantle-surface with three annular channels B′ *b*′ *b*′, of trapezoidal section, which channels are so arranged regarding size and location that they effect a perfect relief of the piston. This is done in the following manner: The sum of the projected surfaces of the two lateral channels *b*′ *b*′ (which must not, however, have the same area) must be equal to the projected section of the middle and large channel B′, and the resultant of the pressures of the two lateral channels must fall in line with the resultant of the pressures on the middle channel, but must have the opposite direction, so that no turning moments occur. In this case a perfect relief of the piston is obtained because steam is admitted into the middle or central channel B′ exactly on the opposite side of the two lateral channels *b*′ *b*′. As the channels are in the rotating body, they are closed by the piston itself on three sides, so that only the fourth side is to be tightened. This can be effected in a simple but perfect form by virtue of the conical shape of the piston-body.

Each of the annular channels is broken on two diametrically opposite points by sliding pieces D *d d*. The sliding pieces are larger than the channels and are guided in radial slots on the piston or piston-arms. They are pressed outward steam-tight against the inner wall of the casing by springs D′ *d*′ *d*′. As above mentioned, the sliding pieces D *d d* are wider than the channels. This has for its object to effect a surface-tightening of the guiding-slots. In the channels B′ *b*′ *b*′ engage somewhat smaller segments C *c c*, which are held tight on the inner wall of the casing *a* and serve to separate the steam-inlet side and the exhaust or discharge side of the channels which are on the right and left side of the sliding pieces D *d d*. It further serves to effect the motion of the sliding pieces D *d d*, and thereby the alternating inlet into and discharge from the spaces in the annular channels B′ *b*′ *b*′, which are inclosed by the two sliding pieces. The segments C *c c* are so arranged that the large segment C, engaging the central channel B′, is exactly opposite to the two segments *c c*, which engage the two small lateral channels *b*′ *b*′ for the purpose of admitting the steam from opposite sides with the same force on the piston and the sliding pieces, so that the piston is perfectly relieved. Each of the segments C *c c* possesses two channels C′ *c*′ *c*′ and C^2 c^2 c^2, which are in front of or before the steam-conducting channels of the cylinder *a* and serve for the admission and discharge of steam into the piston-channels B′ *b*′ *b*′.

The channels for the central section are designated by H^1 H^2, and the channels for the smaller segments are designated by h^1 h^2. They have on the embouching-points $H^{1'}$ $H^{2'}$ $h^{1'}$ $h^{1'}$ $h^{2'}$ $h^{2'}$ an enlarged cross-section on the inner wall of the casing in order to maintain the full cross-section of the channels C' c' c' and C^2 c^2 c^2 of the segments, so that the admission of steam is not diminished while the piston b is tightened up. In the illustrated form the channels H^1 H^2 and h^1 h^2 are cast into the cylinder-body a; but it is obvious that these channels may also be constructed of piping. The location of this channel for the large segment is shown in Fig. 4, and the location of the channels for the two small segments is shown in Fig. 3.

It is readily understood that the channels H^1 h^1 h^1 may effect the admission of steam as well as the channels H^2 h^2 h^2, and accordingly the engine will run backward or forward. The cylinder a is closed on both sides by hollow covers g g', having openings g^2 g^2 g^3 g^3, which fit the end openings of the channels in the flanges, so that one hollow cover receives the fresh steam and the other the exhaust-steam from the cylinder. Each hollow cover is connected to a pipe-conduit at points g^4 g^5, one conduit serving for the admission of steam, the other for the exhaust of the same.

In order to obtain a perfect tightening between the segments C c c and the sliding pieces D d d and the channels B' b' b', each of the segments is provided with an automatic adjusting and tightening device. The segments are grooved in the center in such a manner that they form yokes or bridges C^5 c^5 c^5 The yokes are embraced by tightening-straps N n n, of flexible metal sheeting, preferably of copper. The edges of these straps are turned over and extend below the yokes, the extensions being somewhat inclined or oblique. Here are provided engaging wedges or keys N' N' n' n' n' n', which are distanced by a spring f as long as the wedges bear against the oblique edges of the channels. The closure is not tight, and the straps N n n are worn only on their broad surface. According to such wear the wedges which are separated by the spring f' are hereby pressed forward until they bear tightly against the oblique surfaces of the channels, thus effecting a perfect closure. Further wear of the wedges and straps takes place, and in accordance with such wear the wedges are automatically pressed forward by the springs f, thereby assuring a constant and perfect tightening. Care should be taken to select proper force for pressing in the wedges. By proper adjustment or setting of the keys or wedges involuntary removal is prevented, even at high steam-pressure, so that the tightening device is reliably self-acting.

