No. 702,844. Patented June 17, 1902.

A. WRIGHT.

ELECTRICITY METER.

(Application filed May 26, 1900.)

(No Model.) 3 Sheets—Sheet 1.

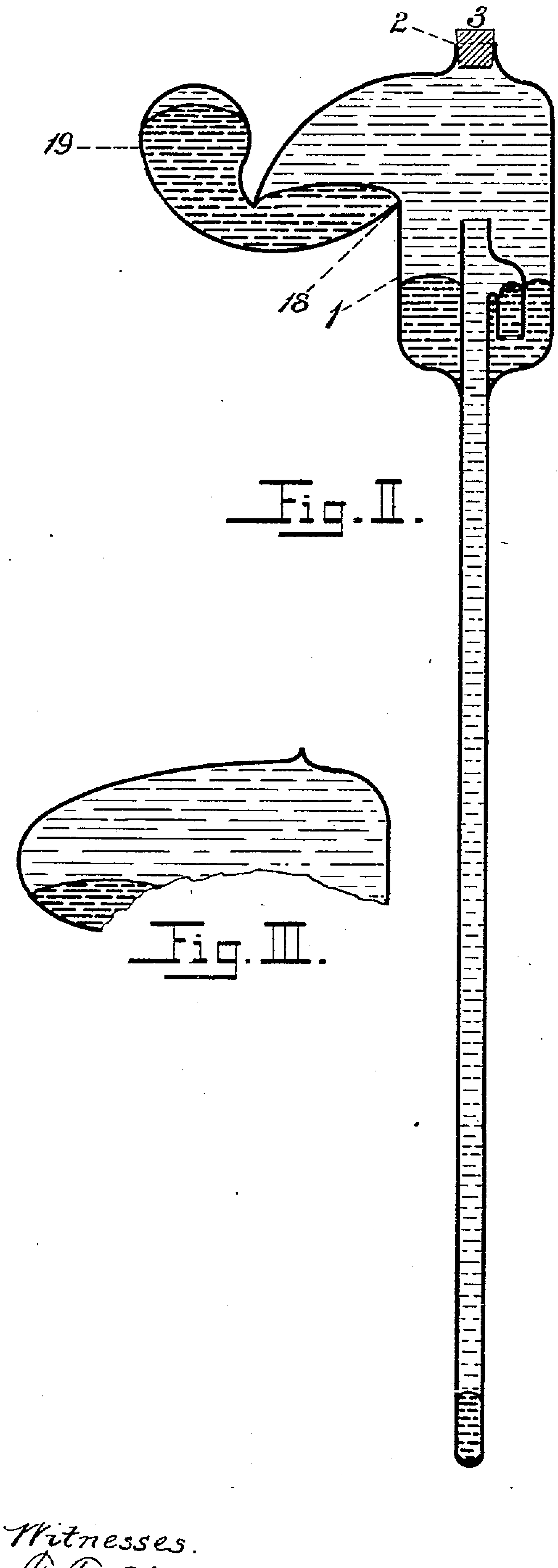

Fig. II.

Fig. III.

