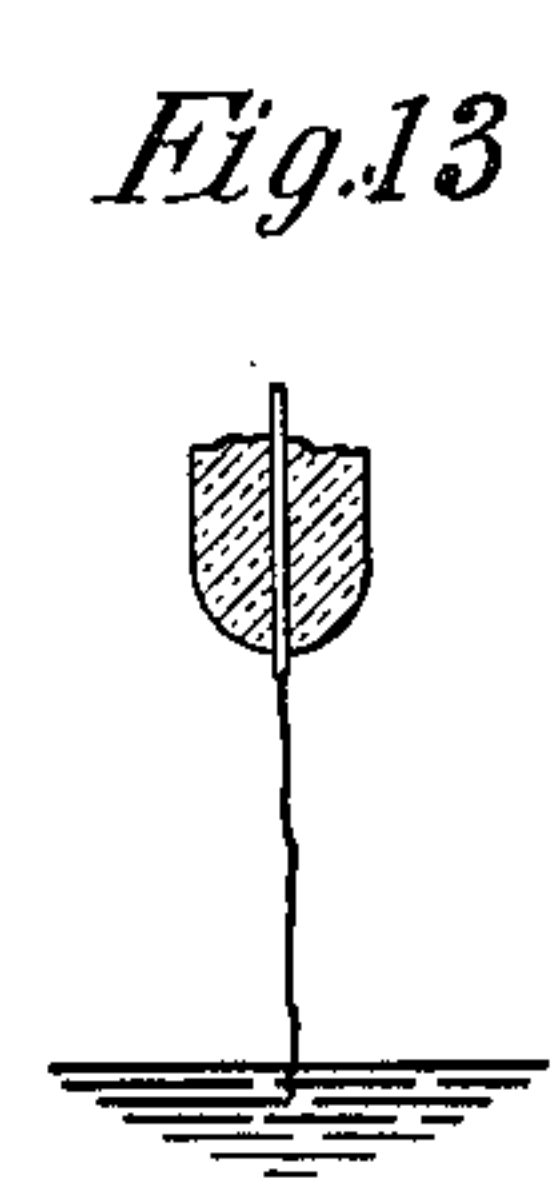
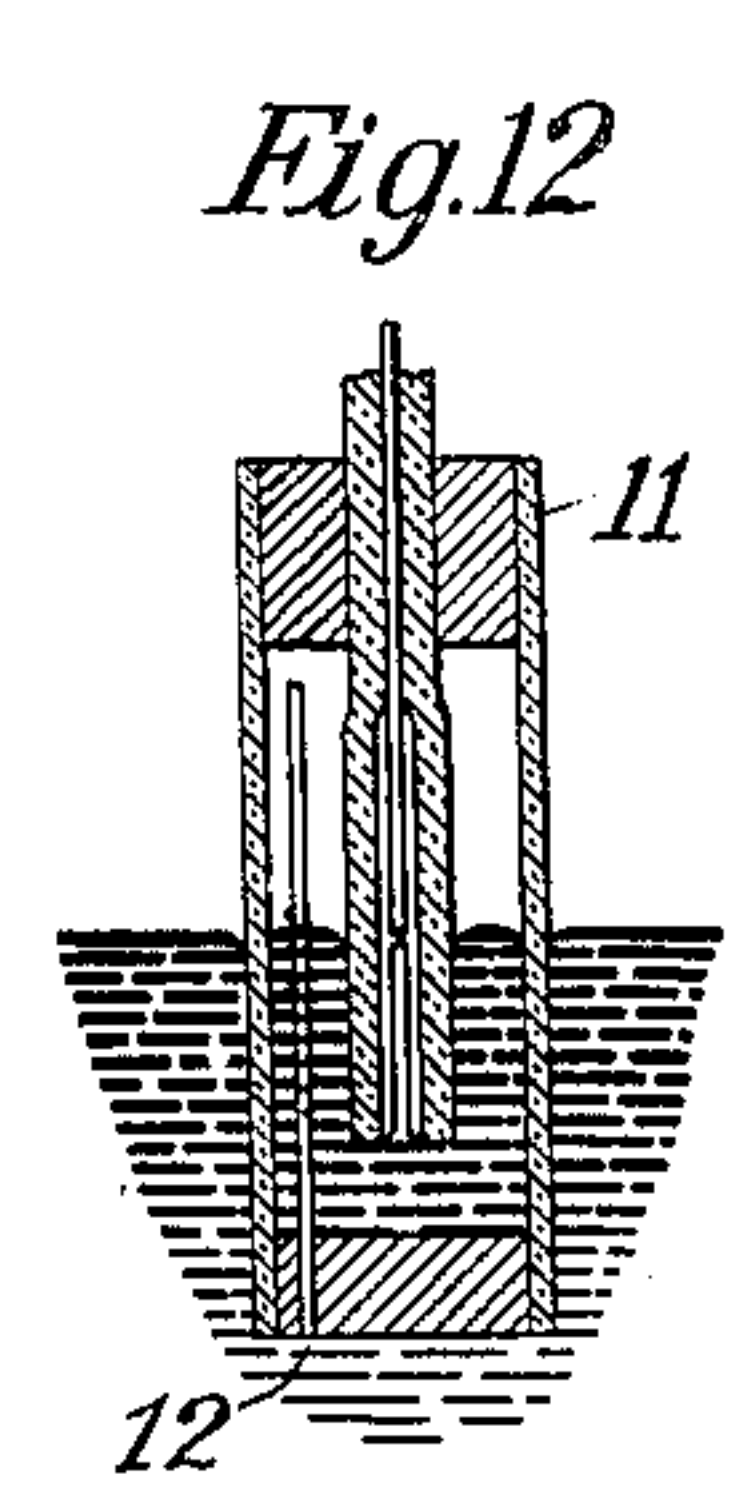
