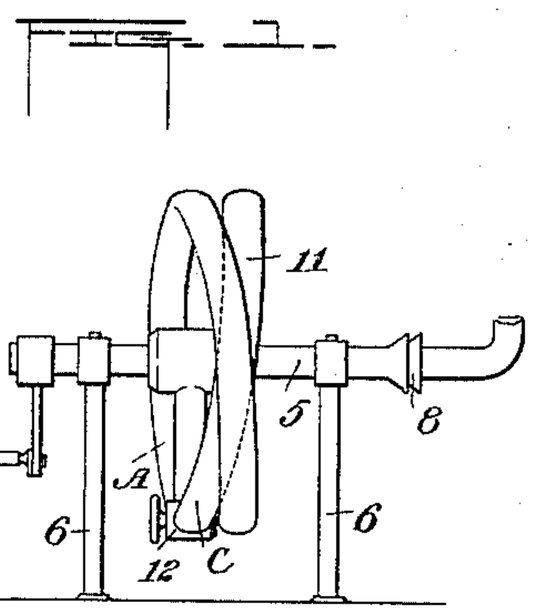
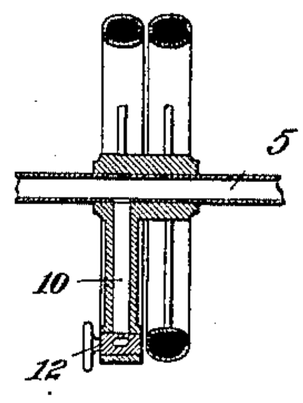
(No Model.) 2 Sheets—Sheet 1.

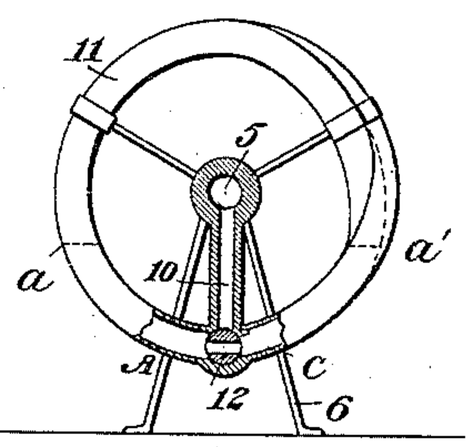
F. G. A. SCHULZE-BERGE.

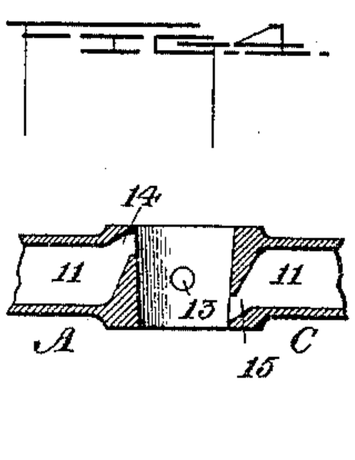
VACUUM PUMP.

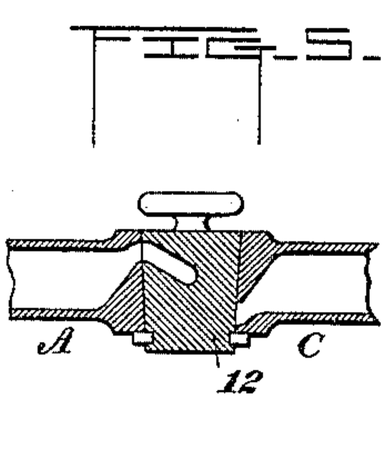
No. 452,852. Patented May 26, 1891.