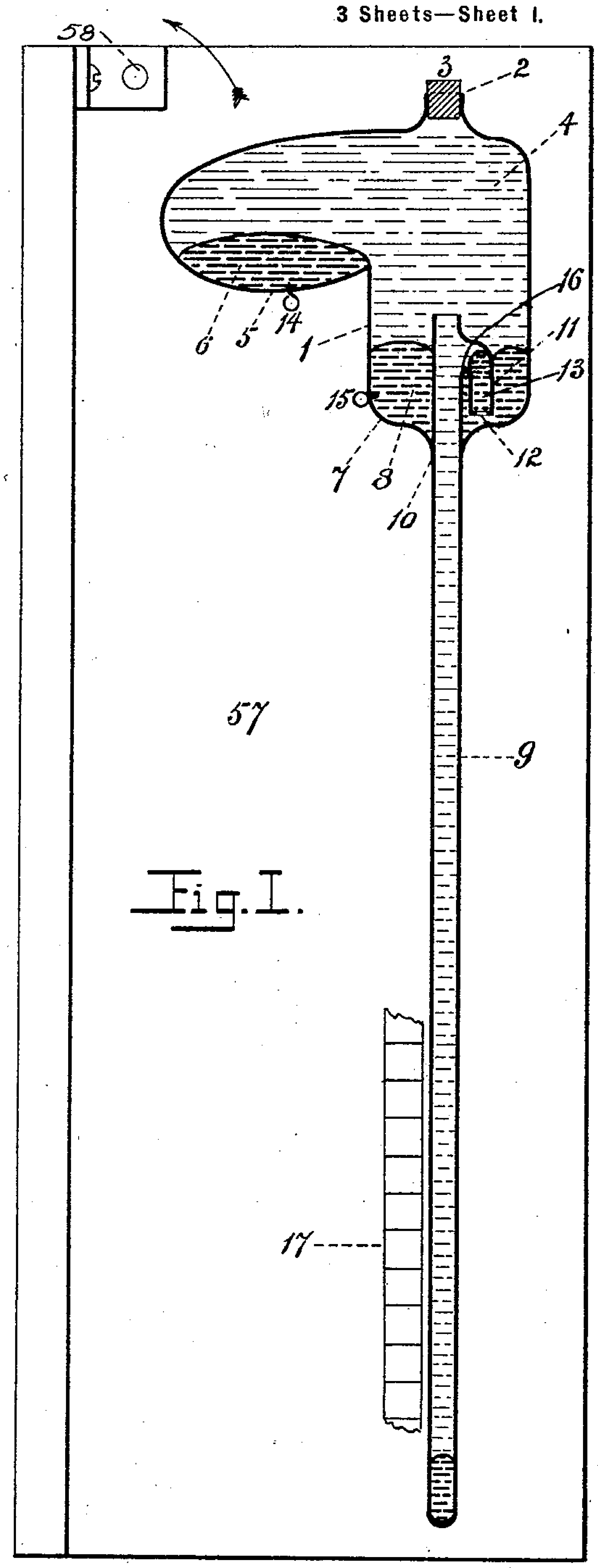

Fig. I.

Witnesses.
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Inventor:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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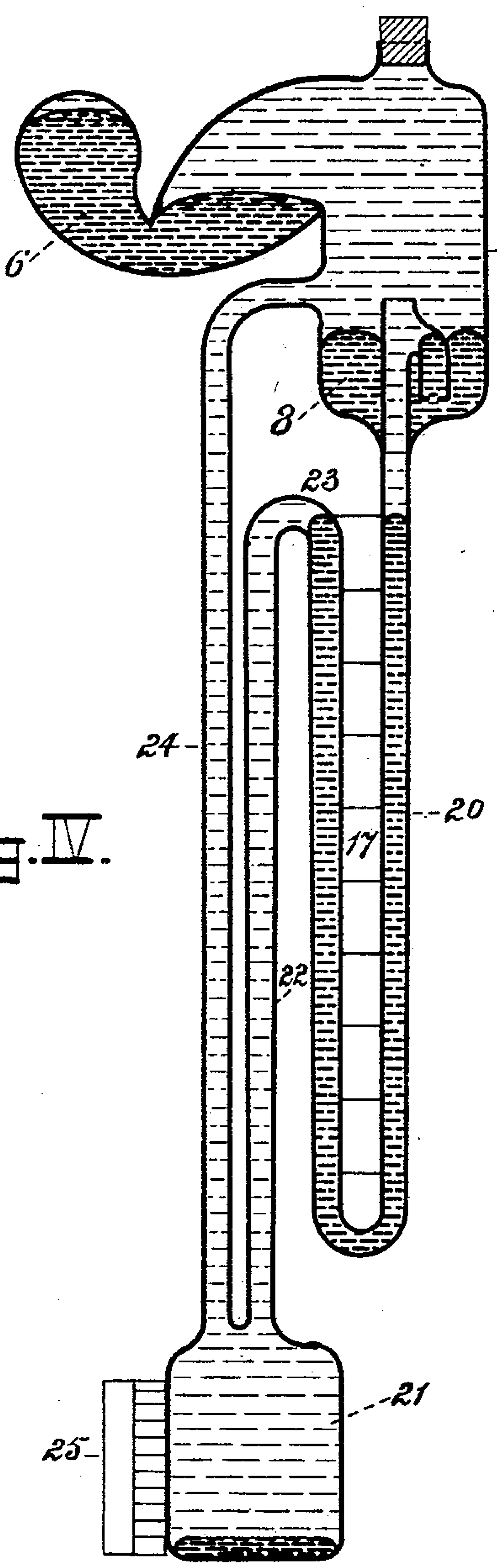

Fig. IV.