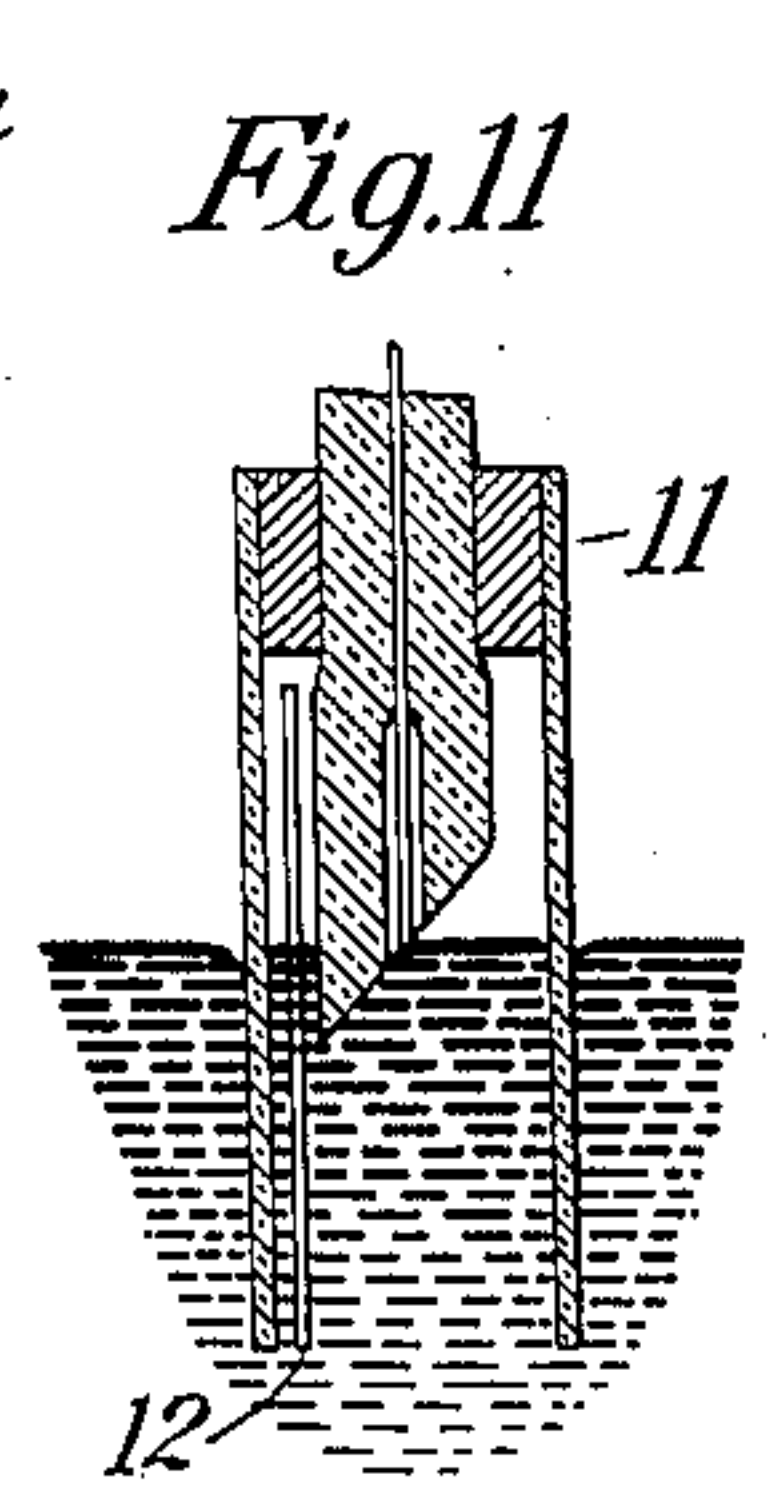
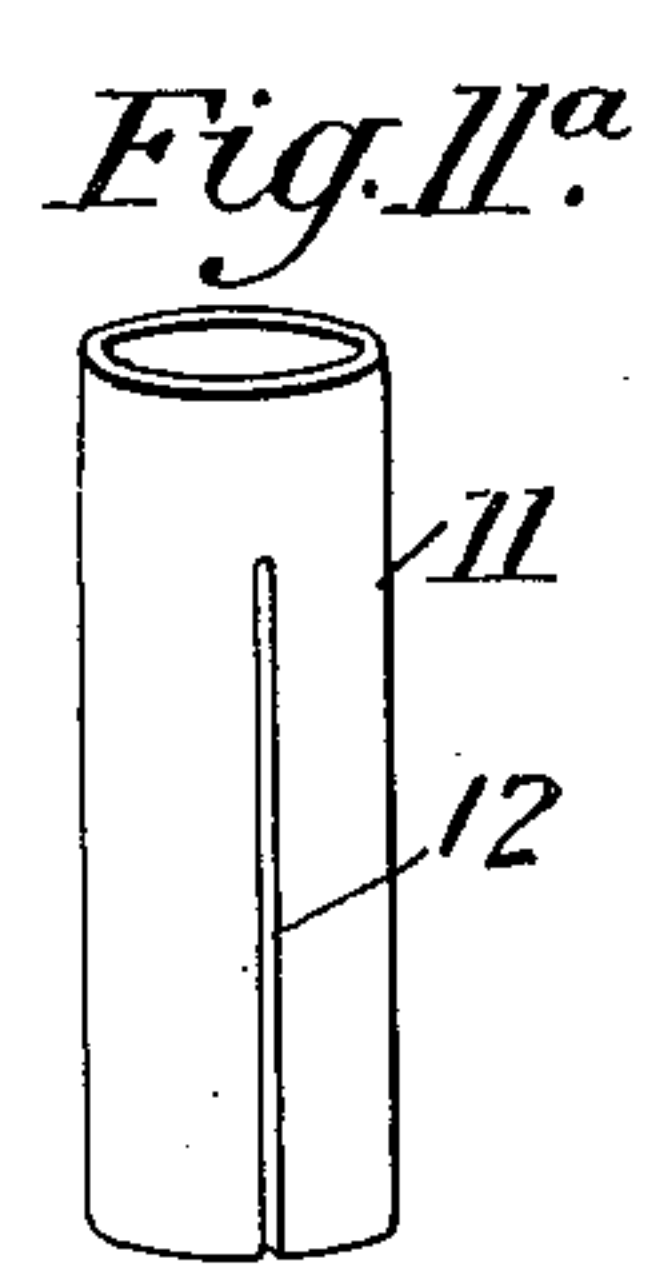
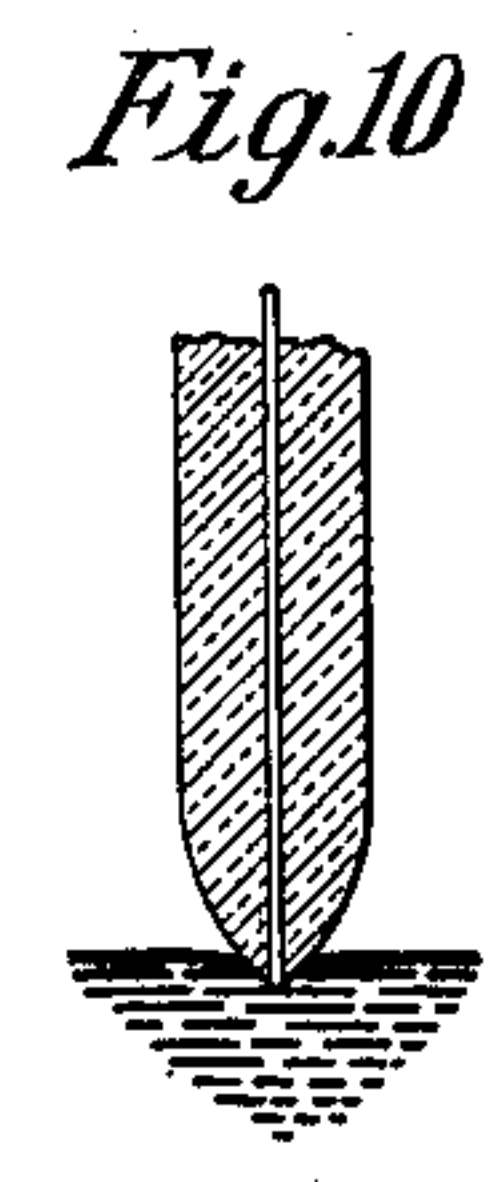
