No. 649,220. Patented May 8, 1900.

C. A. SCHOPPER & A. W. H. RÖDER.

ROTARY EXPANSION ENGINE.

(Application filed Dec. 20, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

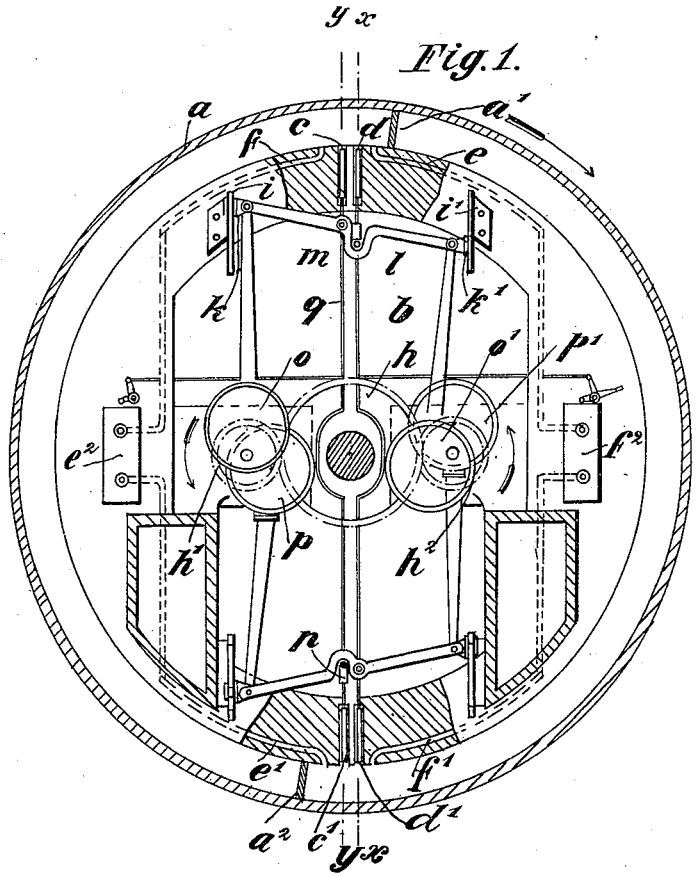

Fig. 4.

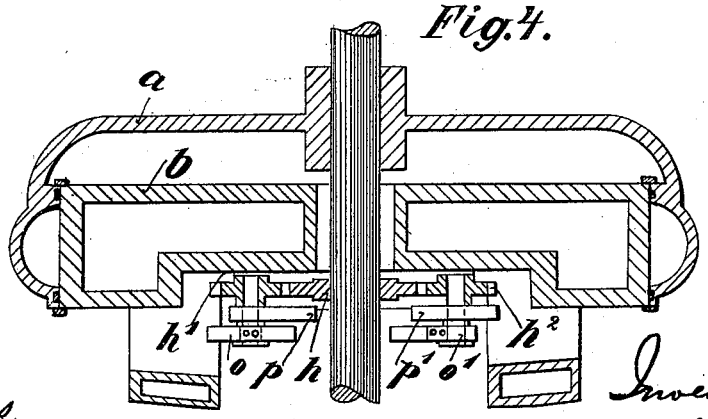

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Fig. 3.