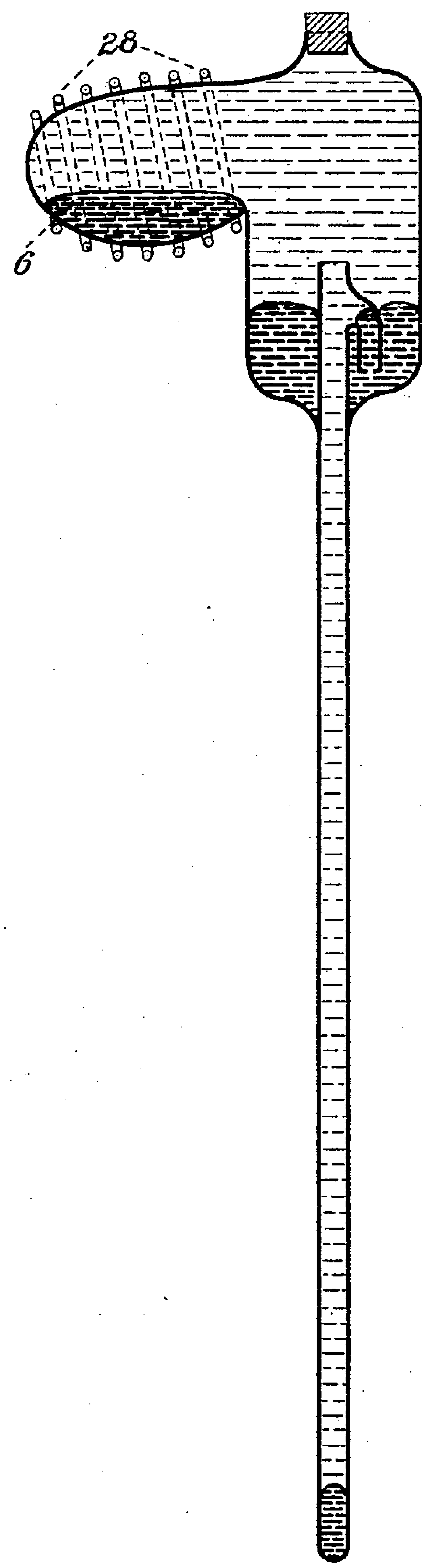

Fig. VI.

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(No Model.) 3 Sheets—Sheet 3.

Fig. V.

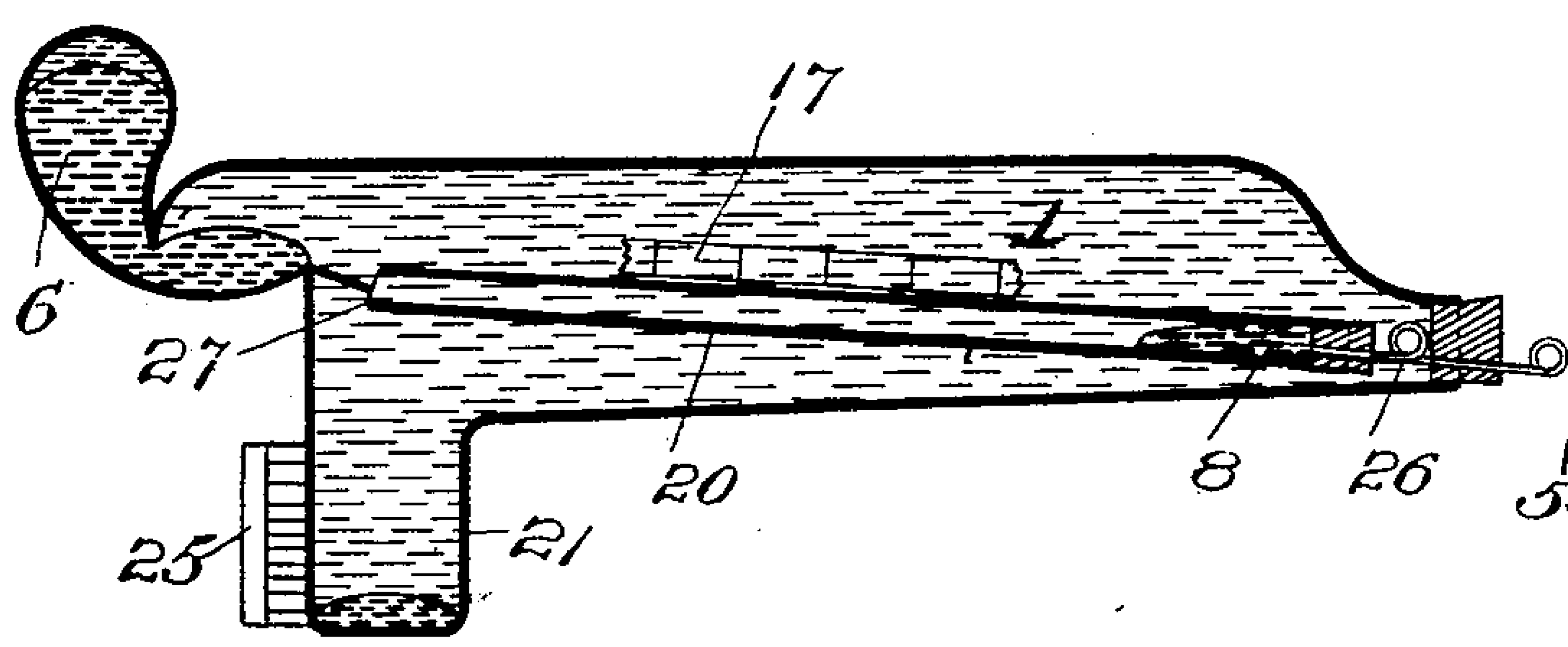


Fig. VII.

