

(No Model.)

2 Sheets—Sheet 1.

P. SCHOOP.

METHOD OF AND APPARATUS FOR CIRCULATING LIQUID ELECTROLYTES.

No. 529,199.

Patented Nov. 13, 1894.

Fig. 1.

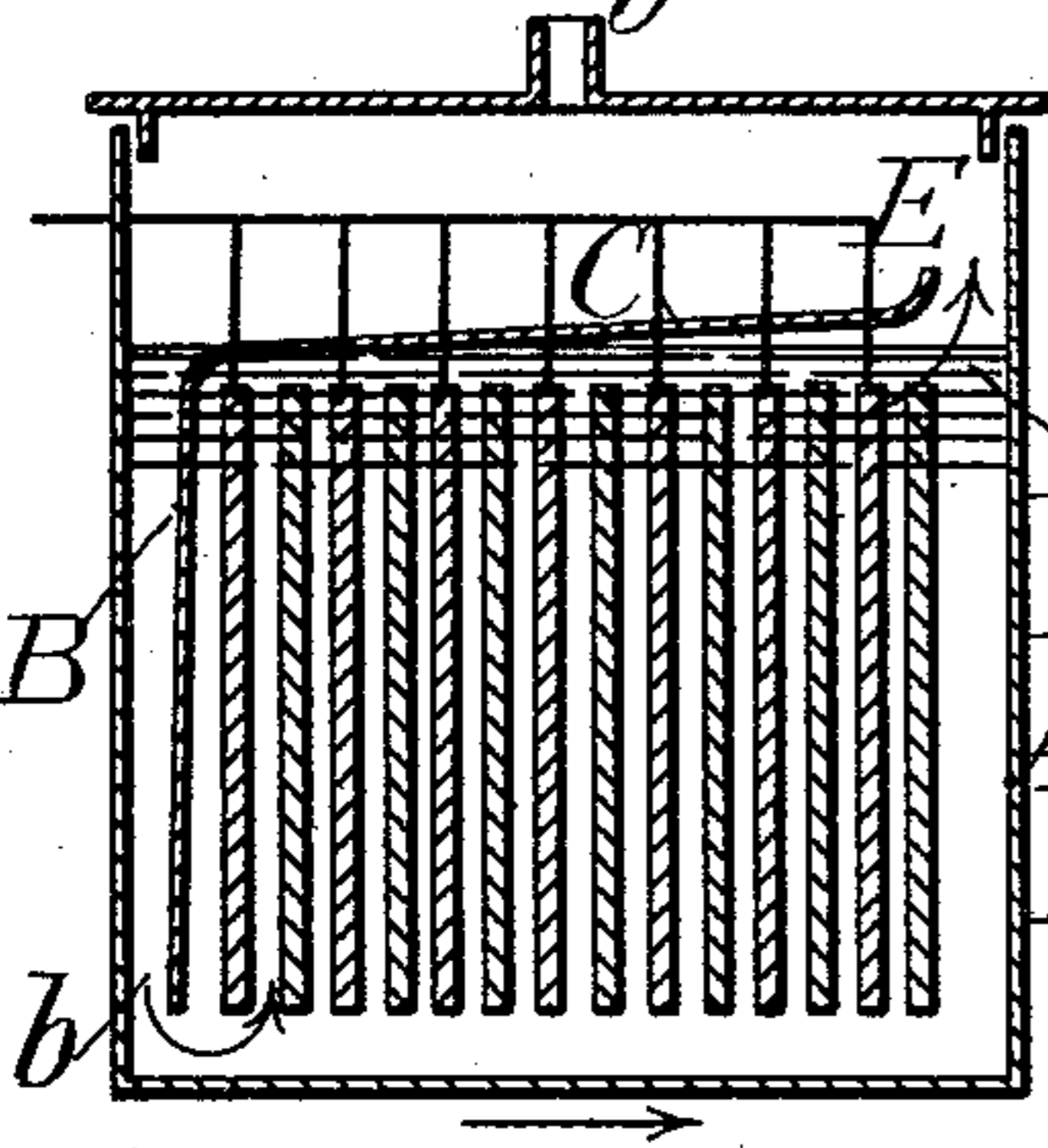


Fig. 3.