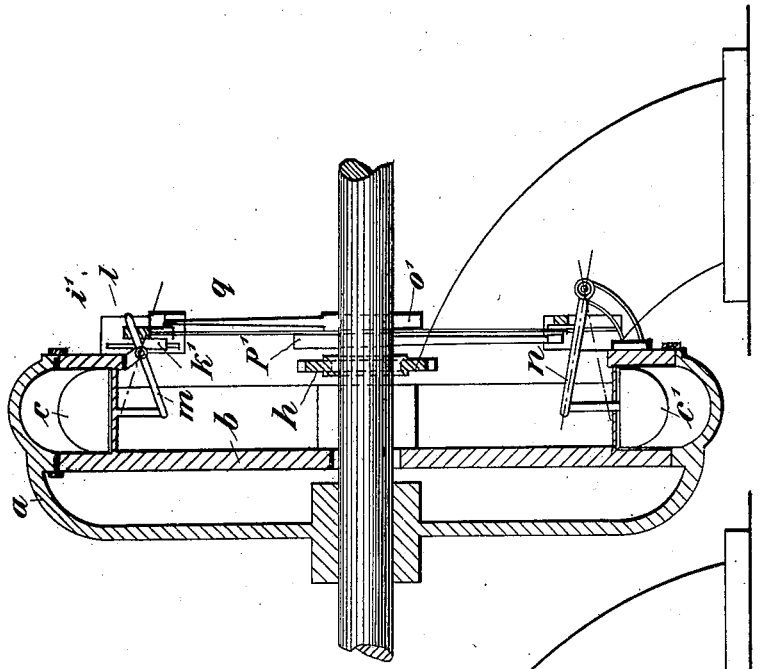
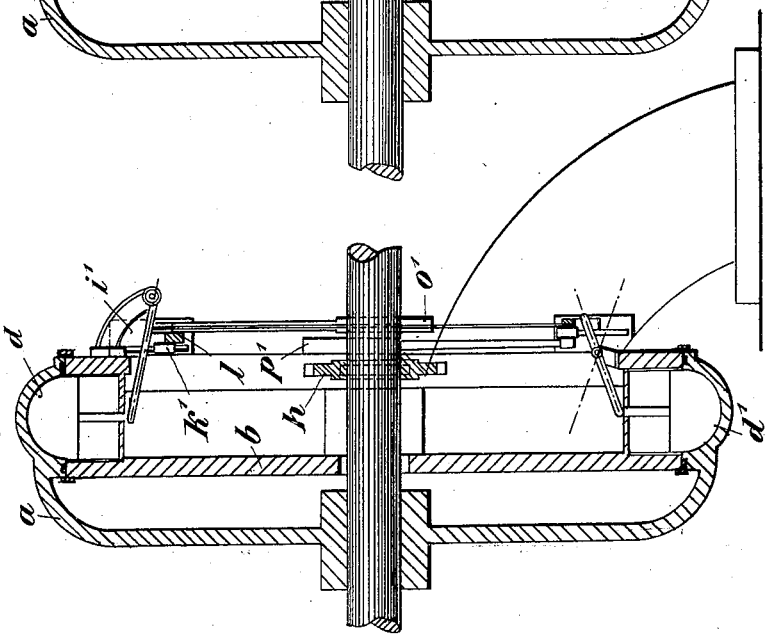


Fig. 2.



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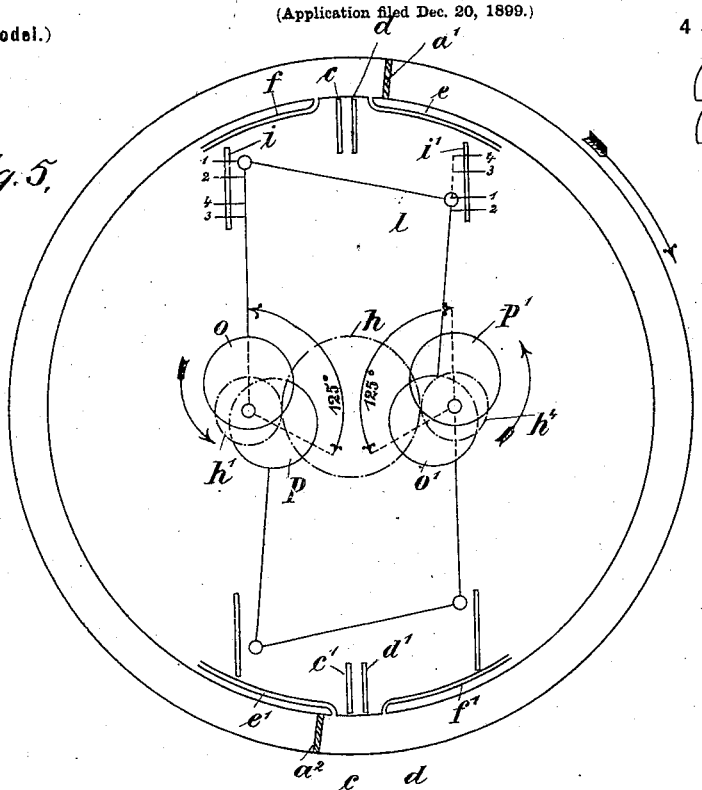
(No Model.) 4 Sheets—Sheet 3.

Fig. 5.