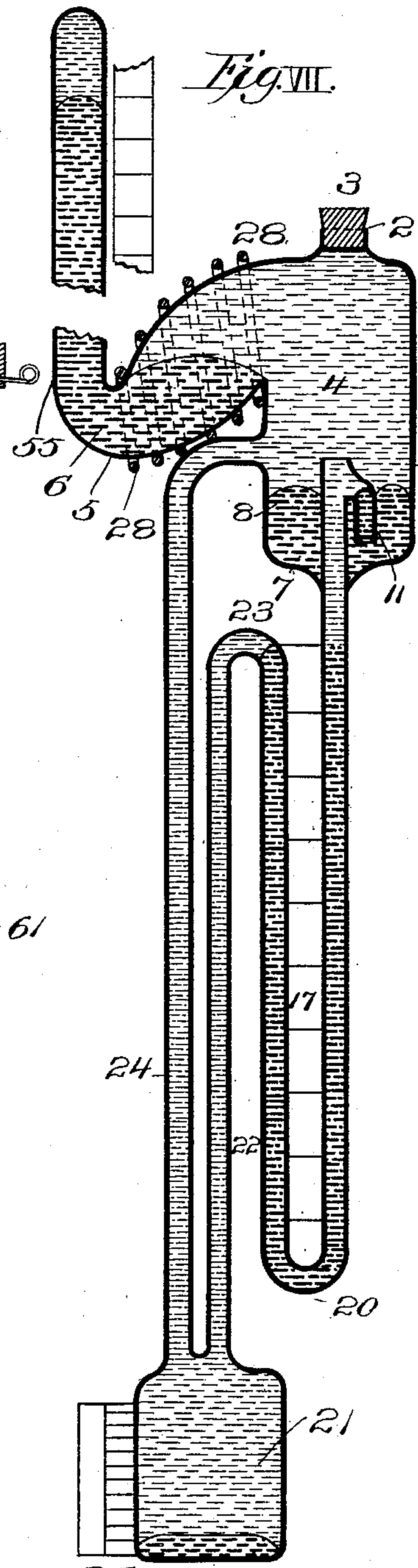


Fig. V a

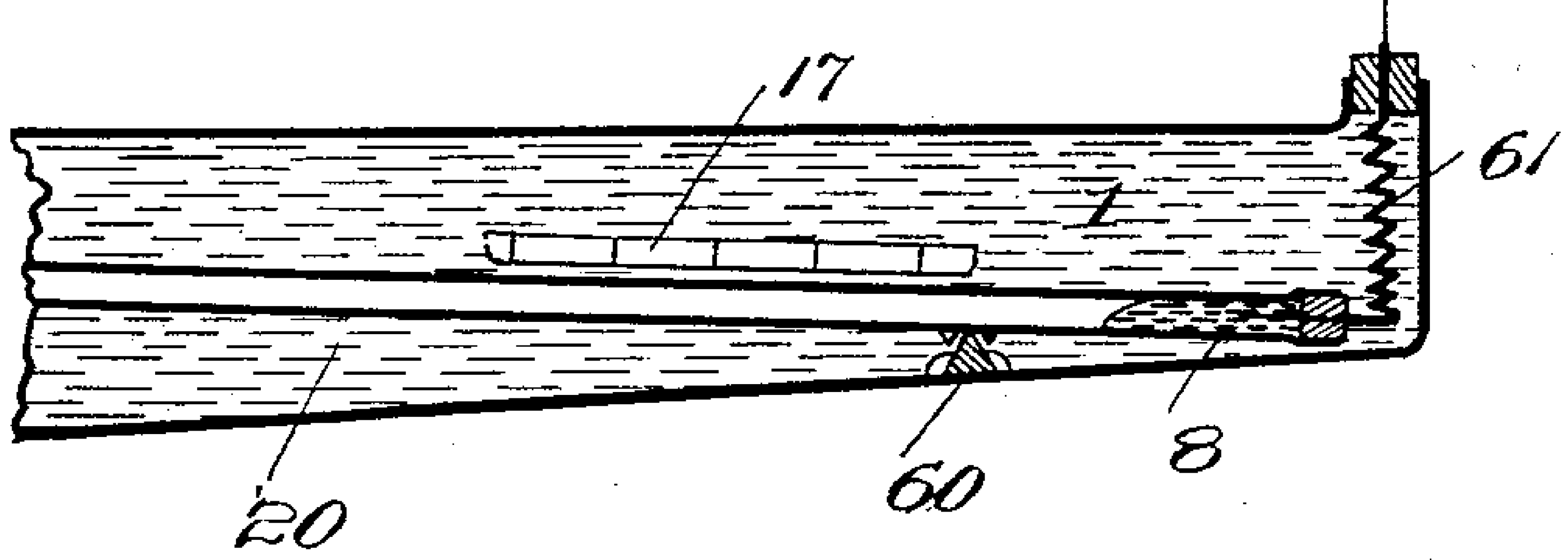
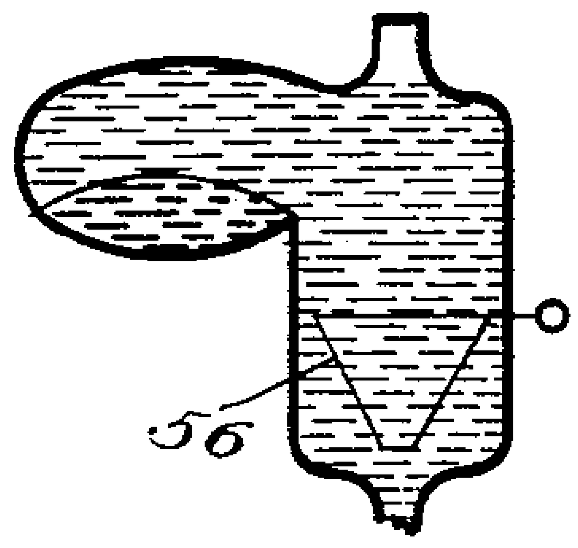


Fig. VIII.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ARTHUR WRIGHT, OF BRIGHTON, ENGLAND, ASSIGNOR TO MUTUAL ELECTRIC TRUST, LIMITED, OF BRIGHTON, ENGLAND.

ELECTRICITY-METER.

SPECIFICATION forming part of Letters Patent No. 702,844, dated June 17, 1902.

Application filed May 26, 1900. Serial No. 18,124. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR WRIGHT, a subject of the Queen of Great Britain, and a resident of Brighton, in the county of Sussex, England, have invented certain new and useful Improvements in Electricity-Meters, of which the following is a specification.

My invention relates to improvements in electricity-meters of the electrolytic mercury type, by means of which certain advantages are obtained. Meters of this type have hitherto been unsuccessful in practice; but by means of the improvements constituting my present invention good results may be obtained.

In order that the principles of my invention may be readily understood, I have appended hereto five sheets of drawings, in which similar letters of reference indicate similar or equivalent parts. These drawings illustrate by way of types or examples certain forms of my invention.

In the said drawings, Figure I is a diagrammatic illustration of a simple form of my invention where a ground-glass stopper is employed. Fig. II is similar to Fig. I, but shows the anode-feeder. Fig. III corresponds with Fig. I, but shows the main chamber of the meter as sealed instead of having a glass stopper. Fig. IV illustrates what I have termed the "second-dial effect." Figs. V and V[a] illustrate equivalent methods of obtaining the second-dial effect. Fig. VI corresponds with Fig. I, but illustrates the means for setting up convection-currents. Fig. VII illustrates what I have termed a practical form, in which several of the features illustrated in the previous drawings are combined. Fig. VIII illustrates a simple form having a platinum cathode.