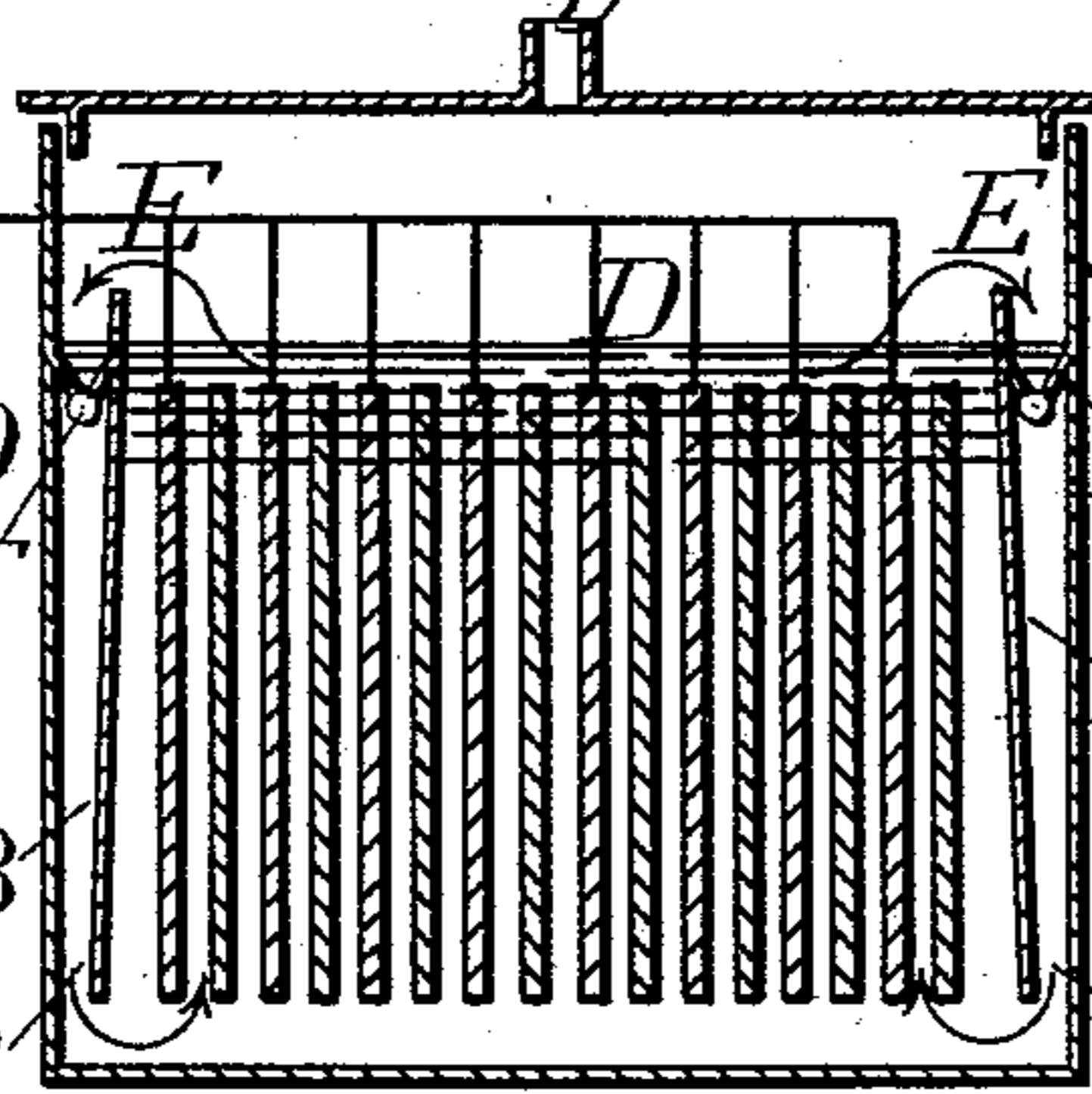


Fig. 5.