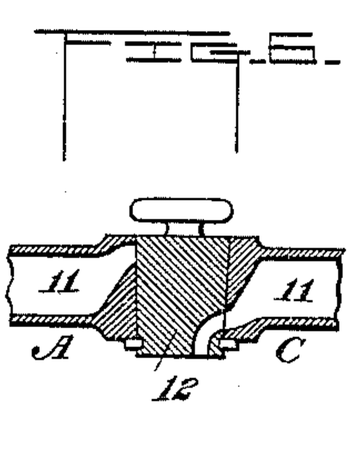


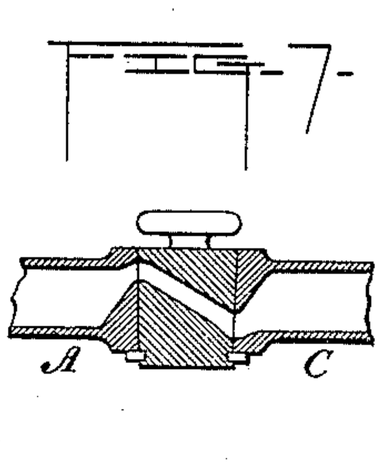


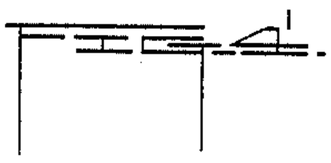




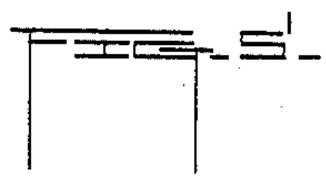




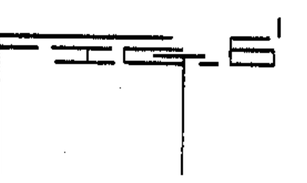




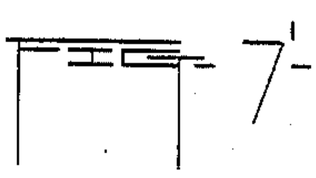
Position 2.



Position 1.



Position 3.



WITNESSES.

W. B. Corwin

J. K. Smith

INVENTOR.

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by W. Baxewell & Sons

his attorneys

(No Model.) 2 Sheets—Sheet 2.

F. G. A. SCHULZE-BERGE.

VACUUM PUMP.

No. 452,852. Patented May 26, 1891.

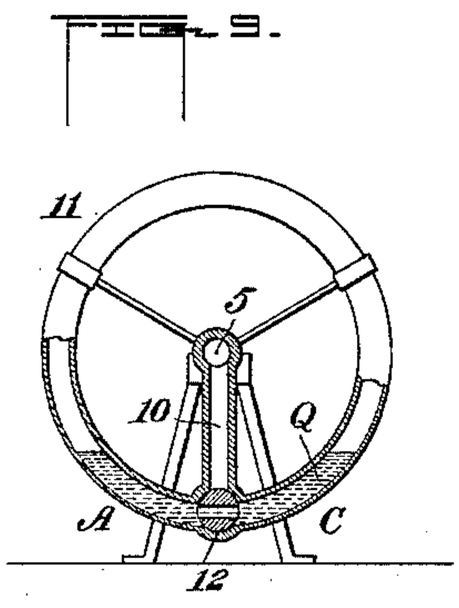


FIG. 10.