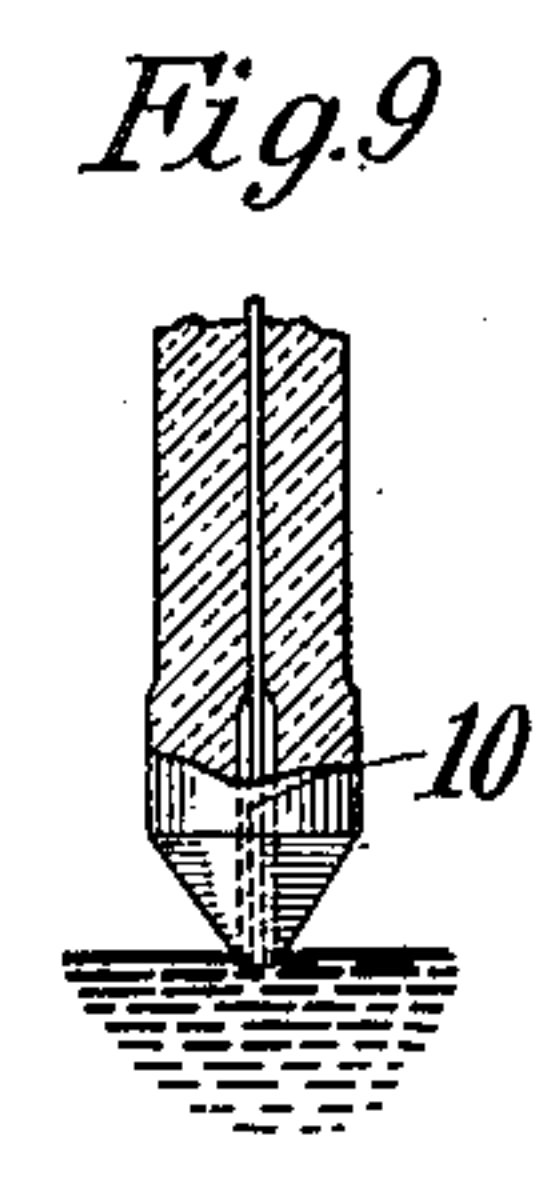
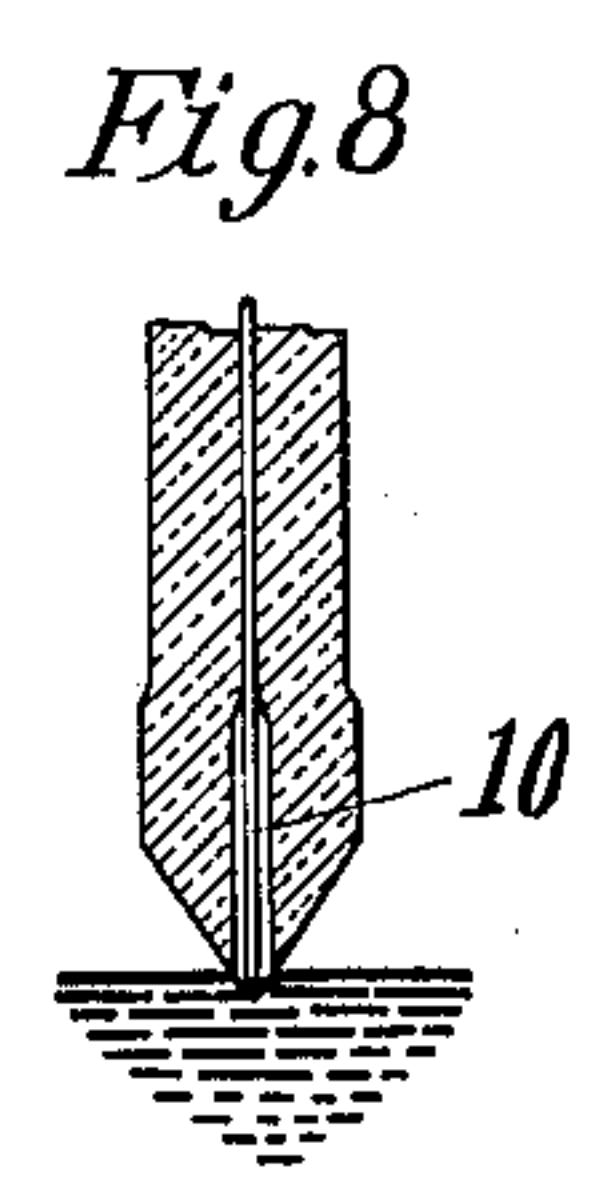