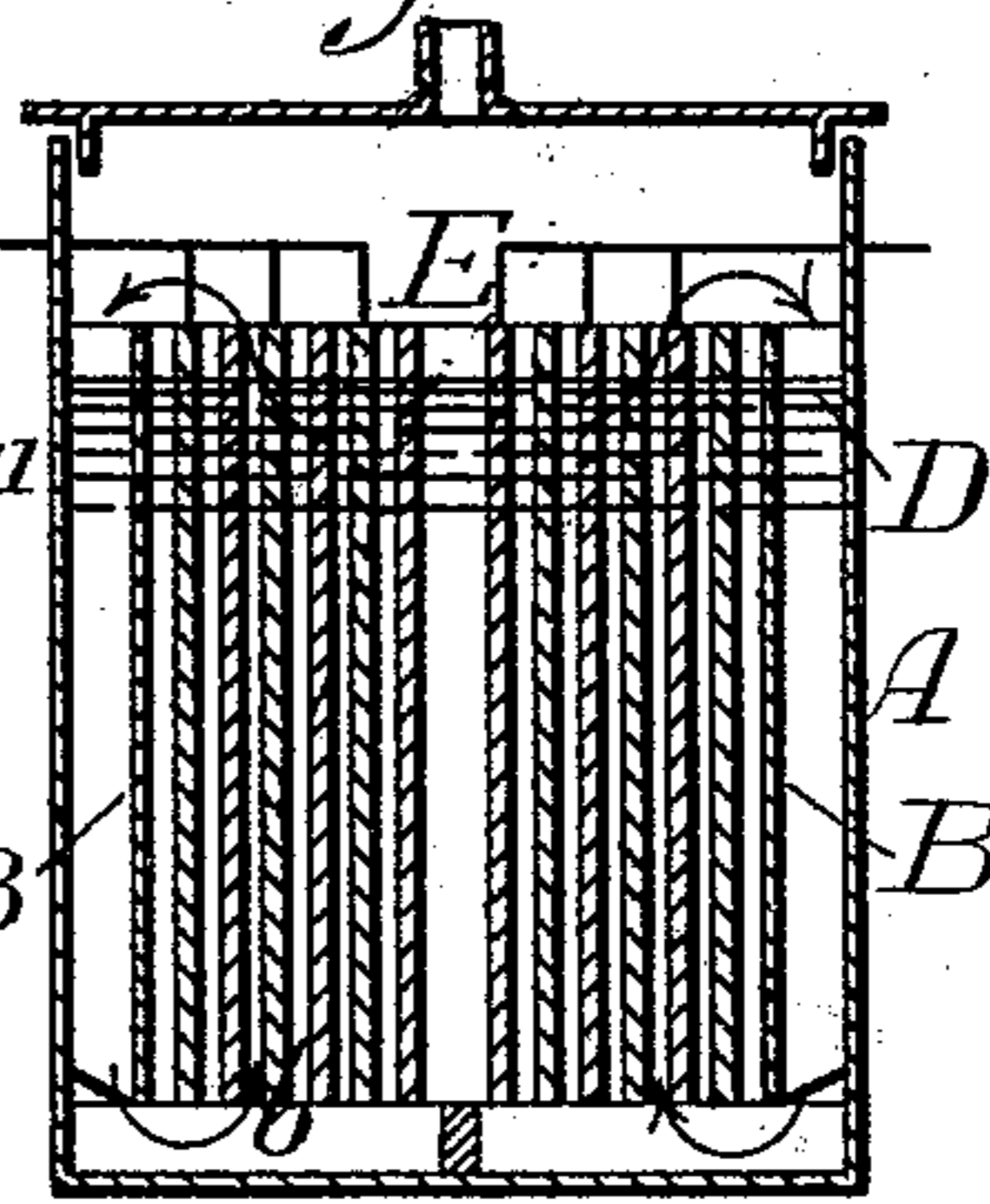


Fig. 2.

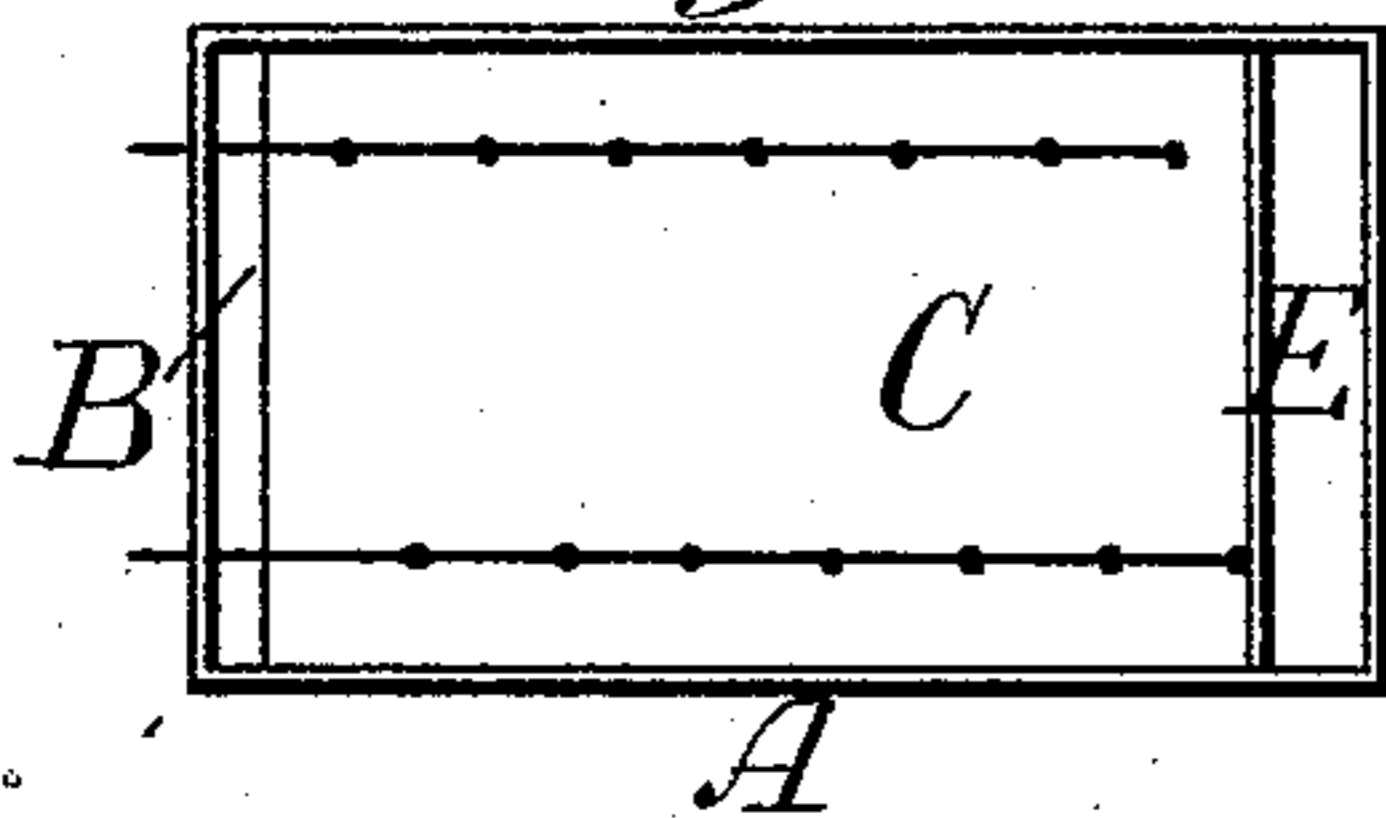


Fig. 4.