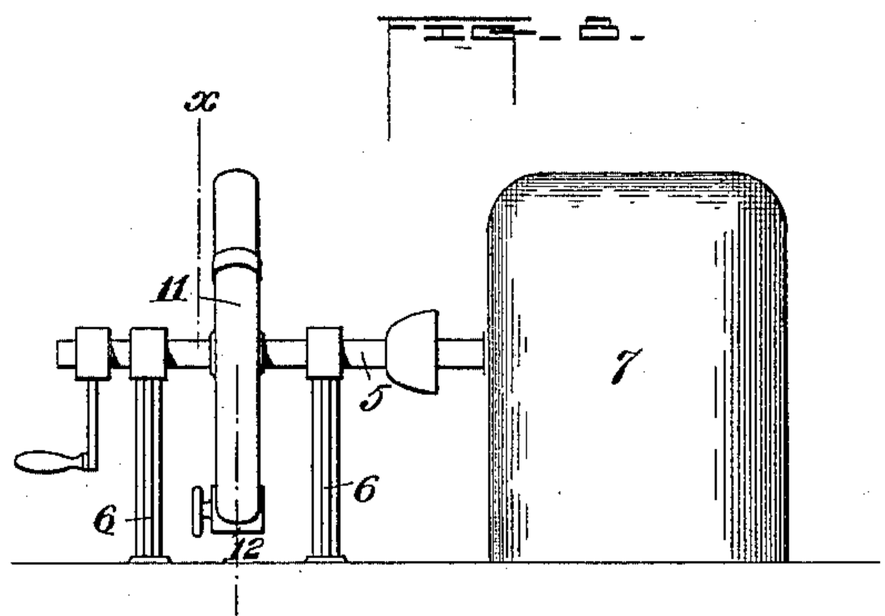


FIG. 11.

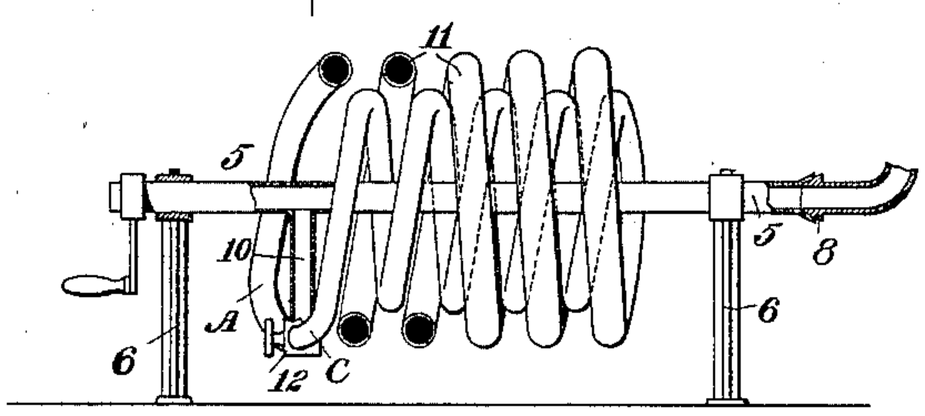


FIG. 17.

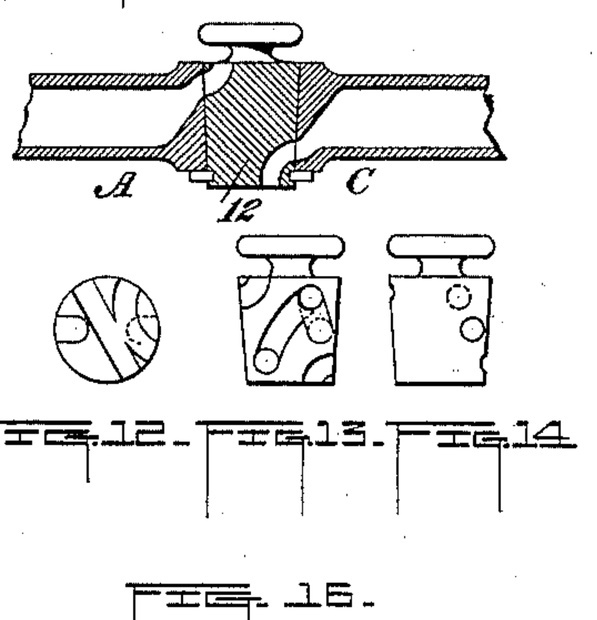


FIG. 12.

FIG. 13.

FIG. 14.

