(No Model.) 3 Sheets—Sheet 1.

J. W. T. OLÁN.

ELECTRIC ARC LAMP.

No. 547,127. Patented Oct. 1, 1895.

Fig. 2.

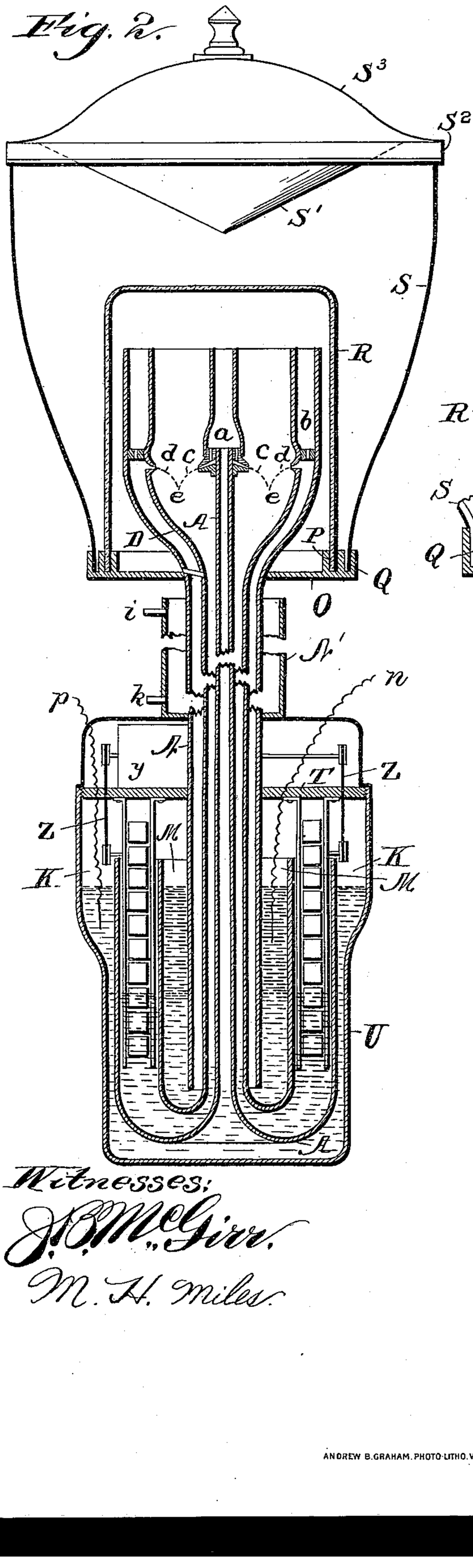
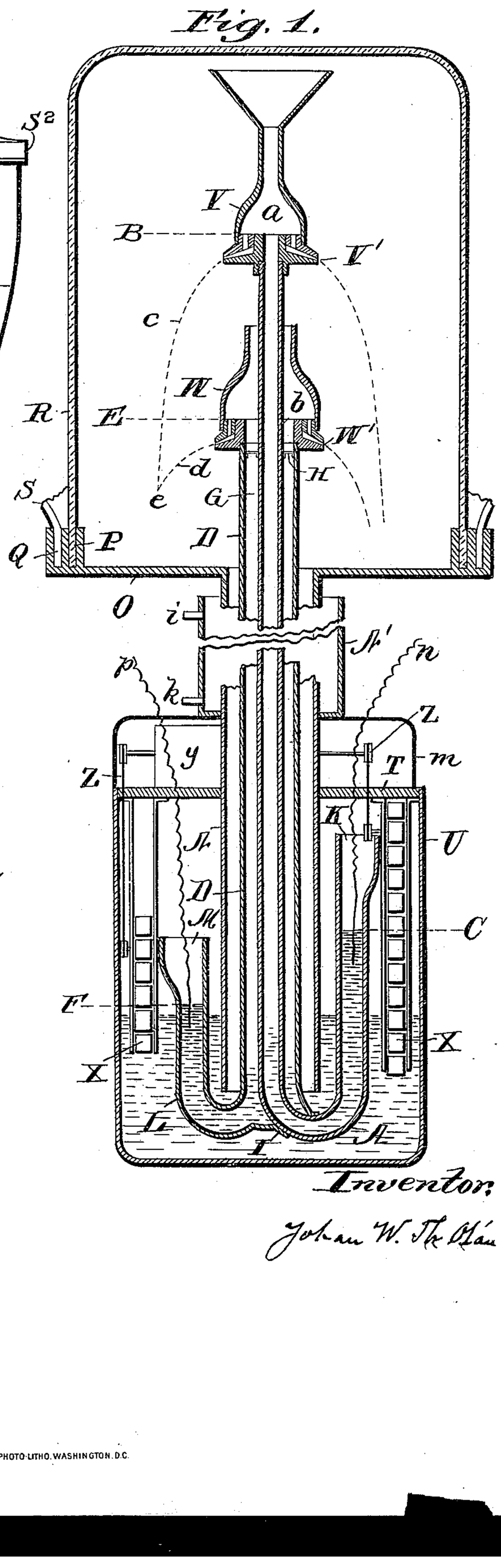


Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

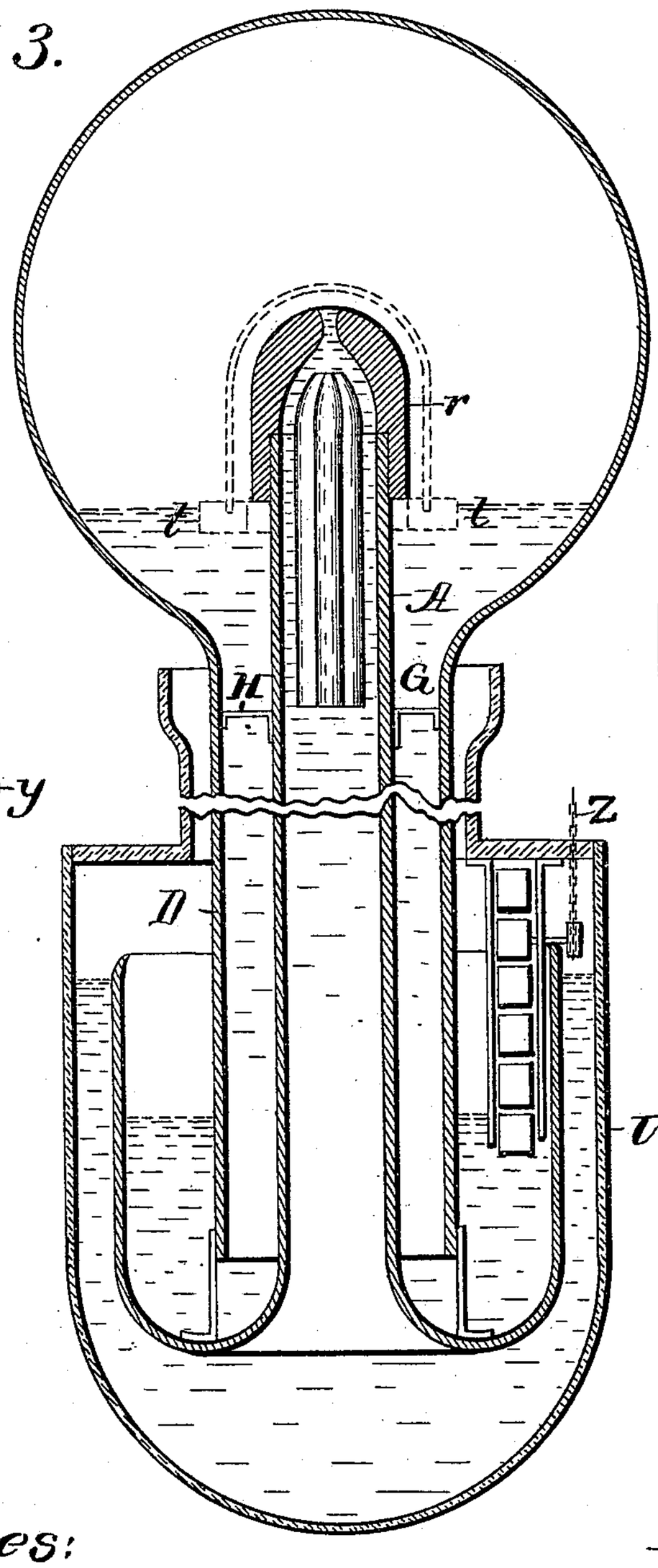


Fig. 8.