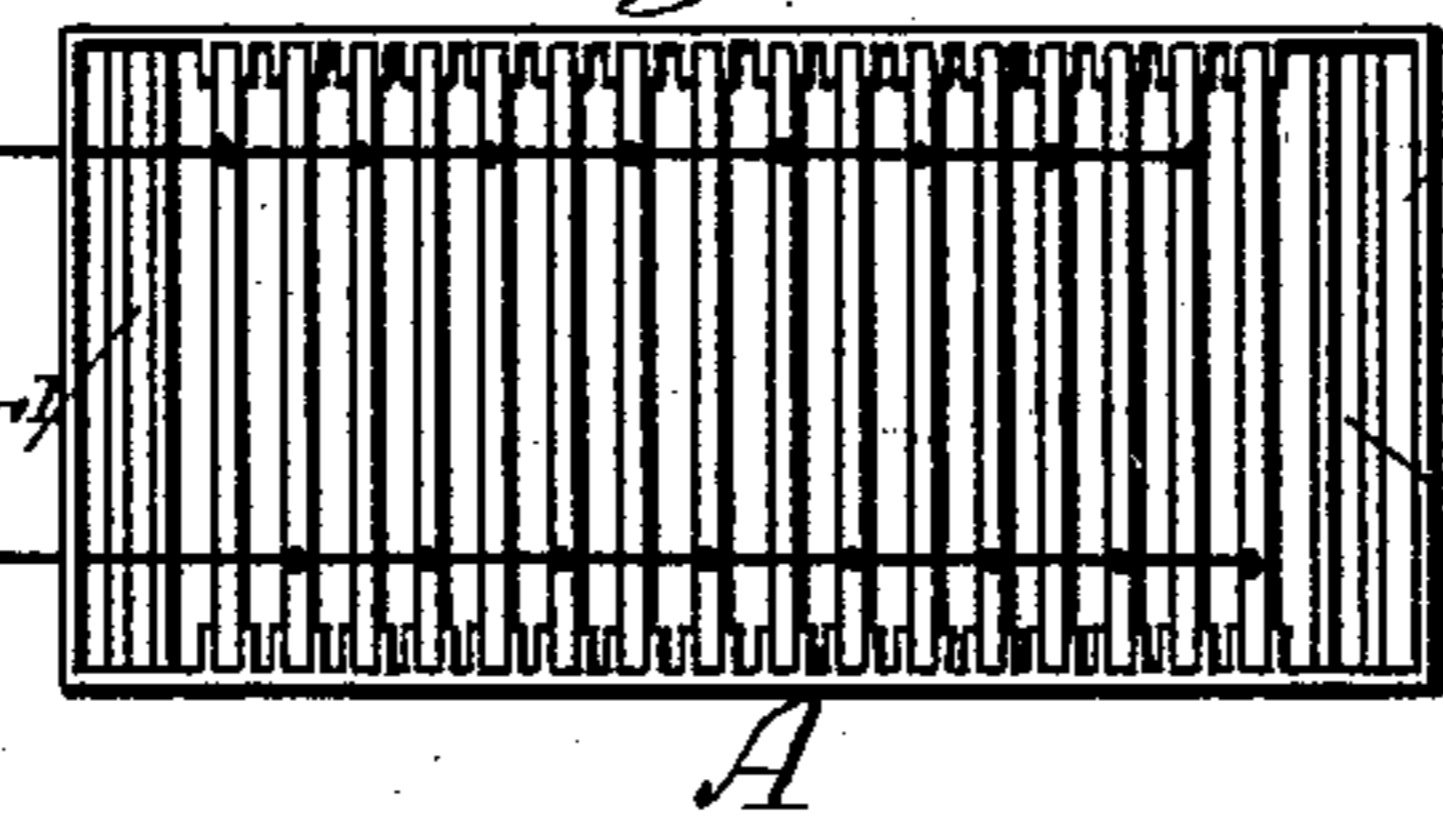


Fig. 6.