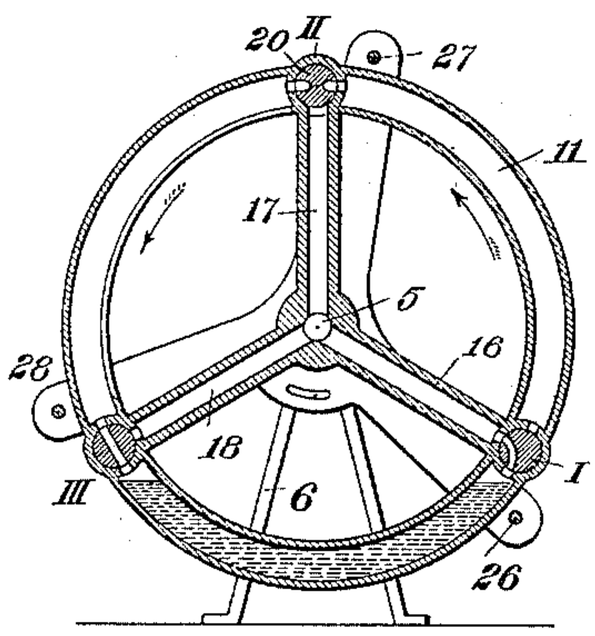


FIG. 15.

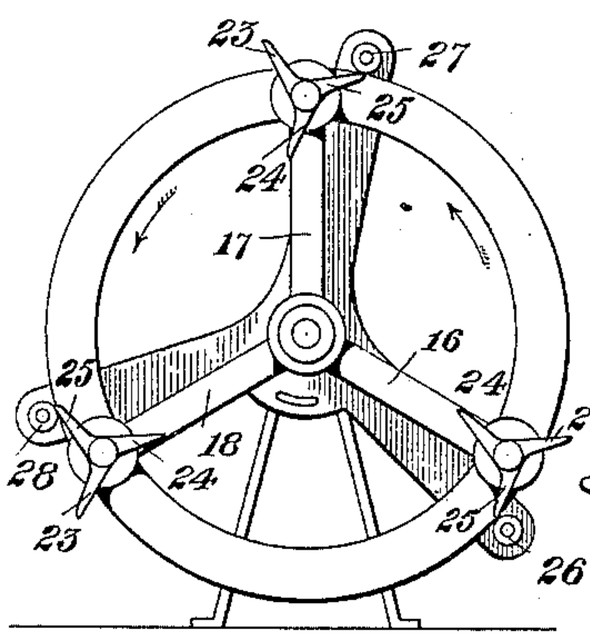
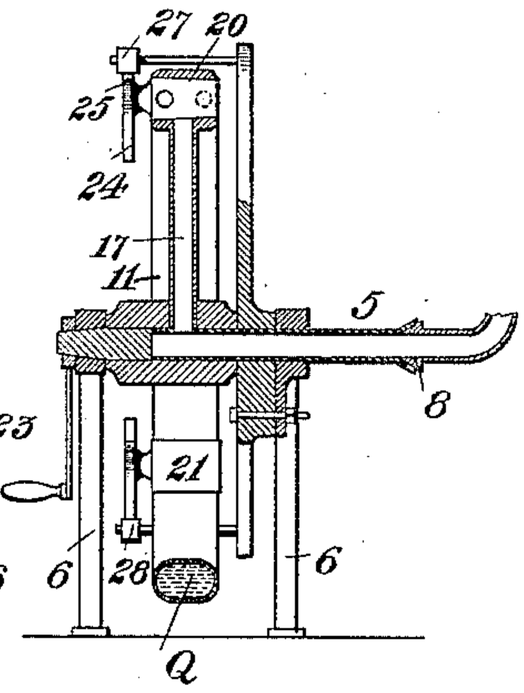


FIG. 16.



WITNESSES.

W. B. Corwin
J. K. Smith

INVENTOR.

Franz G. A. Schulze-Berge
by W. Baxewell & Sons
his Attorneys

UNITED STATES PATENT OFFICE.

FRANZ G. A. SCHULZE-BERGE, OF BROOKLYN, NEW YORK.

VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 452,852, dated May 26, 1891.

Application filed November 17, 1888. Serial No. 291,133. (No model.)

To all whom it may concern:

Be it known that I, FRANZ G. A. SCHULZE-BERGE, of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Vacuum-Pumps; and I do hereby declare the following to be a full, clear, and exact description thereof.

My apparatus for producing a vacuum consists in a rotatory curved or endless tubular vessel, a part of which is filled with a liquid mass.