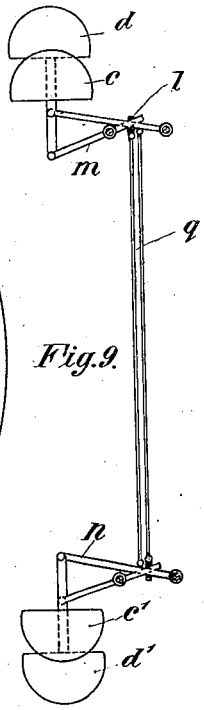
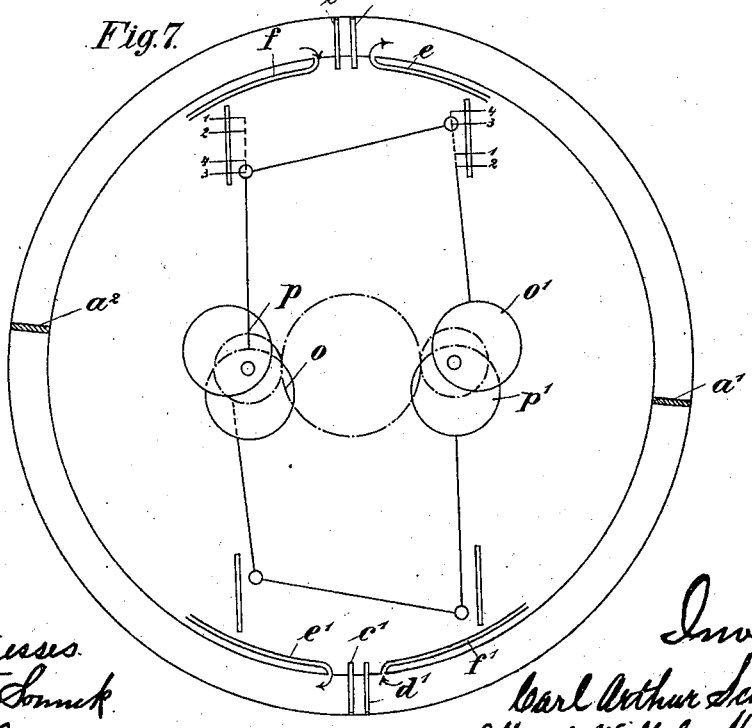


Fig. 9.

Fig. 7.



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ROTARY EXPANSION ENGINE.

(Application filed Dec. 20, 1899.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 6.

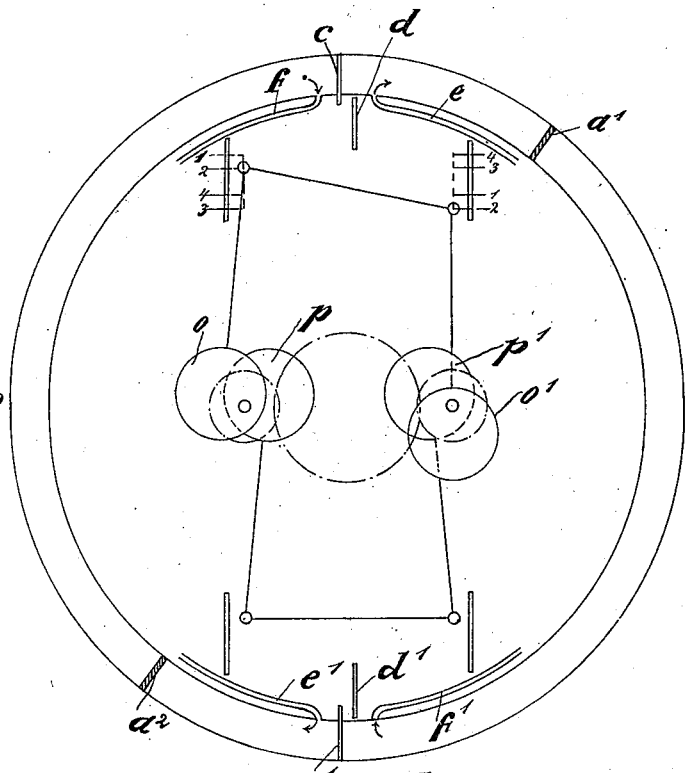
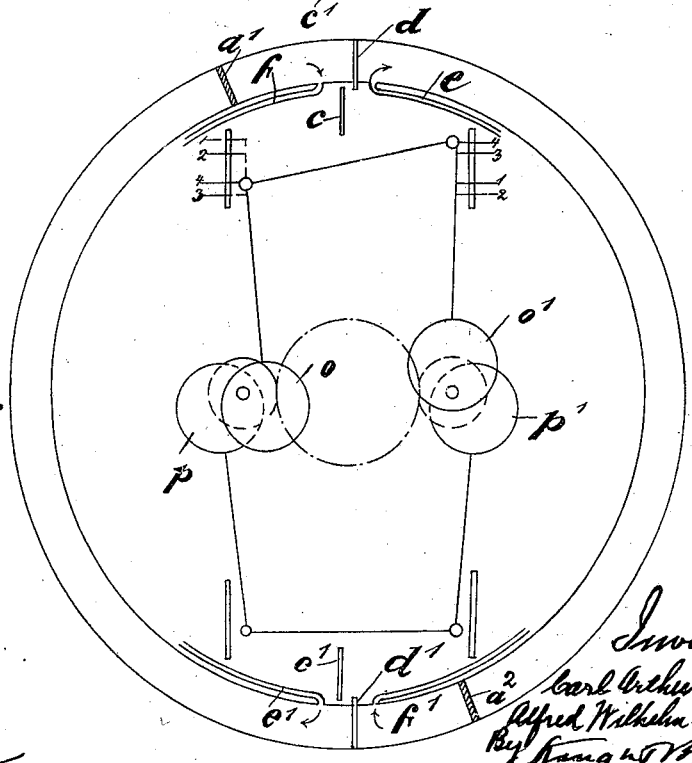