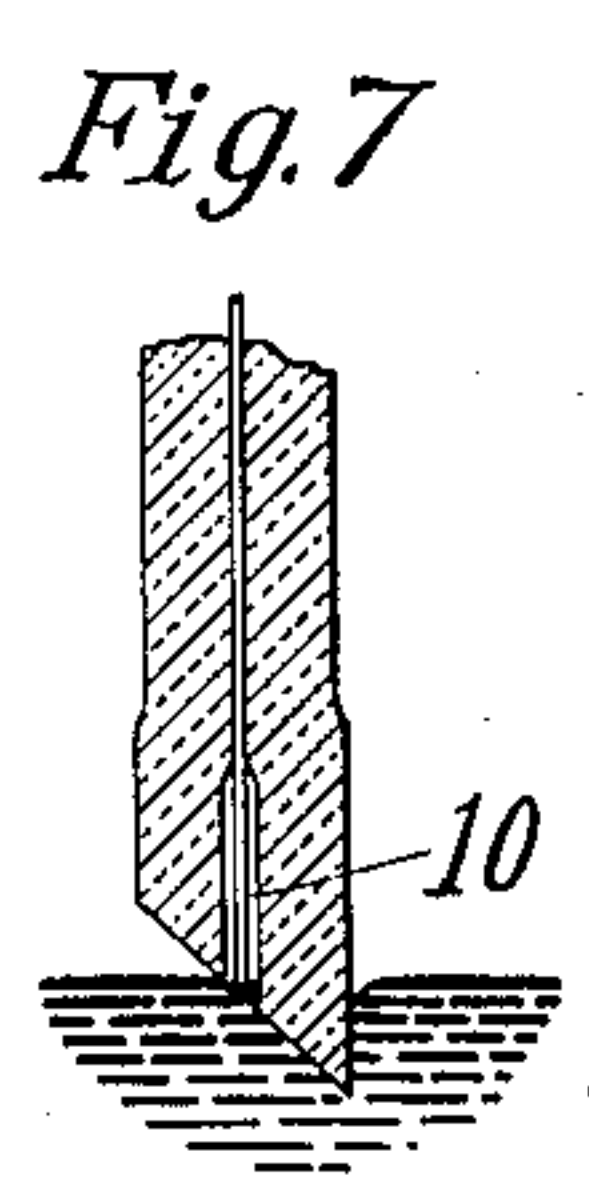
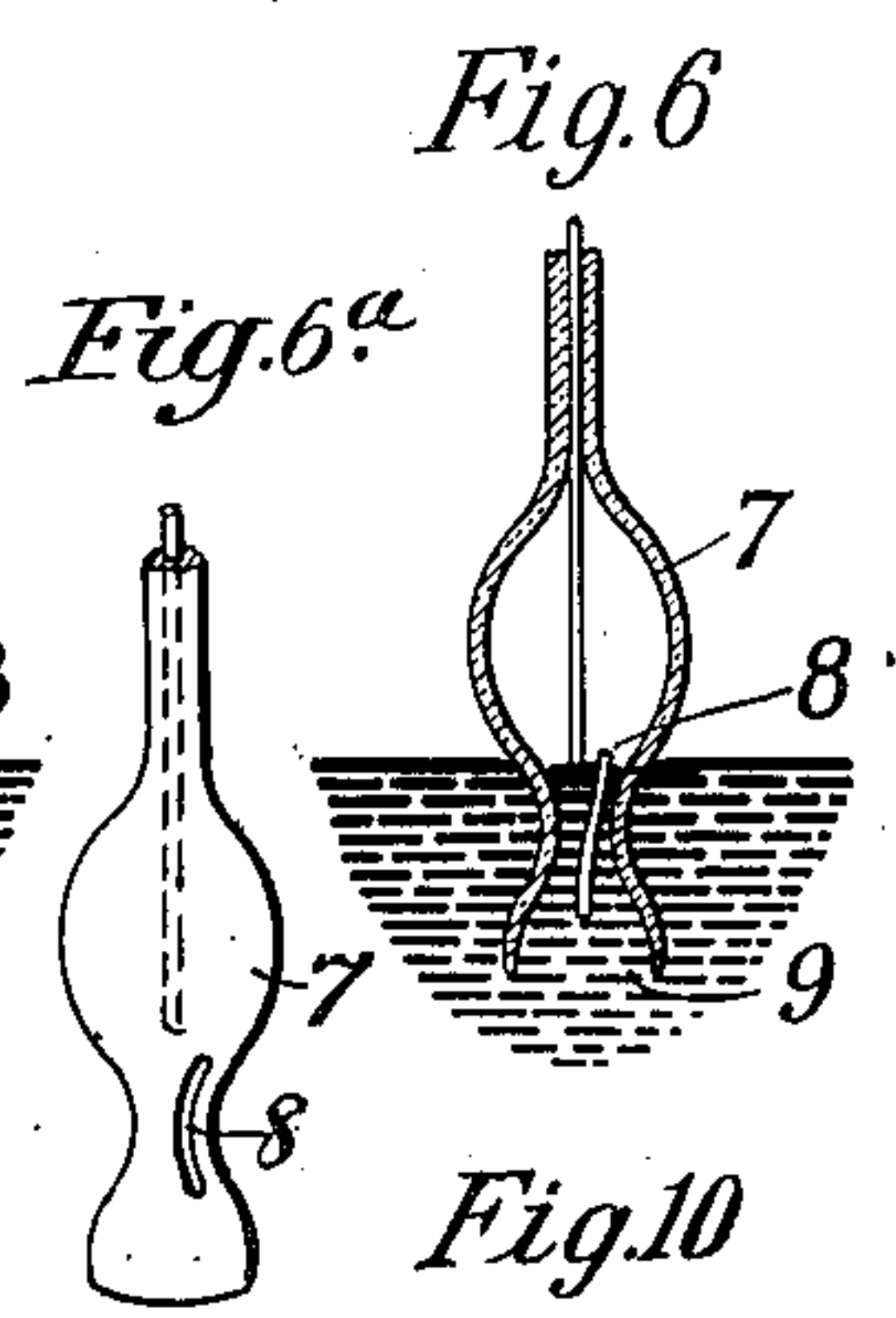