In the accompanying drawings are illustrated apparatus by means of which my method can be practiced.

Figure 1 shows in side elevation a form of my improved apparatus. Fig. 2 is a vertical longitudinal section. Fig. 3 is an end elevation. Fig. 4 is a vertical section, and Fig. 4′ a horizontal section, of the chamber of the valve used in this apparatus. Figs. 5 and 5′ are respectively vertical and horizontal sections of the valve and valve-chamber. Figs. 6 and 6′ are similar sections showing the valve in an altered position. Figs. 7 and 7′ are similar sections showing the same in a third position. Fig. 8 is a side elevation of a modified form of the apparatus. Fig. 9 is a vertical section thereof on the line x' x' of Fig. 8. Fig. 10 is a side elevation of another modification. Fig. 11 represents the valve of Fig. 17 in longitudinal section. Fig. 12 is a bottom plan view of the valve-plug. Figs. 13 and 14 are side views thereof. Fig. 15 is a side elevation of another modified form. Fig. 16 is a vertical diametrical or transverse section, and Fig. 17 is a longitudinal section thereof.

Like symbols of reference indicate like parts in each.

Figs. 1 and 2 represent an apparatus in which the vacuum is produced by rotation in a single direction.

In Figs. 1, 2, and 3, 11 represents a tube bent so as to form a continuous loop with two convolutions, each of, say, about one meter in diameter, the width of the tube being some centimeters. The ends A and C of the tube are joined together, and at the point of connection there is a stop-cock 12, and a radial tube 10 communicating with the tubular axis 5. One end of the axis is closed, the other end being in air-tight communication with the vessel 7 to be exhausted. Q represents a quantity of mercury forming two branches limited by the levels a and a' and filling about one-half of one convolution of the tube 11.

The construction of the stop-cock 12 is illustrated in Figs. 4 to 7′. In Fig. 4′ the bores of the stop-cock are not indicated, the purpose of this figure of the drawings being to show that the bore 13 of the radial tube 10 connects with the middle part of the stop-cock, while the channel of the tube 11 at one end A turns upward into the seat of the stop-cock, as at 14, and at the end C turns downward, as at 15. The stop-cock 12 itself has three passages, which permit the establishment of three different connections, according to three positions of the stop-cock, differing from each other by one hundred and twenty degrees. In position 1 (illustrated by Figs. 6 and 6′) the valve connects the end C of the tube with the atmosphere. In position 2, Figs. 5 and 5′, it connects the end A with the radial tube 10, and in position 3 it connects the end C to the end A, as shown in Figs. 7 and 7′. The valve 12 should now be put into position 3 and the rotary tube 11 be turned until the mercury level a' reaches the end A of the tube. The valve 12 is then put into position 1, in which one end of the mercury is prevented from communication with the atmosphere by the stop-cock 12. The tube 11 should then be turned so as to raise the end A of the tube and the rotation continued until the mercury reaches the end C. The valve 12 should then be put into position 2, whereupon the air will expand from the vessel 7 into the tube 11. The valve 12 should then be turned into position 3 and the tube 11 rotated in the same direction as before, so as to let all mercury pass through the bore of the valve. The valve may then be turned again into position 1 and all the movements above described repeated until the desired degree of exhaustion of the vessel 7 is reached.

In the apparatus shown in Figs. 8 and 9 the tube 11 is not bent so as to form two circumferences, but only one circumference, which is suitable for the same purpose and adapted to be operated in substantially the same manner

as just described. On the other hand, the tube 11 may be arranged so as to have a great number of convolutions in the shape of a double (or multiple) spiral, as shown in Fig. 10, the ends A and C of the spiral being joined to the stop-cock 12 and radial tube 10. This apparatus is a very effective one. Of course a great many variations of this arrangement are possible to be made for the same purpose.