Fig. 8.



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UNITED STATES PATENT OFFICE.

CARL ARTHUR SCHOPPER AND ALFRED WILHELM HERMANN RÖDER, OF KIEL, GERMANY.

ROTARY EXPANSION-ENGINE.

SPECIFICATION forming part of Letters Patent No. 649,220, dated May 8, 1900.

Application filed December 20, 1899. Serial No. 741,055. (No model.)

To all whom it may concern:

Be it known that we, CARL ARTHUR SCHOPPER, engineer, and ALFRED WILHELM HERMANN RÖDER, machine constructor, subjects of the King of Prussia, Emperor of Germany, residing at Wilhelminenstrasse 3, Kiel, in the Kingdom of Prussia and Empire of Germany, have invented certain new and useful Improvements in Rotary Expansion-Engines, of which the following is a full, clear, and exact description.

In order to obviate the concussions occurring in connection with cylinder-machines caused by reversing the direction of motion of the steam-piston and for which, as is known, a very large portion of the generated power must be employed for the purpose of effecting transmission, rotary machines have been produced in which the rotary pistons transmit the power to the driving-shaft. If these machines have already secured the attention of all persons skilled in the art by reason of the principle employed, the new invention, which in comparison with existing rotary machines is far more complete, will receive even greater attention, as it embodies an idea whereby the working capacity of the machine is made greater than any hitherto attained.

In the present invention the uniform running of the machine, as well as a better transmission of power, is assured by the arrangement whereby a rotary cylinder fixed to a shaft exercises through its total weight its full influence on the motion and on the easy action of the machine. This rotary cylinder is set in motion in the following manner: Partitions or walls are arranged in the same, which serve as working surfaces for the steam, a number of slides, which are seated in a fixed frame, alternately entering the cylinder, whereby shut-off steam-chambers are created between the wall and the slide and in which chambers the steam can exercise its pressure on the sides or walls of the cylinder, so that thereby the cylinder is kept constantly rotating.

The accompanying drawings illustrate the new machine.

Figure 1 is a front view of the machine, partly in section. Fig. 2 is a side view in section along the line $x\,x$ with the slides $d\,d'$ within the steam-chambers. Fig. 3 is likewise a side view in section along the line $y\,y$ with the slides $c\,c'$ outside of the cylinder. Fig. 4 is a sectional plan view of Fig. 1. Figs. 5 to 8 are diagrams showing the movement of the valves. Fig. 9 is a side elevation of the valve-gear.