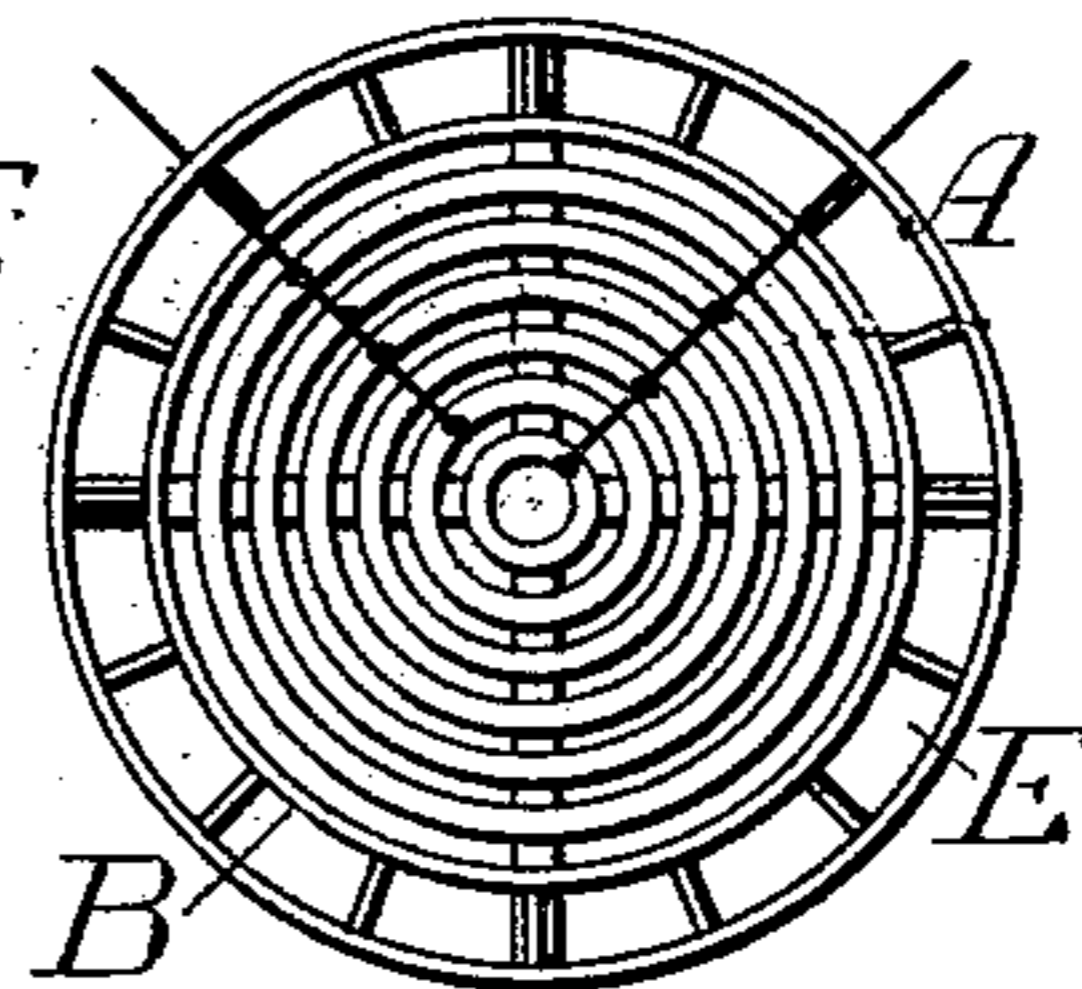


Fig. 7.

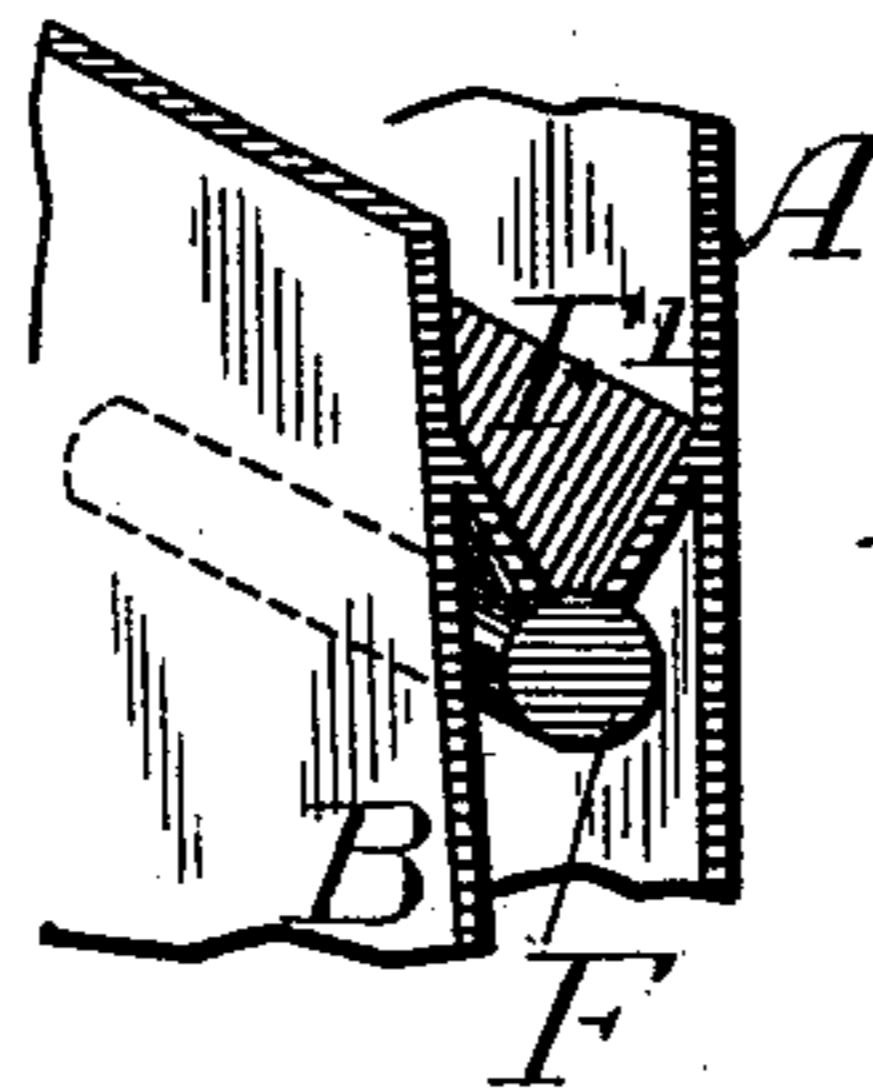
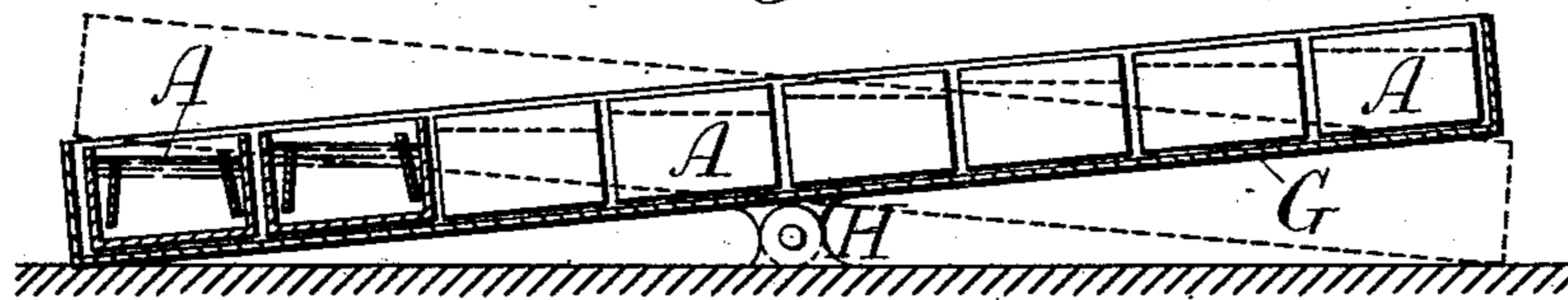