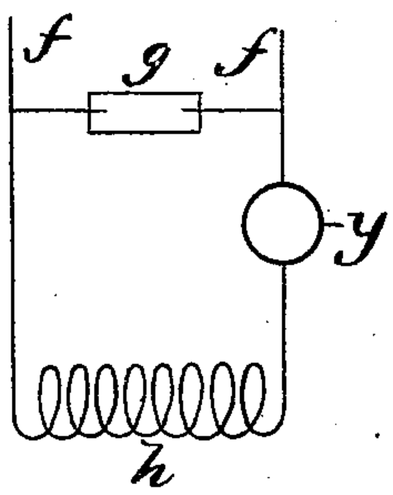
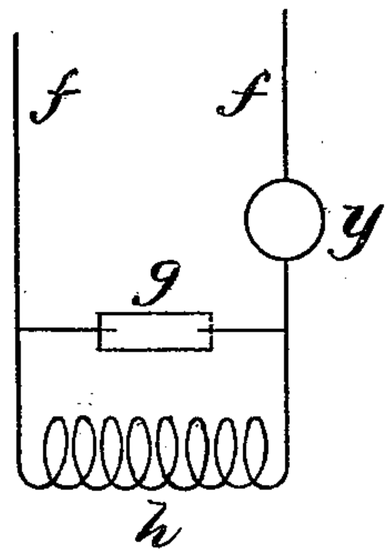


Fig. 9.



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(No Model.) 3 Sheets—Sheet 3.

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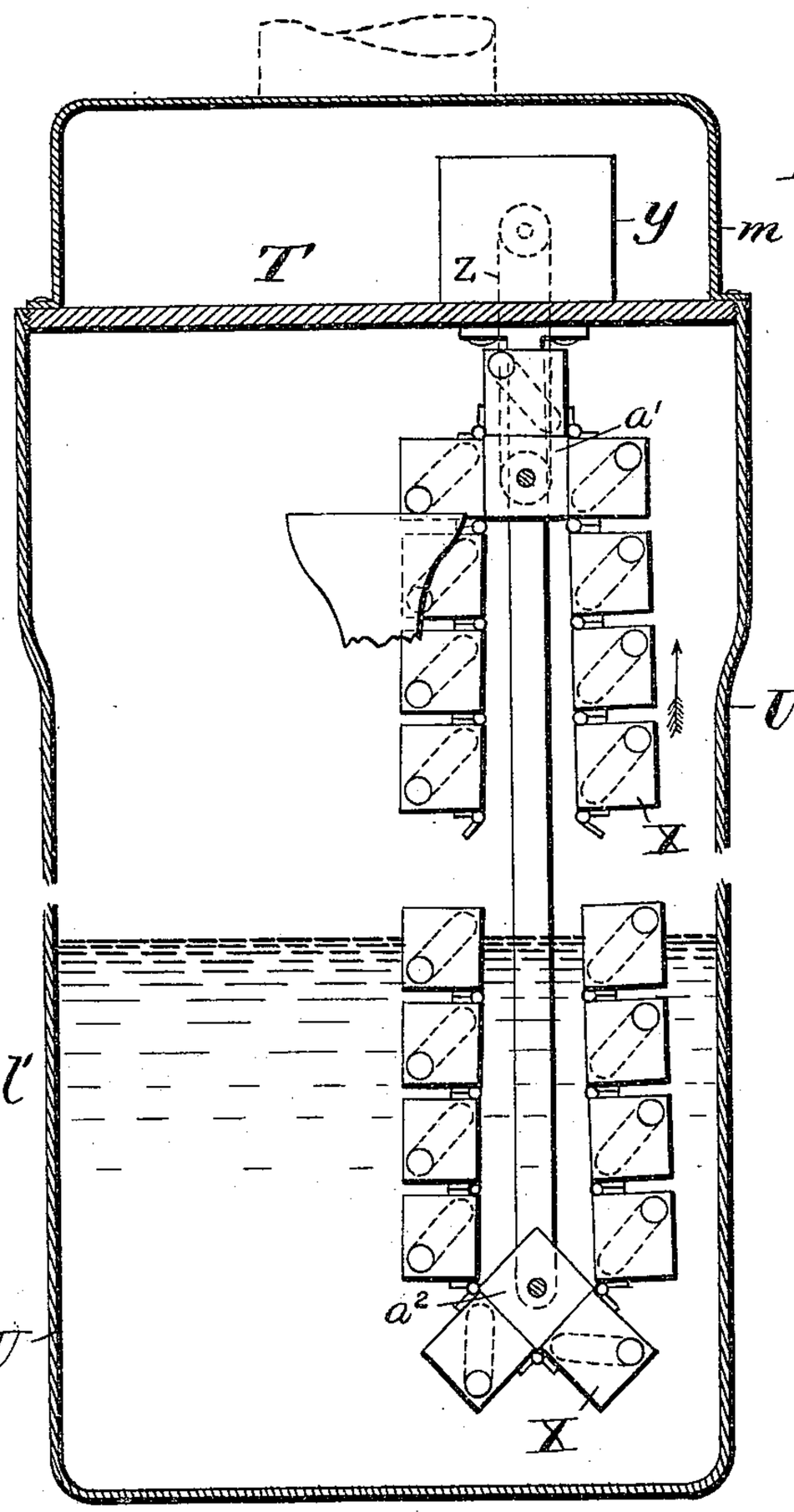