On the driving-shaft of the engine which transmits the power to the working machine, which is driven by the engine, is a steam-cylinder a, actuated by the steam and firmly connected with the shaft. This steam-cylinder a is closed all around, except the inside, and moves on a fixed frame b. In the cylinder are two fixed walls or partitions $a'\,a^2$, corresponding exactly with the size of the cylinder cross-section. Above and below in the frame b two slides $c\,c'$ and $d\,d'$ are arranged, which are alternately carried into the cylinder a by means of the eccentric mechanism actuated by the driving-shaft, so that when the slide c is pushed in the slide c' is also introduced, the two slides $d\,d'$ acting just as the two slides $c\,c'$.

In consequence of a slide being introduced into the cylinder at the same time above and below closed chambers are created between the slides and the walls, of which chambers two are connected with the inlet-channels $e\,e'$, while the two other steam-chambers are connected with the exhaust-steam channels $f\,f'$. By an alteration in the steam-conduits, the active-steam channels $e\,e'$ being converted into exhaust-steam channels and the exhaust-steam channels $f\,f'$ being allowed to act as active-steam channels, the engine is caused to rotate in the opposite direction to that shown in the drawings. For this purpose the slide-boxes $e^2\,f^2$ are attached, which by means of their slides, that are adjustable by a hand-lever common to both, enable the reversing to be effected.

The entry of steam could be regulated by an arrangement under which the steam before passing these slide-boxes $e^2\,f^2$ would be forced to pass through a special slide or valve, which would open twice at each rotation of the engine, so that the steam could only flow through to the cylinder when it is required to produce an effect. By means of a simple

steam-valve, which may be arranged in front of the special slide or valve, the admission of steam from the boiler can be effected or stopped.

In order that the movement of the slides may be accurately shown, the regulating contrivance for the one pair of slides $c\,c'$ is illustrated on Sheet 2, which slides $c\,c'$ are temporarily (or from time to time) introduced into the cylinder a by the arrangement of a pair of eccentrics $o\,o'$ and suitable connecting-rods.

The regulating of the pair of slides $c\,c'$ is effected as follows: On the driving-shaft of the engine, inside the fixed frame b, is a toothed wheel h, which engages with two other toothed wheels $h'\,h^2$. The two latter wheels have a circumference of half the size of that of the wheel h, as two fixed walls or partitions are arranged in the cylinder a. Upon the wheel h being rotated once the two small wheels $h'\,h^2$ rotate twice. Thus each of the wheels acts for one-half of the cylinder. Two eccentrics $o\,p$ and $o'\,p'$ are each connected with one small wheel, these eccentrics being actuated by the rotation of the toothed wheels. Of the two pairs of eccentrics the two eccentrics $o\,o'$ actuate the slides $c\,c'$, while the two other eccentrics $p\,p'$ bring about the introduction of the slides $d\,d'$ into the cylinder.