Referring to Fig. I, 1 is a glass vessel hermetically closed at all points except at the point 2, where it is tightly closed—as, for example, by the ground-glass stopper 3, which stopper for extra safety may be tied or fastened by any convenient means to prevent its falling out when the instrument is turned upside down. 4 is the electrolyte, which may consist of a solution of mercurous nitrate or other suitable solution. 5 is a pocket in the upper part of the glass vessel designed to contain a mass of mercury 6, constituting the anode. 7 is a chamber containing another mass of mercury 8, constituting the cathode. 9 is a tube closed at the bottom and passing up through the cathode-chamber and opening into the upper part of the vessel, as shown. The glass tube 9 is sealed into the upper part of the glass vessel 1 at the point 10. At or about the level of the normal surface of the mercury constituting the cathode 8 the vessel 9 has a small tubular extension 11, the bottom of which is partially closed, leaving a small opening 12, into which extension through the said opening a part 13 of the mercury cathode rises. This tubular extension constitutes, in fact, a separate chamber, hereinafter termed the "intermediate" chamber. 14 is the connecting-wire leading to the anode, and 15 the connecting-wire leading to the cathode, the said connecting-wires being conveniently formed of platinum and sealed into the glass. The action is as follows, the instrument being arranged usually in shunt: When current passes, the volume of mercury constituting the anode decreases, while the volume of mercury constituting the cathode increases, the increase of the cathode being a measure of the electricity passed. This is ascertained in the following manner: As the volume of the cathode increases mercury will pass from the cathode-chamber through the orifice 12 into the intermediate chamber 11 and flow over the lip 16 into the tube 9, at the bottom of which it will collect. Tube 9 being graduated or having a scale 17 attached to or placed beside it, the volume of mercury in the said tube can be read off by noting the level of its surface, the said level showing the amount of current which has passed since the instrument was reset. Such resetting may be obtained by turning the instrument over in the direction of the arrow through half a revolution until it is upside down and then onward through the other half of the revolution until it again reaches its normal position, in which it is shown in the drawings.

The function of the intermediate chamber is as follows: As is well known, the surface tension of a mass of mercury is so great that as soon as a small quantity can pour over a lip a considerable mass is brought over after it. In other words, it flows over not in minute quantities, but in considerable "blobs," as it is termed. I have found that by partitioning off a small part of the mercury by means of what I term an "intermediate" chamber instead of the mercury coming over in large blobs it may be made to come over in very minute quantities, so as in fact to give delicate readings. The intermediate chamber may be of any desired form and may consist of a mere partitioning off of a part of the mercury or of its chamber. A mere strip of glass, for example, placed close to the overflow-lip may suffice for the purpose of partitioning off, so as to obtain an intermediate chamber.

The object of forming the instrument wholly of glass is to avoid any joints at which crystallization or efflorescence may occur. The placing of the anode above the cathode also serves to prevent the formation of crystals at the anode. This formation of crystals is one of the drawbacks which has hitherto existed in meters of this type. This formation of crystals at the anode is due to the electrolyte at that point becoming very rich in mercury, and it is therefore desirable to provide for the easy flow of the electrolyte from this point. The surface of the mercury being convex, the position of the anode above the cathode allows of such flow of the enriched part of the electrolyte, as aforesaid. As, however, the anode decreases in bulk such facility of flow would cease if the level of the mercury fall below the lip 18 (see Fig. II) of the anode-chamber. I therefore provide that the level of the mercury in the anode-chamber shall be kept constant, and for this purpose I employ what I may term an "anode-feeder." This anode-feeder may consist of any convenient known means of maintaining a constant level of liquid in a vessel, and I show one means of effecting this in Fig. II. Here I show a bulb 19, blown upon the glass vessel 1 and communicating with the anode-chamber. This is filled with mercury, and the action is identical with that of an ordinary bird-fountain, except that instead of the water being displaced by air, as in the case of a bird-fountain, the mercury is here displaced by the electrolyte. I may here state that in practice I may do away with the opening 2 and stopper 3 by sealing the glass at this point after the mercury and the electrolyte have been placed in position. In that case my instrument is hermetically closed throughout, as much so as in an ordinary incandescent electric lamp of the carbon-filament type. This is shown in Fig. III.

An object of my invention is to obtain in a mercury electrolytic meter the equivalent of what I shall term for the purposes of this specification a "second-dial" effect, which effect I shall now proceed to describe. In ordinary counting mechanism as employed in meters there are a series of wheels gearing with one another, and these are so arranged (usually by mounting upon each arbor of the train two toothed wheels of different sizes) that each step, space, mark, or degree of the second wheel indicates an amount equal to the total number of steps of the first wheel or one revolution thereof. Thus if there be three indicating-dials, each divided into ten steps or spaces, it is usual for ten steps of the first dial to produce or equal one of the second dial and a hundred steps or ten complete revolutions of the first dial to produce or equal ten steps or one complete revolution of the second dial and one step or one-tenth of a revolution of the third dial. It is of course understood that the revolution of a dial is equivalent to the revolution of an index over a dial or other graduated space. By my present invention I am able to obtain in a mercury electrolytic meter the equivalent of the second dial and in the same way the equivalent of a third, fourth, or other dial, if desired. In order to make this part of my invention clear, I show by way of types or examples in Figs. IV and V of the acccompanying drawings two ways in which this second-dial effect or equivalent of the second dial of an ordinary counter is obtained.