Fig. 4^a.

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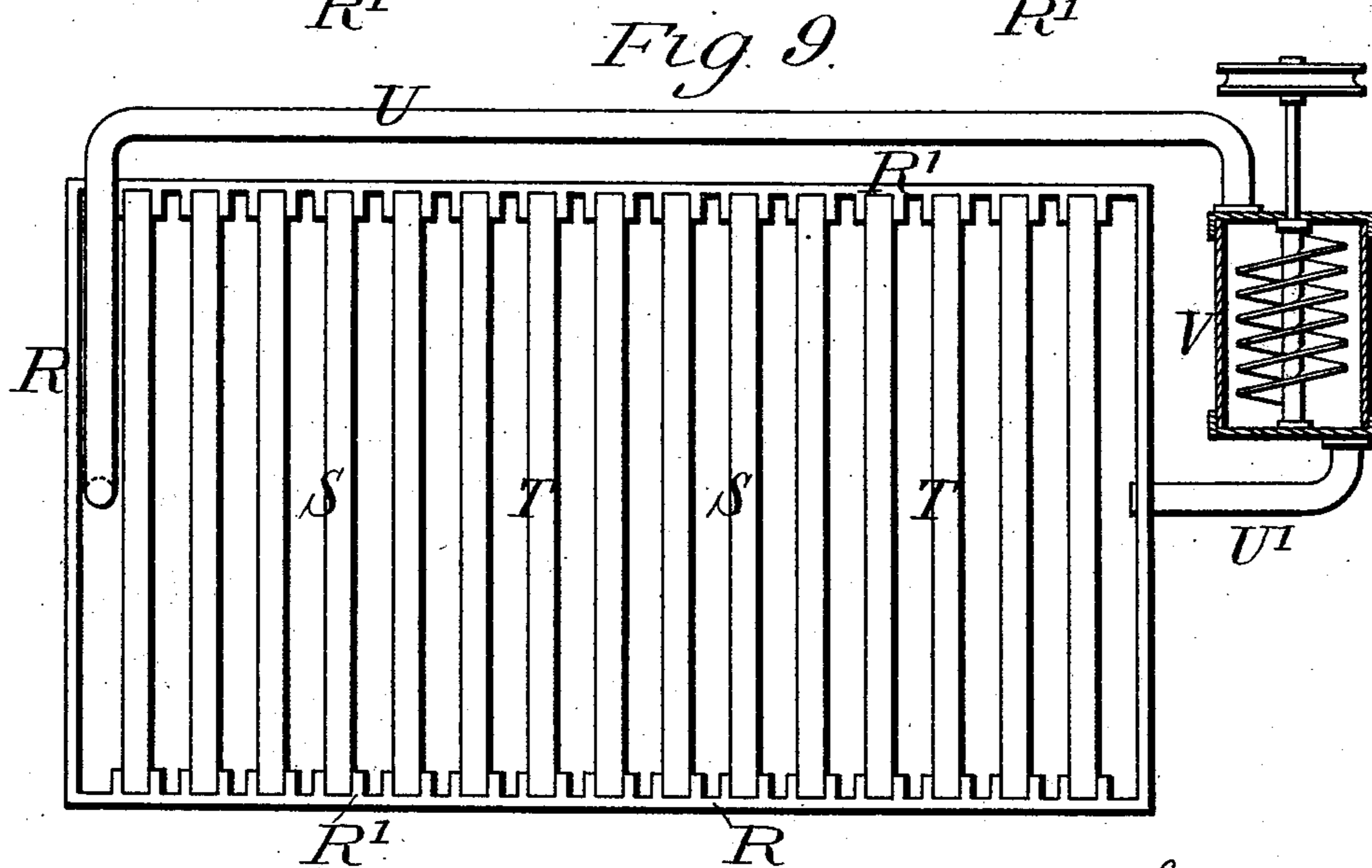
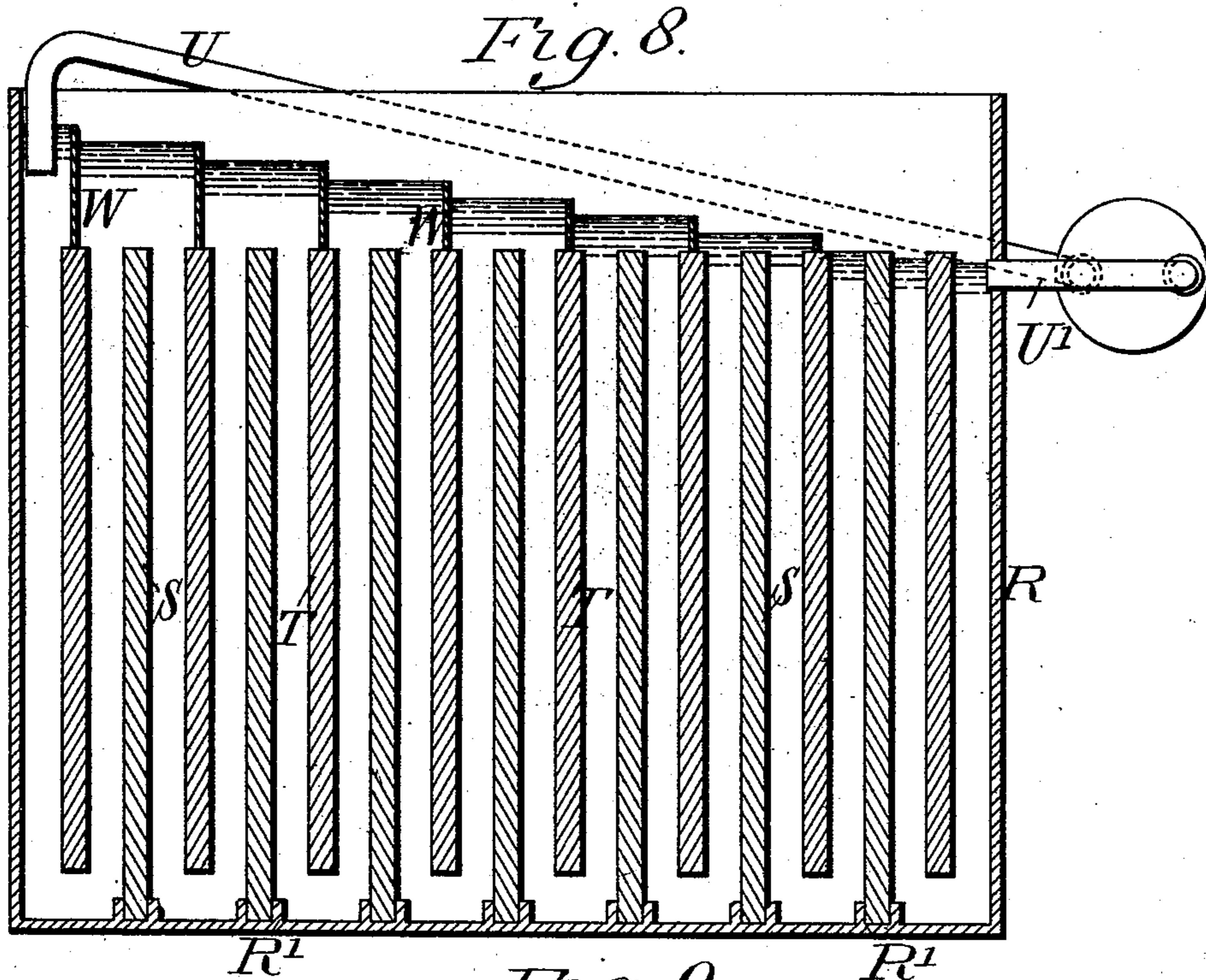
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UNITED STATES PATENT OFFICE.