Fig. 4.

Fig. 6.

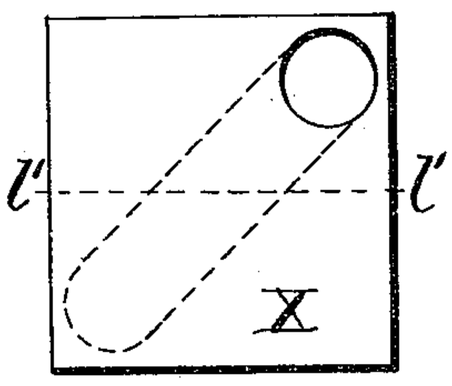


Fig. 7.

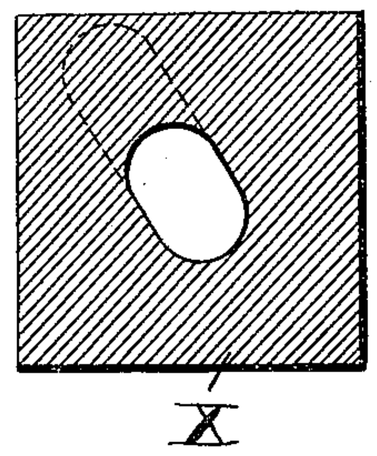
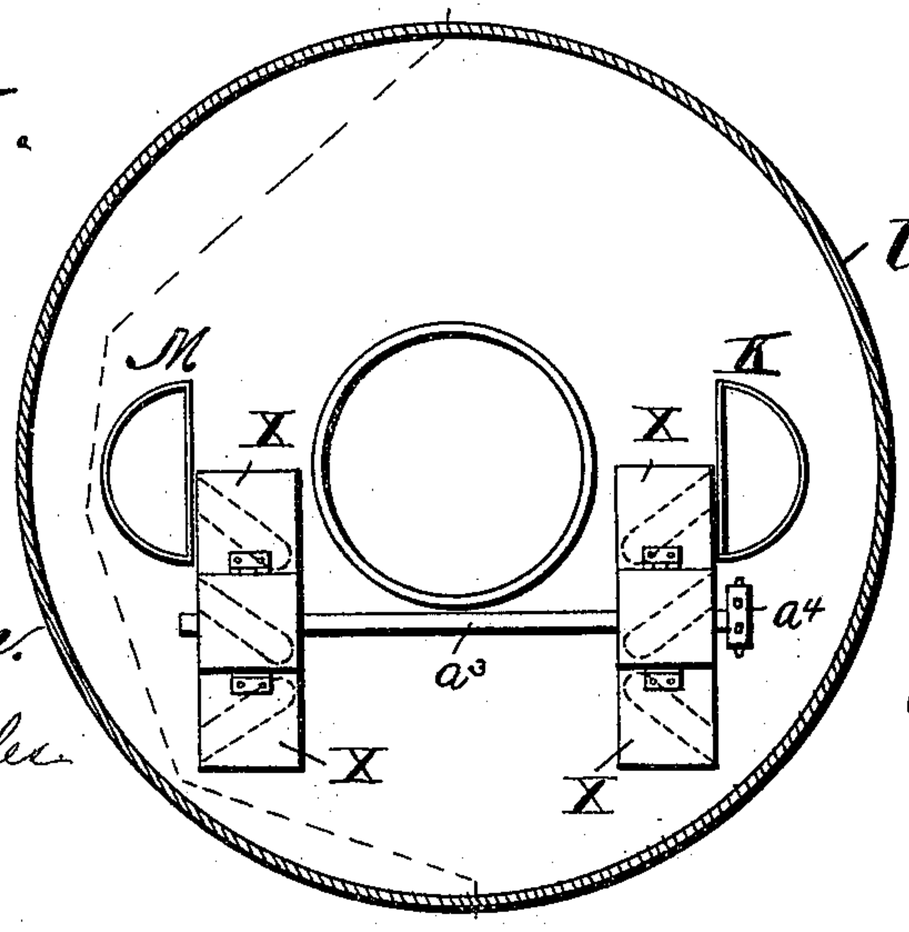