Fig. IV illustrates a form of my invention hereinbefore described, but adapted to produce the second-dial effect. In this figure, 1 is the main chamber of the meter, containing the electrolyte, 6 is the anode, and 8 the cathode. Increase of the mass of the cathode on passage of the current causes mercury to be transferred to the U-shaped tube 20, where its height in the two limbs can be read off by the scale 17. 21 is a receptacle connected by a tube 22 with the upper part 23 of the second limb of the U-tube 20. 24 is another tube connecting at a point above the cathode the main chamber 1 with the receptacle 21. The action is as follows: When sufficient mercury has passed into the U-tube to rise through the bend at the point 23, a flushing action of a well-known kind will take place, and the whole of the mercury in the tube 20 will flow into the receptacle 21, and each time that the U-tube is filled with mercury it will empty itself into the receptacle 21. If a scale, such as 25, be attached to or placed beside receptacle 21, each division of which is equal to the whole space of the U-tube, it will be seen that a reading of a true second-dial effect is obtained.

Fig. V illustrates another way of obtaining the second-dial effect. In this case numerals 1, 6, 8, 17, 20, 21, and 25 indicate the same parts as in Fig. IV; but the tube 20 instead of being a U-tube is in this case a straight one. This tube 20 is normally maintained in an inclined position by a spring or weight or the like and is hinged at any convenient part. In the precise form illustrated the coiled spring, which also serves as a connecting-wire 26, fulfils the function both of a hinge and of a spring, retaining the tube

20 in its normal position. When current passes, the mass of mercury constituting the cathode 8 is increased and rises along tube 20, where its height, which is a measure of the current which has passed, can be read off on the scale 17. As soon as a sufficient quantity of mercury has been added to the cathode to overcome the spring 26 the tube 20 is depressed until its free end 27 is lowered sufficiently to tip the mercury from tube 20 into receptacle 21.

It will be obvious that to obtain the true second-dial effect with an instrument of the form suggested by Fig. V it will be necessary that the cathode-chamber or equivalent of the first dial be filled full or to the given level before tilting and that at each tilting it be emptied or the level of mercury be reduced to zero position. To insure this, I arrange that the said cathode-chamber shall reach a state of unstable equilibrium on becoming full and that before returning to its normal position it shall empty the whole or the required portion of its contents. One way of securing this is shown in Fig. V^a. Here it will be seen that instead of supporting tube 20, as shown in Fig. II we support it on a fulcrum 60, and we lead the current to it through a spring 61, which spring also serves to restore the tube 20 to its normal position after it has emptied itself of mercury. This requires some adjustment of the spring 61, so that it shall press the right-hand end of the tube downward with a sufficient pressure only. Such adjustment is easily obtained by pushing that part of wire 61 which passes through the stopper downward to a greater or less extent.

It is seen that in both Figs. IV and V there is what might be called a "primary" measuring-chamber 21 for the large quantities of mercury, corresponding, we may say, to the ten or hundred column, and a secondary measuring-chamber 20 communicating therewith, which is more finely calibrated, corresponding to the units-column, which secondary chamber is in each case constructed to empty its entire contents into the primary chamber at a single operation.

Another result obtained by my present invention is to lessen the chance of crystallization at the anode, (whether the said anode be placed above or below the level of the cathode,) and this I effect by setting up convection-currents in the electrolyte. Such convection-currents or currents generally may be set up by having the anode above the cathode, thus allowing the enriched electrolyte to flow away from the anode, and they may be set up by use of a heating resistance. One way of carrying out this part of my invention is shown in Fig. VI, in which 28 is a resistance-wire coiled around that part of the glass receptacle which contains the anode 6. Here it will be seen that when current traverses said resistance 28 heat is generated therein and convection-currents are set up in the electrolyte above the anode. Such convection-currents have the effect of presenting new surfaces of electrolyte to the surface of the anode, and so of preventing stagnation of the electrolyte, with its accompanying crystallization, from taking place.

I may combine any two or more of the described improvements in any desired manner. It will be obvious that they are capable of considerable modification within the spirit of the invention. Thus in Fig. VII, I show a form of meter embodying details as hereinbefore mentioned and constituting a practical meter giving excellent results in practice. In this form 1 is the main chamber of the meter, hermetically closed at all points except at the point 2, where it is closed by the ground-glass stopper 3. 4 is the electrolyte; 5, the anode-chamber containing the mercury anode 6; 7, the cathode-chamber containing the mercury cathode 8; 11, the intermediate chamber; 20, the U-shaped tube constituting the equivalent of the first dial; 17, the scale for showing the reading of the first dial; 21, the receptacle constituting the equivalent of the second dial; 22, the tube connecting the receptacle with the upper part 23 of the second limb of the U-tube; 24, the tube connecting the receptacle with the main chamber 1; 25, the scale for reading off the level of the collected mercury in the receptacle; 28, the heating-wire for setting up convection-currents to lessen the chance of crystallization at the anode; 55, the anode-feeder, consisting in this case of a long tube, which tube may be graduated and serves as a check upon the reading obtained in tube 20 or in tube 20 and receptacle 21. Such check is not necessary, but is sometimes expedient to adopt for the purpose of convincing consumers of the accuracy of the registration. This practical form of the instrument need not be further specified, as all the features contained in it have already been hereinbefore fully described.