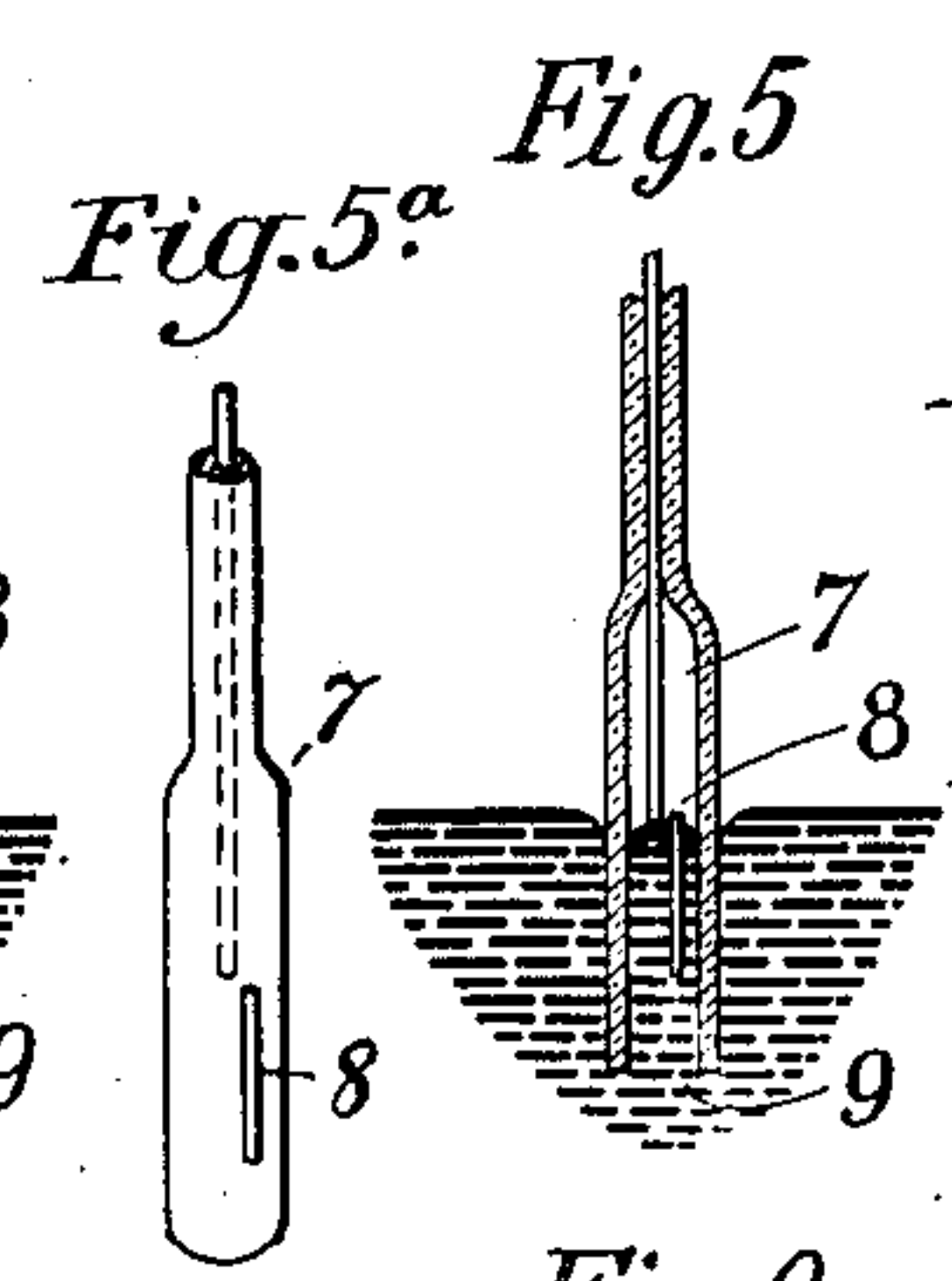
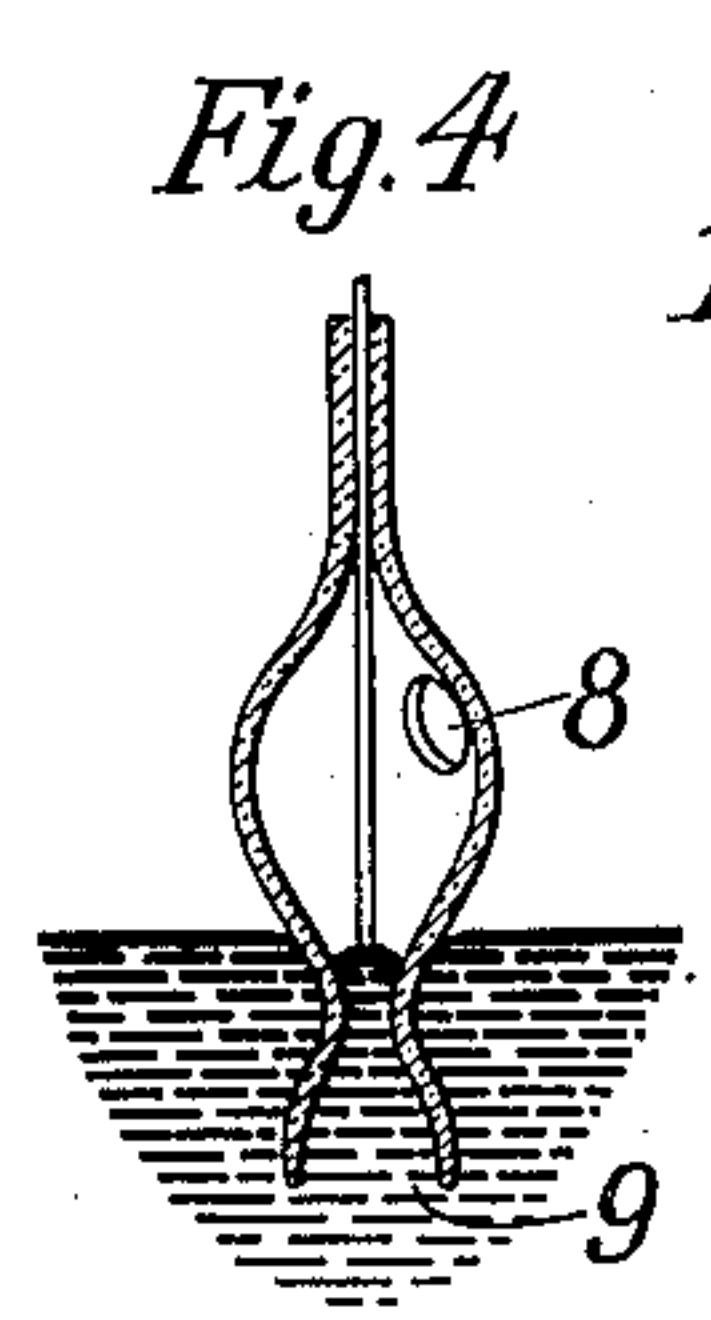
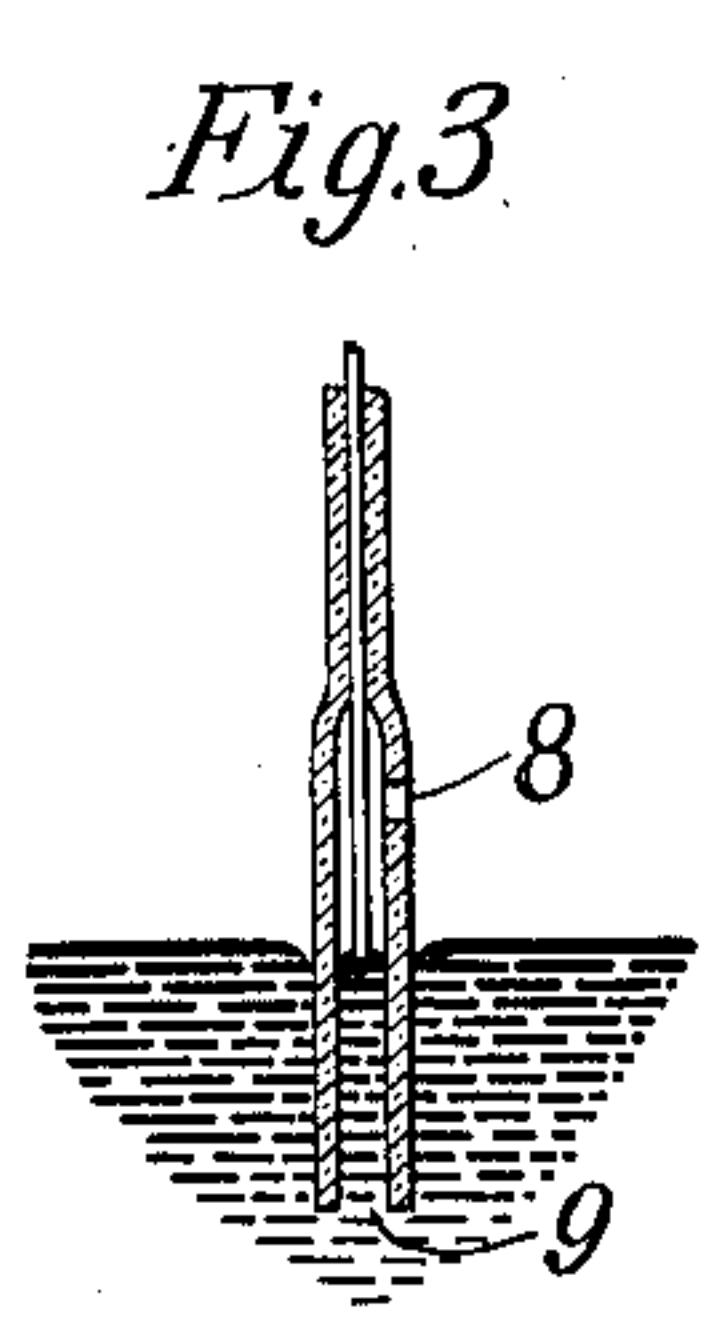