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHAN W. TH. OLÁN, OF NEW YORK, N. Y.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 547,127, dated October 1, 1895.

Application filed April 8, 1893. Serial No. 469,616. (No model.)

To all whom it may concern:

Be it known that I, JOHAN W. TH. OLÁN, a subject of the King of Sweden and Norway, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric-Arc Lights, of which the following is a specification.

My invention relates to that kind of electrical lamps in which light is produced by means of the voltaic arc.

The object of my present invention is to produce a lamp which will give a steady light, and in which the electrodes need not be replaced at all and nevertheless will remain in working order for any length of time.

In carrying out my invention I have attained the desired result by forming an arc between liquid electrodes within an exhausted or rarefied gas-containing globe or inclosure and by making said liquid electrodes automatically circulate within the lamps, so as to regulate automatically the quantity of said electrodes and the conditions under which light between them is produced.

Referring to accompanying drawings, Figure 1 is a vertical sectional view of certain details of a lamp, showing one way of forming an arc between liquid electrodes in accordance with my invention, and in part showing the means for producing automatic circulation of the liquid used for electrodes. Fig. 2 shows a like view of a modification of the lamp shown in Fig. 1. Fig. 3 shows a like view of another modification of the lamp. Fig. 4 represents, on a larger scale and partly broken away, a sectional view of the lower part of the lamp, and shows in side elevation a suitable form of conveyer for elevating the liquid electrode material during the operation of the lamp. Fig. 5 represents a top plan view thereof. Fig. 6 represents, on a larger scale, a side elevation of one link of the conveyer-chain. Fig. 7 represents a sectional view on the line 1′ 1′, Fig. 6. Fig. 8 is a diagrammatic view of the electrical connections to and within a lamp, and Fig. 9 is a similar view showing said connections differently arranged.

Referring to said figures, A, Fig. 1, is a tube of porcelain or glass adapted to contain between lines B and C a barometer-column of mercury, liquid mercury amalgam, or other suitable conducting liquid. D is another tube, also of glass or porcelain, adapted to contain a barometer-column of mercury, &c., between lines E and F. A space G is left between said tubes, arms, or supports H, serving to keep A away from D and in the middle thereof, and A passing through D at I and being hermetically sealed therein. The end of A outside of D is bent upward, as shown, and is preferably provided with a widened mouth K. A branch tube L of D is bent upward in the same way, and has also, preferably, a widened mouth M. A metal tube N, in the middle of which tube D is solidly fixed by proper means not necessary to describe, ends at the top with a solid disk O, said disk having at its circumference ring-compartments P and Q, which are to receive, respectively, the inclosures R and S. R is hermetically sealed in P and S loosely fixed in Q. The tube N carries at its lower end another metal disk T, to which is screwed or otherwise solidly fixed the cup U, into which the upwardly-bent end of A and the branch tube L rise outside the lower end of tube N, which latter descends so deep in the cup U as only to leave sufficient space for tubes A and L to pass, as shown, between N and the bottom of U. Said cup U is made, preferably, of insulating material, such as porcelain or glass, but may, also, in some cases be made of metal. It is to contain a quantity of mercury, &c., sufficient always to close the opening of N, so as to form therein a barometric seal, and in addition thereto enough to correspond to the barometer-columns of the respective liquid in tubes A, D, and N, and the quantity that may be contained in the top parts V and W, respectively, of tubes A and D.