In Fig. VIII, I show a case in which instead of employing a mercury cathode I employ a platinum one. The form given to the platinum is of little importance, provided it does not prevent the mercury deposited upon it dropping freely into the collecting-tube. In the case illustrated the said cathode consists of a hollow cone of platinum-foil 56, placed with its apex downward and with an opening at the said apex. It is manifest that what I have here called a "platinum cathode," which is, in effect, a special case of a mercury cathode, since mercury is deposited there, can be used in place of the mercury cathodes shown in the other figures of my drawings. I may here also add that if some other metallic conducting substance like mercury be employed in my meter it would be the equivalent of mercury.

The several forms of instrument shown are adapted for resetting by turning upside down. This may be effected in several ways. One convenient way is to mount the instrument upon a board, as shown at 57 in Fig. I. The said board 57 is pivoted to the case of the instrument at the point 58, and the mercury can be reset by turning the board around this pivot through an angle of between ninety and one hundred and eighty degrees in the direction shown by the arrow. The whole of the mercury will then flow into the pocket 5, and as the instrument is slowly brought back to its normal position again part of the mercury will flow from pocket 5 to the cathode-chamber 7. This method of resetting applies to all the forms illustrated.

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

1. An electrolytic mercury-meter comprising a means for setting up currents in the electrolyte near the anode whereby that portion of the electrolyte which has been enriched by mercury is removed from the neighborhood of the anode, substantially as described.

2. An electrolytic meter comprising two electrodes of mercury, the anode being placed at a higher level than the cathode for the purpose stated.

3. An electrolytic mercury-meter comprising two electrodes, one at least of mercury, the anode being placed at a higher level than the cathode, for the purpose stated.

4. An electrolytic meter comprising two electrodes of mercury, and a heating device for setting up convection-currents in the electrolyte near the anode for the purpose stated.

5. An electrolytic meter comprising two electrodes, one at least of mercury, and a heating device for setting up convection-currents in the electrolyte near the anode, for the purpose stated.

6. An electrolytic meter comprising two electrodes, one at least of mercury, and an electric-heating resistance for settting up convection-currents in the electrolyte near the anode, for the purpose stated.

7. An electrolytic mercury-meter comprising an intermediate chamber inserted in the path of flow of the mercury for the purpose of feeding the mercury in minute quantities, substantially as described.

8. An electrolytic mercury-meter comprising an intermediate chamber inserted in the path of flow of the mercury of the cathode for the purpose of feeding the mercury in minute quantities, substantially as described.

9. An electrolytic mercury-meter comprising a receptacle for the mercury anode and a lip or ridge in the path of flow of the mercury of the anode, substantially as described.

10. An electrolytic mercury-meter comprising an anode-chamber and an anode-feeder for supplying mercury thereto, substantially as described.

11. An electrolytic mercury-meter comprising an anode-chamber and a graduated anode-feeder for supplying mercury thereto, substantially as described.

12. An electrolytic meter comprising a primary measuring-chamber for the mercury and a secondary measuring-chamber of more delicate calibration connected therewith, substantially as described.

13. An electrolytic mercury-meter comprising a primary measuring-chamber for the mercury and a secondary measuring-chamber connected thereto and constructed to empty its entire contents into the primary chamber when filled, substantially as described.

14. An electrolytic mercury-meter comprising a primary measuring-chamber and a secondary measuring-chamber in the form of a siphon-tube connected therewith, substantially as described.

15. An electrolytic mercury-meter comprising the anode and cathode chamber, a primary measuring-chamber, a secondary measuring-chamber in the form of a siphon-tube connected with the above-specified chambers and a tube for the flow of the electrolyte connecting the primary measuring-chamber with the anode and cathode chamber, substantially as described.

16. An electricity-meter comprising a primary measuring-chamber and a secondary measuring-chamber connected thereto and constructed to empty its entire contents into the primary chamber when filled, substantially as described.

17. An electricity-meter comprising a primary measuring-chamber and a secondary measuring-chamber in the form of a siphon-tube connected therewith, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

ARTHUR WRIGHT.

Witnesses:

JOHN REID DICK,

JAMES G. LORRAIN.