The working of the motor may be understood from the drawings. The steam entering, for instance, through hollow cover g will be distributed by the channels D d d and passes through openings $H^{1'}$ $h^{1'}$ $h^{1'}$ and then through the segment-channels C' c' c', behind each of the sliding pieces located in front of the segment-channels, and pushes the sliding pieces forward, together with piston b, thus effecting a rotation of the piston of one hundred and eighty degrees. In this moment a second sliding piece arrives in front of the opening, admitting the steam, effecting a further rotation of the piston, because the steam acts now on the second sliding piece, and so on. At each revolution each sliding piece passes close on the segment, and when leaving it it receives live steam. The return of the sliding pieces into their slots is effected by the segment itself. The renewed forward motion, however, chiefly is effected by the springs behind the sliding pieces and by centrifugal force and partly by the steam-pressure, too. Each sliding piece is provided with a bore or opening D^2 d^2 d^2, through which the steam may discharge when moved backward by the segment. Thereby the rearward motion of the sliding pieces is essentially facilitated. After passing the segment-closing device steam passes through the openings D^2 d^2 d^2, behind the sliding pieces, and assists the spring force acting in the outward direction.

In order to effect a uniform reciprocating motion of the sliding pieces, it is preferable to shape the surfaces of the segments paraboliform. The active surface is composed of four equal surfaces of paraboliform shape, of which the two outside surfaces have the concave side toward the piston, while the two inner adjoining surfaces have the convex side toward the same. In order to have both ends of the parabola substantially strong, it is advisable to sink the pieces of the segments a little into the cylinder.

If it is desired to rotate the motor in opposite direction, then the admission of steam is reversed, so that steam enters into the hollow cover g', while the exhaust-steam passes through the hollow cover g. This reversion of the steam may be effected by any known device, preferably by valves.

The motor may also be provided with a device for varying the degree of expansion; but this is not essential for the purpose of this invention. I wish to further point out that the number of channels B' b' b' must not be exactly three, but that any other number may be employed; but care must be taken that the resultants of the pressures be always equal and of opposite direction, so that no turning moment exists, insuring an equal pressure on the journals and thereby a perfect uniform motion of the motor.

It is obvious that the machine employed as a driving apparatus may be used as a pump. It is further obvious that it may be used as a water-meter, turbine, air-motor, or explosion-motor, &c.

I do not limit myself to exact dimensions and materials or to any construction of details.

Having thus described my invention, what I claim therein as new, and desire to secure by Letters Patent, is—

1. A rotary motor consisting of a conical piston rotating steam-tight in a conical case *a* and provided with recessed annular channels B′, *b*′, *b*′ of trapezoidal section, movable sliding pieces D, *d*, *d* breaking the channels on two diametrically opposite points, radial slots guiding the sliding pieces, segments C, *c*, *c*, engaging the channels and possessing channels C′, *c*′, *c*′, C², *c*², *c*² and admitting steam into and discharging same from the piston-channels B′, *b*′, *b*′ and hollow covers *g*, *g*′, channels B′ and *b*′ *b*′ receiving actuating-steam from opposite sides and being so proportioned that the sum of the projection surfaces of B′ is equal to the sum of the projection surfaces of *b*′ *b*′ for the purpose of totally relieving the piston and bearings, substantially as described.

2. In a rotary motor having a conical piston rotating steam-tight in a conical case the combination of segments C, *c*, *c* serving for the motion of sliding pieces D, *d*, *d* closing the steam-channels, a self-adjusting tightening device between the segments and the somewhat larger piston-channels B′, *b*′, *b*′, yokes C⁵, *c*⁵, *c*⁵ provided in the segments straps N, *n*, *n* of flexible metal embracing the yokes and corresponding exactly to the cross-section of the piston-channels and wedges N′, *n*′, *n*′ engaging the straps below the channels, springs *f* actuating the wedges and engaging under the outwardly-bent edges of the straps whereby the edges are automatically adjusted for the purpose of effecting a perfect tightening, substantially as described.

In testimony whereof I have signed this specification in presence of two subscribing witnesses.

GIULIO SILVESTRI.

Witnesses:
HENRY C. CARPENTER,
CHAS. E. CARPENTER.