Another apparatus producing a vacuum by a rotatory movement of continuous direction is shown in Figs. 15, 16, and 17. In this form the tube 11 is, say, two centimeters wide, and is bent into the shape of a hollow ring of about three meters in diameter. The interior of the ring communicates by three radial tubes 16, 17, and 18, with the interior of the tubular shaft 5, which is constructed and arranged relatively to the vessel 7, as before described. The points of connection of the tubes 16, 17, and 18 with the ring are provided with stop-cocks 19, 20, and 21, respectively. These stop-cocks, which may be identical in construction, are illustrated in Figs. 11, 12, 13, and 14. The seat of the stop-cock is the same in construction as that shown in Figs. 4 and 4′.

Figs. 5 and 5′ and 7 and 7′ show the same construction as illustrated in Fig. 11, except that the latter figure differs therefrom, in that it shows an additional bore in the stop-cock. In three different positions, differing from each other by one hundred and twenty degrees, each stop-cock will allow three different connections to the parts of the apparatus, which are illustrated in Fig. 17, and are marked, respectively I, II, and III. In position I it will connect the adjacent radial tube with that division of the ring which is reached first by starting from the cock in the direction indicated by the hands of a running watch. In position II it will connect the two neighboring divisions of the ring with the atmosphere, as shown in Figs. 11 and 17. In position III it will connect the two neighboring divisions of the ring with each other, as shown in Figs. 7 and 17.

General views of the passages or bores of the stop-cock are given in Figs. 11 to 14. In case the diameter of the stop-cock is made sufficiently large it may be arranged in such way that in an intermediate position between any of the positions I, II, and III it will prevent any communication between the corresponding radial tube and the neighboring divisions of the ring.

In Figs. 16 and 17, Q represents a quantity of mercury forming two branches, limited by the levels a and a'. In order to produce a vacuum with the apparatus shown in these figures, supposing it to be in the position shown in Fig. 17, I bring the stop-cock 19 into position I, the stop-cock 20 into position II, and the stop-cock 21 into position III, so that the level a of the mercury is prevented from communicating with the atmosphere, but is in communication with the vessel 7. I now turn the ring in the direction of the arrow, Fig. 17, until the mercury has passed through the stop-cock 21, and then bring the stop-cock 21 into position I, 19 into position II, and 20 into position III, and continue turning the ring in the direction of the arrow until the mercury has passed through the stop-cock 20. I then put the stop-cock 20 into position I, 21 into position II, and 19 into position III, and proceed to turn the ring in the direction of the arrow until the mercury has passed through the cock 19. Then I put 19 into position I, 20 into position II, and 21 into position III, and so on. The effect will be the gradual exhaustion of the air from the vessel 7.

The movement of the stop-cocks in the machine shown in Fig. 17 can be carried out automatically by the motion of the apparatus itself. One way in which this can be done is shown in Fig. 15. Let the head of each stop-cock be provided with three radial arms 23, 24, and 25, forming angles of one hundred and twenty degrees with each other. Let three rollers 26, 27, and 28 be placed near the circumference of the ring 11, parallel to and equidistant from its axis, projecting over the circumference of the ring and having equal distances from each other, as shown in Fig. 10. If then the radial arms 23, 24, and 25 of the stop-cocks are made long enough, they will meet the rollers 26, 27, and 28 during the rotation of the hollow ring 11 and will be turned simultaneously for a certain angle, and if the length of the arms 23, 24, and 25 is properly chosen, this angle can be made to be exactly one hundred and twenty degrees. By this arrangement the movement of the stop-cocks necessary to perform the evacuation by a continuous rotation of the ring, as above described, will be carried out automatically. Of course instead of the stop-cocks, valves or any other devices suitable for the purpose of establishing the connections required may be used in all the apparatus described above. It is not necessary that the liquid employed should be mercury, though it is a very suitable medium for the purpose on account of its fluidity and high specific gravity. Any other liquid will answer the purpose; but the dimensions of the apparatus must be altered for other liquids, according to their specific gravity.