PAUL SCHOOP, OF ZURICH, SWITZERLAND.

METHOD OF AND APPARATUS FOR CIRCULATING LIQUID ELECTROLYTES.

SPECIFICATION forming part of Letters Patent No. 529,199, dated November 13, 1894.

Application filed December 29, 1893. Serial No. 495,077. (No model.)

To all whom it may concern:

Be it known that I, PAUL SCHOOP, a citizen of Switzerland, residing at No. 14^a Weinberg Strasse, Zurich, Switzerland, have invented a certain new and useful Improvement in a Method of and Apparatus for Circulating Liquid Electrolytes, of which the following is a specification.

It has been found that in order to obtain uniform results and the greatest possible regularity of electrolytic processes, it is essential to maintain the fluid electrolyte at a practically constant composition. According to my present invention I effect this by bringing about a flow or circulation of the liquid in a definite direction throughout the vessel, such as from the top to the bottom and thence to the top again. For this purpose, according to the arrangement which I prefer to employ, I produce by any suitable means a recurring lateral motion to the upper layer of liquid relatively to the vessel, whereby a portion thereof, being raised by the undulating or splashing motion imparted thereto above the general level, is made to pass into the opening of a channel or channels formed at the side or sides of the vessel and leading down to and communicating with the bottom thereof, so that the increased head of liquid thus produced in such channel will cause the bottom portion of the liquid therein to be forced into the main body of the liquid at the bottom of the vessel. This operation being repeated at intervals, it will be seen that the whole of the liquid at the top of the vessel will be made to gradually descend in the said channel to the bottom of the vessel, and will thus cause the liquid there situated to ascend to the top again. This action may be produced in various ways, and the said channels may be variously arranged as will be presently more particularly described. Another mode of effecting the circulation in a definite direction is by connecting one part of the vessel with another part by means of a passage containing a propelling device, such as a screw propeller, or worm, whereby the liquid will be continuously withdrawn from the one part and discharged into the other part, thereby causing a definite flow of the liquid in the body of the vessel from the last named part to that first named.