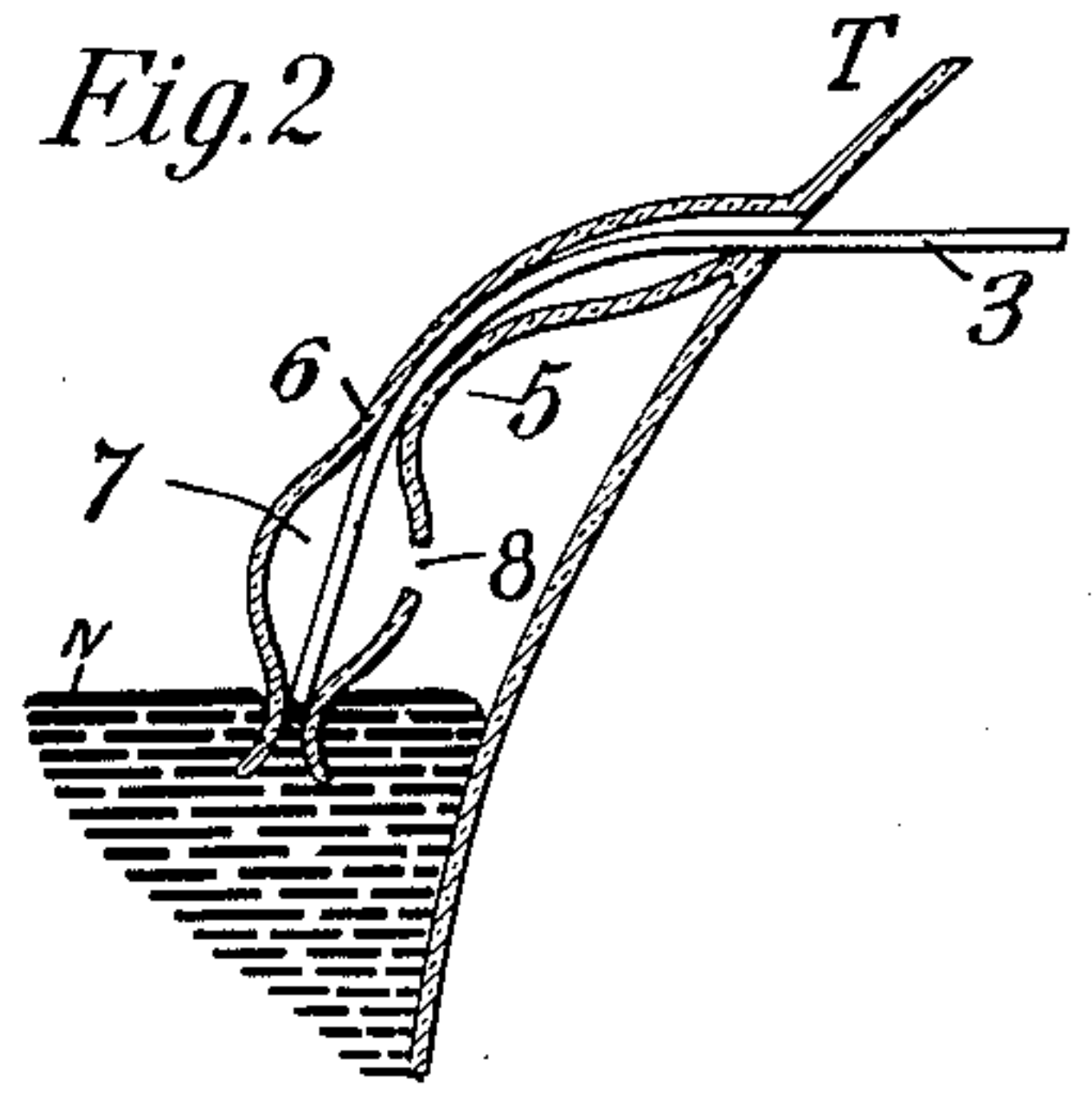
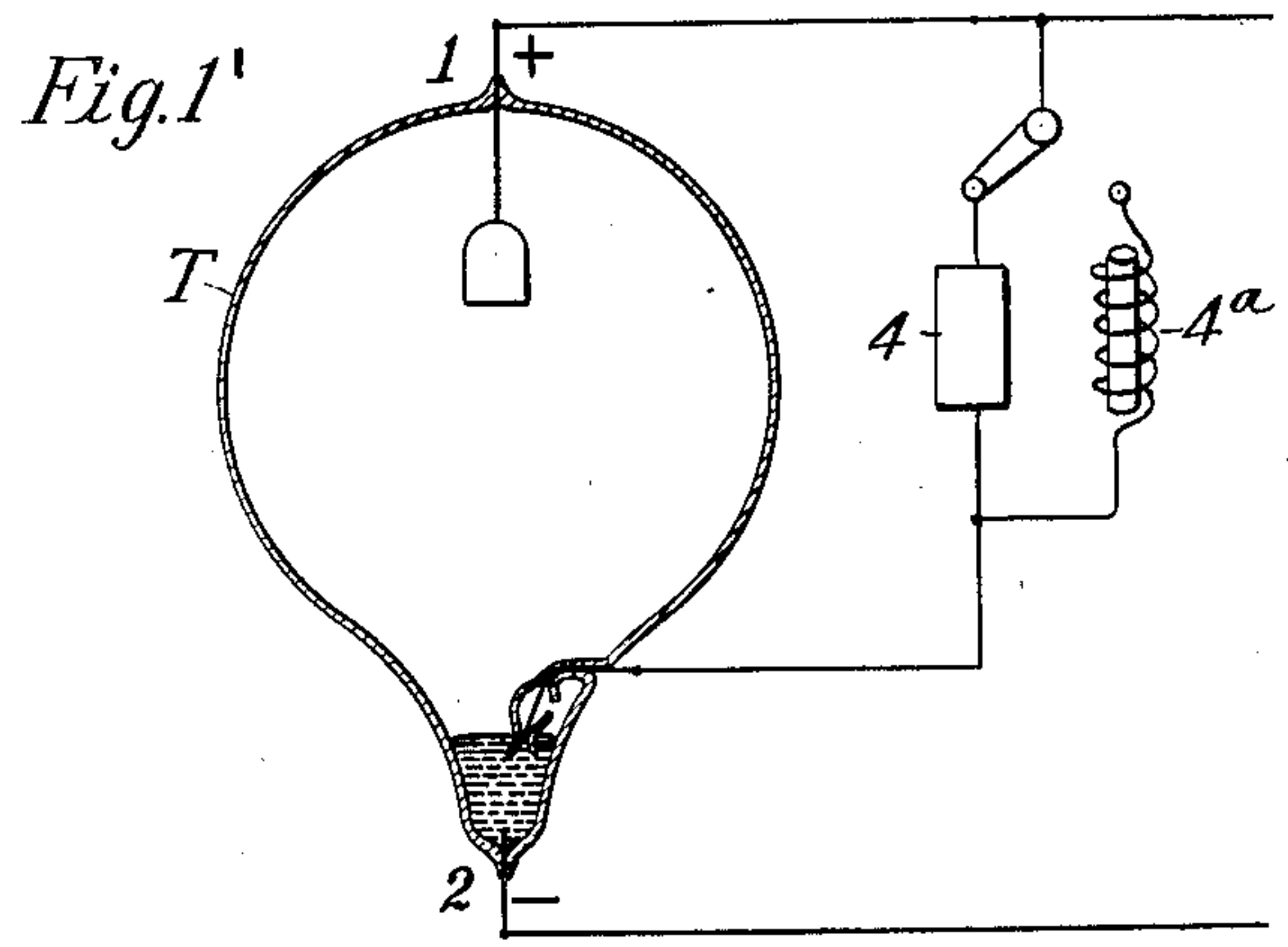