There is one feature of my improvement which makes it distinctly different from the Geissler vacuum-pump or a Sprengel vacuum-pump. While in those pumps the parts in which a vacuum is produced maintain a stationary position, in my apparatus the curved tubular vessels are moved themselves axially in a continuous direction. I can therefore produce a vacuum of great extent by sending a comparatively small quantity of mercury through the apparatus.

Another distinctive feature common to all the forms of my improved apparatus is that the tubular vessel is so constructed that it affords a passage through which the liquid mass travels in a single direction without re-

versal or oscillation of the vessel. The advantage attained by this is very marked and will be appreciated by those skilled in the art.

By the term "a tubular vessel," which is used in this specification and in the claims, I wish to include any kind of passage-way, whether actually formed by a tube or by a casting or otherwise, it being immaterial whether it has a round, square, or other shape or internal construction, and by the words "curved tubular vessel," I intend to include any such tubular vessel which deviates from a straight line, whether the curve be a strictly mathematical curve or otherwise.

By the term "vacuum," as used in the specification and claims of this patent, I mean as well a perfect vacuum as a partial vacuum containing some rarefied air, gas, or vapor.

I claim—

1. In an air-pump, a tubular vessel journaled in suitable bearings in which it is rotatable, said vessel containing a liquid-piston and having its ends connected together, substantially as described, to permit the passage of the liquid-piston therethrough continuously in one direction, whereby the pump is adapted to exhaust without reversal, substantially as and for the purposes described.

2. In a vacuum-pump wherein a vacuum is produced by movement of a vessel containing a liquid mass, a tubular vessel containing such liquid mass acting as a piston and provided with suitable stop-cocks or valves, said tubular vessel being rotary on a horizontal axis and having its ends connected together, substantially as described, so as to permit the passage of the liquid-piston through the vessel and through the stop-cocks or valves continuously in one direction, substantially as and for the purposes described.

3. In a vacuum-pump wherein a vacuum is produced by movement of a vessel containing a liquid mass which serves as a piston therefor, a tubular vessel containing such liquid mass and provided with suitable stop-cocks or valves by which the vessel is divided into segments, said tubular vessel being rotary on a horizontal axis and having its ends connected together, as described, so as to permit the passage of the liquid-piston through the vessel and through the stop-cocks or valves continuously in one direction, and valve-controlled passages connecting the several segments of the tubular vessel with the receiver to be exhausted and with the atmosphere, substantially as and for the purposes described.

4. In a vacuum-pump wherein a vacuum is produced by movement of a vessel containing a liquid mass which serves as a piston therefor, a tubular vessel containing such liquid mass and provided with suitable stop-cocks and valves, said tubular vessel being rotary on a horizontal axis and having its ends connected together, as described, so as to permit the passage of the liquid-piston through the vessel and through the stop-cocks or valves continuously in one direction, and mechanism, substantially as described, by which the valves are moved automatically during the rotation of the vessel, substantially as and for the purposes described.

5. In a vacuum-pump wherein a vacuum is produced by movement of a vessel containing a liquid mass which serves as a piston therefor, the combination with a hollow rotary shaft forming an air-passage and adapted to be connected with the receiver to be exhausted, a tubular vessel having its ends connected together, substantially as described, so as to permit the passage of the liquid-piston through the vessel and through the stop-cocks or valves continuously in one direction, said tubular vessel encircling said shaft and connected therewith by hollow connection, and valves dividing the vessel into segments and controlling the communication between the segments and the shaft and between the segments and the atmosphere, and mechanism, substantially as described, for operating said valves, substantially as and for the purposes described.

6. In a vacuum-pump, the combination, with the tubular vessel 11, of the shaft 5, hollow arms connecting the vessel with the shaft, and valves, such as valves 19, 20, and 21, controlling the connection between the segments of the vessel and the shaft and between the segments of the vessel and the atmosphere, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand, this 7th day of November, A. D. 1888.

FRANZ G. A. SCHULZE-BERGE.

Witnesses:
EDWD. ROBINSON,
P. SCHULZE-BERGE.