On Sheet 2 of the drawings, as already mentioned, the one eccentric mechanism is illustrated, which regulates the two slides $c\,c'$. Therefore it is unnecessary to illustrate the eccentric mechanism for the slides $d\,d'$, as the function of the latter is precisely the same as that of the eccentrics $o\,o'$. The whole difference in the effect of the two pairs of eccentrics only consists in the eccentrics $p\,p'$ being set back in relation to the eccentrics $o\,o'$ to the extent of one hundred and twenty-five degrees; otherwise the effect is the same. In consequence of the fact that the eccentrics $p\,p'$ first exercise the same effect, after the eccentrics $o\,o'$, after a rotation of one hundred and twenty-five degrees, the result is produced on the cylinder that, as the "course" is here reduced to the half, such course is only equal to an arc of sixty-two and one-half degrees. Thus the slides $d\,d'$ effect sixty-two and one-half degrees after the slides $c\,c'$ exactly the same movement. The eccentric-rods of the eccentrics $o\,o'$ run upward and are seated so as to oscillate freely in guide-shoes $k\,k'$, moving upward and downward in guides $i\,i$. A stay l serves to connect the two guide-shoes $k\,k'$. By this stay the slides $c\,c'$ are moved into and out of the cylinder through the medium of a lever with two unequal (or dissimilar) arms $m\,m$. The eccentric c' is arranged at an angle of one hundred and twenty-five degrees in relation to the eccentric o and for the following reasons: Assuming that the course on the sliding way $i\,i$, which is transmitted to the same by the eccentrics $o\,o'$, be divided into four parts and the limits on each side are indicated by the Figs. 1, 2, 3, and 4, (see Sheet 2 of the drawings,) while in Fig. 5 the guide-shoes $k\,k'$ are in the position 1, it will be seen that the eccentric o is in its highest position, whereas the eccentric o' is placed one hundred and twenty-five degrees below in the direction of the arrow. If now the engine be rotated to the extent of twenty-seven and one-half degrees, the small tooth-wheels $h'\,h^2$ are moved further to the extent of fifty-five degrees. The result hereby attained is that the guide-shoes $k\,k'$ move on the guides from 1 to 2. The stay l of the guide-shoes $k\,k'$ in being pushed from 1 to 2 actuates a lever m with unequal (or dissimilar) arms, which causes the slide c to enter very quickly into the cylinder. The lever m is connected, by means of a connecting-rod q, which runs downward, with a lever n, having unequal (or dissimilar) arms, whereby the lever m having introduced the slide c the slide c', actuated by the lever n, is also quickly pushed into the cylinder a, so that the steam can act on the walls of the cylinder and cause the latter to rotate rapidly. The slides $c\,c'$ remain during a rotation of the small wheels $h'\,h^2$ of one hundred and twenty-five degrees in the cylinder—that is, a stretch of sixty-two and one-half degrees on the cylinder circumference. The eccentrics $o\,o'$ now reach, after a complete revolution of one hundred and eighty degrees, the position 3. (See Fig. 7.) Owing to the guide-shoes $k\,k'$ being uniformly pushed up and down any influence of the stay l on the slides $c\,c'$ is avoided. If, however, the eccentrics $o\,o'$ are rotated again to a further fifty-five degrees, the guide-shoes $k\,k'$ will be uniformly pushed in one direction—in this instance from 3 to 4. (See Fig. 8.) In consequence of this also the levers $m\,n$ will be actuated and the slides will leave the cylinder a. From the position of the slides $c\,c'$ in Fig. 8 the latter after the the rotation of the eccentric to the further extent of one hundred and twenty-five degrees will remain outside the cylinder, as during this rotation the eccentric c has moved to the same extent upward as the cylinder c' downward. Hereby, as can be easily seen, a working path of sixty-two and one-half degrees for the steam results. In order now to increase this working area of the steam, so that a favorable effect may be secured, it is advisable, as provided in the present case, to introduce a second pair of slides $d\,d'$, which are actuated by a second pair of eccentrics $p\,p'$. This pair of eccentrics $p\,p'$, being set back one hundred and twenty-five degrees, execute exactly the same movement as the eccentrics $o\,o'$, only reckoned on the circumference of the cylinder to the extent of sixty-two and one-half degrees later, so that after the slides $c\,c'$ are moved out of the cylinder a the slides $d\,d'$ are introduced into the same, whereby the working course of the steam is raised sixty-two and one-half degrees, and therewith a working course of the steam of one hundred and twenty-five degrees re-

sults on each side for each half of the cylinder. In this course the steam can thus exercise an effect on each side through the steam-inlets *e e'*, while the exhaust-steam on the other side of the walls is either carried off into the open air through the outlet-channels *f f'* or conducted through the same to the condenser. In Fig. 9 on Sheet 2 the position of the slide-regulating arrangements one behind the other is also shown in side view, which view would correspond with that of Fig. 8.

The employment of the rotary cylinder considerably facilitates the action of the steam, as it has the effect of a fly-wheel. The acceleration which is imparted to the cylinder by the rotation contributes not a little to considerably reducing the filling for the cylinder, whereby it is evident that no small economy of steam is effected as compared with the cylinder-machines and the rotary engines hitherto known.

What we claim, and desire to secure by Letters Patent, is—

An improved rotary expansion-engine, comprising a fixed frame *b*, a rotary cylinder *a*, arranged in the circumference thereof, and having fixed walls or partitions a', a^2, movable slides *c*, *c'*, *d*, *d'*, and actuating means for said slides adapted to introduce said slides alternately, and in pairs, into the cylinder *a*, whereby special steam-chambers are created for the action of the active steam, and for the exhaust, substantially as shown and described.

In witness whereof we subscribe our signatures in presence of two witnesses.

CARL ARTHUR SCHOPPER.
ALFRED WILHELM HERMANN RÖDER.

Witnesses:
F. RÖPKE,
H. MÖLLER.