T. BODDE.
VAPOR TUBE STARTING DEVICE.
APPLICATION FILED MAR. 16, 1904.



Witnesses:
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UNITED STATES PATENT OFFICE.

THEODORE BODDE, OF NEW YORK, N. Y., ASSIGNOR TO LOUIS B. MARKS,
OF NEW YORK, N. Y.

VAPOR-TUBE-STARTING DEVICE.

No. 832,363.

Specification of Letters Patent.

Patented Oct. 2, 1906.

Application filed March 16, 1904. Serial No. 198,475.

To all whom it may concern:

Be it known that I, THEODORE BODDE, a subject of the Queen of the Netherlands, residing in New York city, borough of Manhattan, in the county and State of New York, have invented certain new and useful Improvements in Vapor-Tube-Starting Devices, of which the following is a specification.

My invention relates to vapor-tubes, and more particularly to lamps and rectifiers of mercury-vapor tubes, and has for its object to produce a means of readily starting such tubes with the normal potential used in running them without resort to moving parts. It is well known that such a tube exhibits at starting a high negative-electrode resistance, which requires to be broken down by a high potential discharge from an induction-coil or other suitable source, or else the two terminals of the circuit have to be directly connected together through the mercury in the tube and the circuit so established subsequently interrupted inside the tube in any suitable manner by moving the lamp or one of its terminals, whereby the mercury-lamp is "started," after which the line-potential will maintain the suitable current-flow.

My invention consists of a device in which the positive and negative electrodes are primarily in electrical contact, so that in starting the current flows through the lamp by conduction, and in which the automatic effect of the current thus flowing is to separate or render defective the contact of the said electrodes, (by reason of the vaporization of the mercury-electrode,) whereby the negative-electrode resistance is broken down and the lamp started.

While I have shown my invention applied for starting with low or normal potential, I do not intend to so limit myself, as my invention permits a wide range of starting voltage.

I will describe my invention with reference to the accompanying drawings, in which—

Figure 1 is an illustration of a tube containing my invention. Figs. 2 to 13 are different forms of starting devices, all embodying the broad principles of my invention.

Referring to Fig. 1, T is a vapor-tube of any suitable construction. 1 and 2 are the positive and negative terminals, respectively. 3 is an auxiliary positive terminal normally in contact with the negative terminal, as hereinafter described, and 4 is a suitable device,

such as a resistance or reactance, for controlling the flow of current through the circuit of the auxiliary terminal 3. The auxiliary positive terminal may be constructed in various ways, of which I show several at present preferred by me.

In Fig. 2, 6 is the wall of the tube, into which is sealed a platinum wire inclosed in glass, as indicated at 5. The wire is sealed into the glass for a sufficient length to insure the preservation of the high vacuum of the tube. Below the seal the tube is enlarged, as at 7, forming a chamber surrounding the wire and opening by a passage 8 into the space above the negative mercury-terminal, (indicated at N.) The lower portion of the tube 5 is contracted to form a passage, which I prefer to make of such cross-section as will give a low carrying-current capacity as compared to that of the platinum wire. The platinum wire 3 extends down to and is just in contact with the surface of the mercury, as indicated. A flow of current of suitable volume through the wire 3 will start at the point of contact thereof with the mercury-terminal a center of ebullition, from which mercury-vapor will be given off and the requisite separation of the terminals necessary for starting effected, the vaporized mercury passing out into the main receptacle through the opening 8 and being replaced by the flow of mercury through the contracted passage 9. There is thus established a suitable condition of mercury-vapor within the tube, and the center of ebullition constitutes a break in the electrode resistance, so that the application of the normal potential to the main terminals 1 and 2 is sufficient to start the tube in operation.

Fig. 3 shows a modified form of the construction in which the platinum or other wire just touches the surface of the negative electrode, and Fig. 4 shows a similar construction in a different form.

Figs. 5 and 6 show constructions analogous to those of Figs. 3 and 4, except that the passage communicating with the chamber between the auxiliary-terminal inclosure and the space above the negative electrode is in the form of a slit extending below the surface of the negative electrode for a considerable distance, but a short distance only above it. By this means a difference of vapor tension is created between the inclosure 7 and that

of the tube, whereby a suitable level of the electrode material within the space 7 is preserved, so that the rate of disengagement of vapor may be controlled. Where the slits 8 are employed, the protecting inclosure may be closed at the bottom.

The illustrations Figs. 2 to 6 show various forms in which the output of mercury-vapor depends on and is regulated by the difference of level of the mercury without and within the auxiliary-electrode inclosure, and the small size of passage in the latter and of the columns of the electrode material inclosed therein.

Figs. 7 to 10 show somewhat different constructions from those in preceding figures in that the auxiliary terminal is sealed into the inclosure throughout its length, as in Fig. 10, or has only capillary spaces in which a vapor tension may exist, but in which the mercury and other electrode material will not rise, as shown in Figs. 7, 8, and 9. In these constructions the inclosure is indicated as variously ground away at its ends flush with the end of the auxiliary terminal, whereby contact is established with the extreme end of the terminal only, even though the mercury-level may be somewhat higher than the end of the auxiliary terminal, while owing to the shape of the inclosure the vapor escapes freely to the space above the negative electrode. In the case of the construction of Figs. 7, 8, and 9 this is assisted by the presence of the vapor in the capillary space 10.