In Figs. 4, 5, 6, and 7 I have illustrated on a larger scale a suitable form of conveyer for raising the liquid electrode material. This conveyer may conveniently be mounted upon a frame attached to the under surface of the plate T, as shown in Fig. 4, and may consist of a series of links X, hinged together to form a chain, said chain being mounted upon the square drums a' a^2. The drum a' is fixed upon a shaft a^3, carrying at its outer end a sprocket-pulley a^4, which is adapted to be driven by a chain Z from the electric motor y.

As shown more fully in Figs. 6 and 7, each link X of the conveyer-chain is provided with an oblique recess or compartment adapted to dip up the liquid electrode from the bottom of the receptacle U and to empty it into the receiving-tubes K and M. Each link X is electrically insulated from the other, all being made from suitable insulating material, such as porcelain or glass, &c. The inclosure R contains a vacuum or rarefied gas. To effectuate this said inclosure is either exhausted by suitable means or the vacuum is produced therein in the same well-known way as that in a mercury barometer, not necessary here to describe.

The operation of my lamp is the following: When the current is turned on the motor Y moves, causing thereby the conveyers X continuously to lift mercury from the quantity in the lower part of the cup U and to empty it into the mouths K and M of the respective tubes A and L. As the conveyers are made from insulating material, no short circuit will thereby be formed between the mercury, &c., in tubes A and D or L through the intermediacy of said conveyers. The barometer-columns of said mercury, &c., standing in said tubes up to the lines B and E, respectively, will thereby rise, so as to make the liquid enter and rise into the spaces *a* and *b* of V and W, respectively, and cause it thereby at the same time to escape through annular series of holes or through annular openings V′ and W′. The small streams *c* and *d* of the liquid will thereby meet at a point *e* and thus complete the electrical connection between the columns in A and D. The resistance in the circuit *f*, Fig. 9, where *g* is the lamp and *h* a resistance, will thereby decrease, the motor *y* will run with greater speed, the mercury will rise higher in *a* and *b* until that which is in *b* has reached its maximum height, when the conveyer feeding the opening M will no longer reach down in the mercury, &c., in cup U, while the conveyer still feeding K will make said liquid still rise in *a*. The stream *c* will thereby run out from *a* with greater force and the stream *d* from *b* with less, and consequently the two streams will separate, as shown in Fig. 1, wherein, at the left, are illustrated the streams *c* and *d* meeting at *e* at first, and at the right the same streams after having separated for the reasons just described. When the streams separate, an arc is formed between them, and said arc can never be larger than that which the current in each case is adapted to maintain, as the liquid electrodes continuously tend to approach each other and are only limited in this approach by the heating effect of the arc. The inclosure R must be sufficiently wide and its wall at sufficient distance from the arc not to melt from the heat developed in said arc, and at the same time sufficiently narrow to be heated by the arc to a degree which will not allow any mercury to condense on the glass, which condensation would prevent the radiation of the light; but in order to condense again the mercury-gas volatilized by the arc, the tube N is surrounded by the (tubular) compartment N′, in which water may be continuously present. It may, for instance, enter through the opening *i* and be led off through opening *k*, or vice versa. By this arrangement the mercury in tube N cannot attain a heat above 100° centigrade, and the mercury-gas will continuously condense and run down into tube N and from there successively into cup U, whence it will again resume its before-described circulation. In order to prevent volatilization of the mercury quantity in cup U a quantity of oil is preferably used on top thereof. Over the motor *y*, I preferably use a cup *m*, easily removable when required. Into the mercury quantity in A and L suitable metal conductors *n* and *p* dip down through the respective openings K and M, which conductors are to complete then egative and positive poles of the lamp. They may conveniently be connected to binding-post terminals, which will enable an easy connection of the lamp to the current-supply conductors. In the modified form of lamp shown in Fig. 2 the described arc is formed between tubes A and D, as shown, and other modifications of parts and arrangements are made for obtaining this result. In the way shown the mercury rises between tubes D and N, the latter tube being prolonged at the top, and the condensed metal runs down in cup U between tubes A and D, the receptacle U being in this case of insulating material, or metal with an insulating lining. The connections of the lamp are made as shown in Fig. 8. A first-class reflector or mirror S′ is placed over R, so as to effect the radiation of light from the lamp. Said reflector S′ is connected to the cover S^3, supported on the metal ring S^2 surrounding S, and may also be used for the lamp shown in Fig. 1, but said arrangement is not in the lamp there illustrated of necessity. S, S′, S^2, and S^3 can there be replaced by an inclosure entirely of glass. Fig. 3 shows another modification where connection between the two electrode-columns is first produced by causing the column in tube A to rise in the way hereinbefore described, so as to flow over through the narrow opening of the modified top piece *r* of tube A. Now as the lamp and the motor *y* here are respectively connected, as shown in Fig 8, the indicated flow will lessen as soon as connection in consequence of said flow is formed between the electrodes. The arc will be formed between them, and the top piece *r*, made of non-conducting infusible material, will assist in radiating the light as the material becomes heated to incandescence. In order to make the arc less dependent on variations of expansion of the mercury-gas formed in the arc, a fluted carbon-rod *s*, sufficiently narrow to leave a space between itself and tube A, may float in the mercury-column in said tube, and a ring or disk *t* of the same substance may be