I am aware that it has been proposed to apply heat to the lower part of an electrolytic vessel, whereby eddies or local currents are produced in the body of the liquid that may tend more or less to mix up the contents in an irregular and unreliable manner, but such a method does not amount to the setting up of a flow or circulation of the liquid in a definite direction throughout the vessel whereby alone effectual means are afforded for maintaining uniformity in the electrolyte.

I will describe by way of example some of the various arrangements whereby my said invention may be carried into effect, for which purpose I will refer to the accompanying drawings, in which—

Figure 1 shows a vertical section and Fig. 2 a plan of one arrangement for effecting the circulation by the first above described means wherein there is provided a vertical passage at one end of the vessel only. Fig. 3 shows a vertical section and Fig. 4 a plan of an arrangement with a passage at each end of the vessel. Fig. 4^a is an enlarged sectional detail view of the valve and valve-seat, hereinafter explained. Figs. 5 and 6 show respectively a vertical section and a plan of a circular vessel having passages formed all round it. Fig. 7 shows a diagram view of a number of vessels arranged on a tumbling support. Figs. 8 and 9 show respectively a vertical section and a plan of an electrolytic vessel in which the definite flow or circulation of the electrolyte is produced by a screw propeller or worm.

In Figs. 1 and 2, the electrolytic vessel A has formed at one end thereof a vertical passage B, open to the body of liquid at the bottom, while at the top it has a shield C extending across to near the other end, slightly above the level of the electrolyte D, so as to leave an opening E at that end. Thus on the vessel being slightly tipped to the right hand side, or, assuming the vessel to be travelling in the direction of the arrow Fig. 2, if it be more or less suddenly stopped or retarded, as in the case of an accumulator battery on a tram car, then the upper layer of liquid will dash against the right hand side of the vessel and part thereof will rise through the opening E and flowing down the slightly inclined shield C, will enter the passage B. The column of liquid in this

passage being thus increased in height, a portion of the liquid in the lower part thereof will be caused to pass through the opening *b* into the main body of the liquid in the vessel, and thus it will be seen that by a repetition of the above described operations the whole of the liquid in the upper part of the vessel will by degrees be made to pass down the passage *B* to the lower part of the vessel, while the liquid in such lower part will gradually ascend to the upper part.

The arrangement shown at Figs. 3 and 4 only differs from that just described in that the passages *B B* are provided at each end of the vessel, so that the above described action will take place in whatever direction the vessel travels or is tipped. In this case the shield *C* is dispensed with, and to prevent the liquid from splashing back from either passage into the body of the vessel, the passages are provided with small floating ball- or cylinder-valves *F* of paraffine or other suitable material, not acted upon by the electrolyte, seating upon a seat *F'* formed in the passage.

Figs. 5 and 6 show a cylindrical vessel *A* having passages *B* all round it, so that in whatever direction the vessel moves or is tipped, the above described action will take place.

Fig. 7 shows a number of vessels *A* constructed as at Figs. 3 and 4 arranged upon a support *G* which is carried on pivots *H* at its middle so as to be capable of being tilted at intervals into alternately oppositely inclined positions as shown in full and dotted lines, thus causing the outer layer of liquid in each vessel to flow alternately into one or other of the end passages. The tipping may take place either uninterruptedly or at certain intervals of time, and may be effected either by hand or automatically by suitable mechanism. When the vessels are situated in a boat, such as in the case of a vessel carrying accumulator batteries for propelling it by electrical energy, the undulating or rocking motion of the vessel will be sufficient for setting up the above described circulation of the electrolyte.

According to another modification, instead of tipping the electrolytic vessel as described, I alternately immerse into and withdraw from the upper layer of the liquid, a body of suitable neutral material, so as to cause the liquid level to alternately rise above the top edge of the passages and overflow into these.

Figs. 8 and 9 represent an accumulator battery in which the circulation of the electrolyte is effected by a screw propeller or worm.

R is a rectangular vessel of glass or other suitable material, formed with internal grooves *R'* at the sides and bottom into which are fitted alternate positive and negative electrode plates *S T*, of which say for instance the positive plates *S* are made to fit tight in the grooves both at the sides and the bottom as before described while the negative plates *T* only fit tight at the sides, and terminate at a short distance from the bottom so that the electrolyte which is supplied through a pipe *U* is caused to flow vertically up and down through the zigzag passages thus formed, being brought successively in contact with the surfaces of all the electrode plates, and finally flowing off through a pipe *U'* to a cylinder containing a rotating screw *V* which propels the electrolyte through the pipe *U* back to the other end of the battery. The screw is rotated by a motor which may be worked by a portion of the current of the battery itself, or by any other suitable source of power. Partitions *W* are carried up beyond the tops of the electrode plates to sufficient heights to afford the necessary flow of liquid through the several passages of the battery.

Having thus described the nature of my invention and the best means I know for carrying the same into practical effect, I claim—

1. The method of producing the circulation of the liquid electrolyte in an electrolytic vessel, by causing a portion of the upper layer of the liquid to be propelled at intervals laterally out of the vessel by a lateral motion imparted to the vessel, and reintroducing such portion of the liquid into the vessel at the bottom, substantially as described.

2. The combination with an electrolytic vessel for containing a liquid electrolyte, electrodes and connections of a passage formed on the inner side of the vessel, and establishing a communication between the upper and lower parts of the vessel, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 7th day of December, A. D. 1893.

PAUL SCHOOP.

Witnesses:

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