In Figs. 11 and 12 I show an auxiliary inclosure 11, extending some distance above and below the surface of the negative-electrode material used for the purpose of protecting the auxiliary terminal, so far as possible, from rise and fall of level of the negative-electrode material due to billows or ripples on its surface, which may be caused by ebullition at the point of contact of the auxiliary terminal. This billow-protector may be opened or closed at its ends; but in the latter case it is provided with a slot 12 of sufficient extent to permit of a sufficient inflow of electrode material and the escape of vapor. This slit may also advantageously be employed whether the billow-protector be or be not closed at its ends.

Where convenient, the negative-electrode end of the tube may advantageously be constructed in substantially spherical form with the contact-surface of the auxiliary terminal at the center in order to insure contact with the tube in varying positions.

In Fig. 13 I show a modification in which the auxiliary terminal ends in a fine wire dipping into the mercury and having a carrying capacity so small that the current-flow through it will heat it to incandescence. This may extend into the mercury any desired distance and will start the lamp by causing vapor to be given off around the

wire; but I prefer that it enter a short distance only, as a more active center of ebullition is then formed.

It is obvious that when the tube is once started the auxiliary starting-circuit may, if desired, be cut out by suitable means—as, for example, the hand-switch 4^a. (Shown in Fig. 1.)

Where alternating currents are employed, the auxiliary terminal may advantageously be left in circuit and the current-controlling device 4, Fig. 1, be a reactance-coil 4^a or a device tending also to shift the phase of the current.

Having thus described my invention and several forms of apparatus in which it may be embodied in practice, I wish it to be distinctly understood that my claims are not limited to the precise forms shown, but that various modifications and changes may be made without departing from the spirit of my invention and without exceeding the scope of my claims.

What I claim is—

1. In a vapor-tube, the combination with separated terminals between which a conducting-vapor exists when the tube is in operation, but a non-conducting and highly-resistant interval exists when the lamp has not been started, a stationary auxiliary terminal in normal contact with one of the terminals of the lamp, said contact being of low conductance whereby, on the passage of current, a center of emission of conductive vapor is formed.

2. In a mercury-lamp, the combination with the electrodes thereof for normally operating the lamp, of an auxiliary electrode in contact with one of the electrodes of the lamp before starting, and means whereby the current conducted before starting automatically separates or renders defective the contact of said auxiliary electrode and lamp-electrode, while both remain stationary, whereby the lamp is started.

3. In a vapor-tube the combination of a positive terminal, a liquid negative terminal, an auxiliary starting-terminal in limited contact with the negative terminal and means for restricting the free access of liquid to said auxiliary terminal.

4. In a vapor-tube the combination with the positive and negative terminals, of a stationary auxiliary terminal normally in contact with a lamp-terminal, one of said terminals being liquid, means for supplying a current through said auxiliary terminal, and means whereby the passage of said current will vaporize the liquid terminal and thereby break said contact.

5. In a vapor-tube the combination with a positive and a liquid negative terminal, of a stationary solid auxiliary terminal normally in contact with the liquid terminal, means for supplying a current through said aux-

iliary terminal, means whereby the passage of said current will vaporize the liquid terminal and thereby break said contact.

6. In a vapor-tube the combination with the positive and negative terminals, of a stationary auxiliary terminal normally in contact with a lamp-terminal, one of said terminals being liquid, a non-conducting envelop surrounding said auxiliary terminal whereby contact of the liquid terminal with the side thereof is prevented.

7. In a vapor-tube the combination with a liquid terminal, of a solid auxiliary terminal, an inclosure for said auxiliary terminal, said inclosure having a restricted opening communicating with the liquid terminal whereby the access of the latter to the side of the auxiliary terminal is prevented.

8. In a vapor-tube the combination with a liquid terminal, of a solid auxiliary terminal, an inclosure for said auxiliary terminal, said inclosure having a restricted opening communicating with the liquid terminal, and an opening communicating with the space above the negative terminal whereby the access of the liquid terminal to the side of the auxiliary terminal is prevented and the escape of vapor is permitted.

9. In a vapor-tube, the combination with a liquid terminal, of a solid auxiliary terminal, an inclosure for said auxiliary terminal, said inclosure having a restricted opening communicating with the liquid terminal, and having a space above said terminal communicating with the space above the negative electrode.

10. In a vapor-tube the combination with a positive terminal and a liquid negative terminal of an auxiliary positive terminal sealed into the wall of the tube for a part of its length and having its end in contact with the negative electrode and a non-conducting inclosure around said end having an opening into the space above the liquid terminal and having a limited opening into said liquid terminal as and for the purposes set forth.

11. In a vapor-tube, the combination with the liquid terminal of a solid auxiliary terminal, an inclosure for said auxiliary terminal made of non-conducting material, said inclosure having a restricted opening communicating with the liquid terminal and having a space above said terminal, communicating with the space above the negative electrode.

12. In a vapor-tube, the combination with

a liquid terminal, of a solid auxiliary terminal, an inclosure for said auxiliary terminal, said inclosure having a space above the liquid terminal and a passage from said inclosure opening below the level of the liquid terminal, whereby a limited rate of flow of the liquid to said solid-terminal is permitted.

13. In a vapor-tube, the combination with a liquid terminal, of a solid auxiliary terminal, an inclosure for said auxiliary terminal extending beyond the end thereof beneath the surface of the liquid terminal, whereby access of the latter to the solid terminal is restricted, and means for regulating the flow of said material to replace that vaporized by the flow of current.

14. In a vapor-tube the combination with a positive and a liquid negative terminal, of a solid auxiliary terminal normally in contact with the negative terminal, and an inclosure therefor exposing the positive terminal to contact with the negative terminal at the end thereof only.

15. In a vapor-tube the combination with a positive and a liquid negative terminal, of a solid auxiliary terminal normally in contact with the negative terminal, a tube of non-conducting material surrounding said solid terminal, said tube having a restricted opening filled with negative-electrode material in contact with the auxiliary electrode.

16. In a vapor-tube a liquid negative electrode, an auxiliary positive terminal and a non-conducting inclosure therefor, having a space within said inclosure above the negative-electrode surface, and means for regulating the inflow of liquid and outflow of vapor.

17. In a vapor-tube a liquid negative electrode, an auxiliary positive terminal and a non-conducting inclosure therefor, having a space within said inclosure above the negative-electrode surface and a restricted opening in said inclosure extending above and below the surface of the liquid terminal and regulating the inflow of liquid and outflow of vapor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THEODORE BODDE.

Witnesses:

W. A. PAULING,

G. A. ROEDER.