fixed around and outside A, so as to be present near the surface of the mercury in D, as shown. This will cause the liquid electrodes to be heated by the arc and make the electrodes of the lamp less dependent on sudden variation of expansion of the mercury-gas in the arc, which, for instance, might be caused by variations in the current feeding the lamp. The other modifications as to construction of the lamp shown in Fig. 3 are so apparent from the illustration that they need no further description. It has only to be observed that the two curved dotted lines above the disk *t* indicate an inclosure of infusible material by which I in some instances surround the arc and which inclosure then will be heated to white heat from the arc and thereby produce the desired light effect. It has yet to be added that in some cases, especially when the inclosure R nearest surrounding the arc is large, I use in my lamp instead of mercury a liquid amalgam or composition thereof with other preferably infusible substances or any other conducting liquid which will not be chemically transformed or decomposed by the current; but in such case care must always be taken that the tubes used in the lamp shall still correspond to the barometer-columns of the respective liquids used.

Having now described my invention, what I claim is—

1. An electric arc lamp provided with liquid electrodes and an exhausted inclosure therefor; substantially as described.

2. An electric arc lamp provided with liquid electrodes, an exhausted inclosure therefor, and means for automatically maintaining continuous circulation of the liquid within the lamp; substantially as described.

3. An electric arc lamp provided with liquid electrodes, an exhausted inclosure therefor of glass or its equivalent, and means for automatically maintaining continuous circulation of the liquid within the lamp, substantially as described.

4. An electric arc lamp, provided with liquid electrodes, an exhausted inclosure therefor, and means for causing a stream from one of said electrodes to meet the liquid of the other so as to form connection between said electrodes and for thereafter changing or interrupting said flow in order to start the arc; substantially as described.

5. An electric arc lamp, provided with liquid electrodes, an exhausted inclosure therefor, means for causing a stream from one of the said electrodes to meet the liquid of the other so as to form connection between the electrodes and for interrupting said connection by changing or interrupting said flow in order to start the arc and means for automatically maintaining the continuous circulation of the electrodes within the lamp; substantially as described.

6. An electric arc lamp provided with liquid electrodes, and an exhausted inclosure therefor, said inclosure being sufficiently wide and hard-fusible so as not to melt or be destroyed by the heat developed by the arc and sufficiently narrow and near the arc to prevent any gas developed in the arc to condense on said inclosure; substantially as described.

7. An electric arc lamp provided with liquid electrodes, an exhausted inclosure therefor, and a supply for the electrodes consisting of barometric columns of the liquid, substantially as described.

8. An electric arc lamp provided with liquid electrodes, an exhausted inclosure therefor, and a supply for the electrode consisting of barometric columns of the liquid, and means for causing an overflow from said columns and the establishment of an arc between the over flows; substantially as described.

9. An electric arc lamp, provided with liquid electrodes, an exhausted inclosure therefor, and a supply for the electrodes consisting of barometric columns of the liquid, means for causing an overflow from said columns and the establishment of an arc between the overflows, and return conduits for leading the overflows back to the barometric well; substantially as described.

10. An electric arc lamp, provided with liquid electrodes, an exhausted inclosure therefor, and a supply for the electrodes constituted of barometric columns, a resistance in shunt to the lamp, and an electric motor in the current supply circuit for causing an overflow of said columns and the establishment of an arc between the overflows; substantially as described.

Signed at New York, in the county of New York and State of New York, this 7th day of April, A. D. 1893.

JOHAN W. TH. OLÁN.

Witnesses:
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