

Chapters II through VI from: Study on the Artificial Rearing of Infants Born Before Term, or Born at Term but Weak

New Automatic Incubator

Thesis presented and publicly defended at the Faculty of Medicine of Montpellier, 15 December 1891,
for the degree of Doctor of Medicine

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competitions 1886-87, 1887-88 (1st prize), 1888-89 (2nd prize), 1889-90*

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Editor's Note: These chapters in Jules Roux's 1891 thesis contain a unique third-party account of the earliest model of Lion's incubator, which he patented in 1889 (patent 201550), when he was still exhibiting live babies in incubators in Marseille in 1890 for the first time. The address given in the paper, 101 Avenue du Prado, Marseille, is confirmed in contemporary news accounts. The patent can be viewed at https://neonatology.net/pdf/lion_patent_201550.pdf and Lion's Marseille exhibit at <https://neonatology.net/gallery/exhibitions/alexandre-lions-first-incubator-exhibit-in-marseille/>

Machine translation of Chapters II to VI (pp. 16 to 35) from the original French, the portion of the thesis describing the A. Lion automatic incubator. Original page breaks are marked in gray brackets. Italics follow the original. Measurements are given as in the source; unlabeled dimensions are in meters. Original footnotes are set below the paragraph that cites them.

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Chapter II

THE A. LION AUTOMATIC INCUBATOR

The incubator is a large box in the shape of a parallelepiped, resting on a four-legged stand 66 cm high. The interior dimensions are: height 0.75, width 0.59, depth 0.63, giving a capacity of 280 liters, more than double the capacity of the Auvard incubator. The upper two-thirds of the front wall form a glazed frame that allows the interior to be seen without touching the apparatus; one can thus very easily see the infant, the indicator thermometer showing the interior heat, and the electric alarm that we will describe shortly. This frame slides up and down in grooves, and since counterweights balance it, it no longer tends to descend or rise by itself once it has been brought to the desired level for removing or replacing the infant (see *fig. 1*).

The top wall is pierced by a hole through which passes a mercury regulator having at its upper end a tubulure T (see *fig. 2*), which is connected by a rubber tube to the burner Br, of the Bunsen type, intended to heat the reservoir of the thermosiphon R. The regulator has on its side a second tubulure T', this one of glass, lower than the first; it is connected to an illuminating-gas outlet. The passage of gas through the regulator, and hence the burner flame, can be decreased or increased by turning toward

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the left in the first case, and toward the right in the second, the disk D fixed to the inner copper tube of the regulator. This inner tube enters the outer tube, which is of glass, with gentle friction through a stopper, by means of a screw thread cut on its outer walls. At its lower end the metal tube has an oblique, bevelled cut O, which dips into the mercury. In this way the opening through which the gas must pass can be more or less reduced or enlarged by acting on the disk (see *fig. 2*).



Fig. 1

Overall view of the incubator

Engraving of the cabinet. Plate on the lower front reads: "Couveuse automatique A. Lion" [A. Lion automatic incubator].

The burner and the water reservoir are placed outside the apparatus, on the right side wall. This reservoir can be removed. It is filled by means of a fixed funnel E, which communicates with its cavity through a pipe ending at its lower part.

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From its upper part, on the other hand, runs another small tube through which the air contained in the whole thermosiphon will escape when it is being filled with water. On the upper and lower parts of the side that is to face the right side wall of the incubator, the reservoir has

two tubulures that fit onto two corresponding nozzles projecting from the incubator. These nozzles carry an external screw thread into which engages an internally threaded sleeve-nut M-E (see *fig. 4*), whose outer rim is furnished with ridges that improve the grip for the fingers and allow it to be screwed on easily and fully, so that no water leaks once the reservoir has been connected in this way to the rest of the piping. The two nozzles just mentioned are the two open ends of a lead pipe of about 40 millimeters internal diameter, which runs twice around the inside of the incubator; the lower circuit is 13 centimeters above the floor of the box, the upper one 22 centimeters.

On the left wall, on the outside, we find an electric bell, to be actuated when needed by three Leclanché cells placed simply on top of the incubator; and further forward we also find a device for interrupting the current.

Let us move to the interior.

There we find the two circuits of pipe E E (see *fig. 4*) mentioned above, and the cradle, which rests on a four-legged support. Between the legs on the side of the infant's head is a crossbar whose rod, pierced with holes, can be raised or lowered and then fixed at the desired level by inserting a simple peg, in the manner of a musician's music stand; the inclination of the cradle can thus be modified. The cradle, so placed, is about 1.15 m above the floor, that is, at the level of the arms of the person watching

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over the infant, which is very convenient; it contains a small straw mattress and a small pillow.

On the left wall: the thermometer T (see *fig. 3* below)

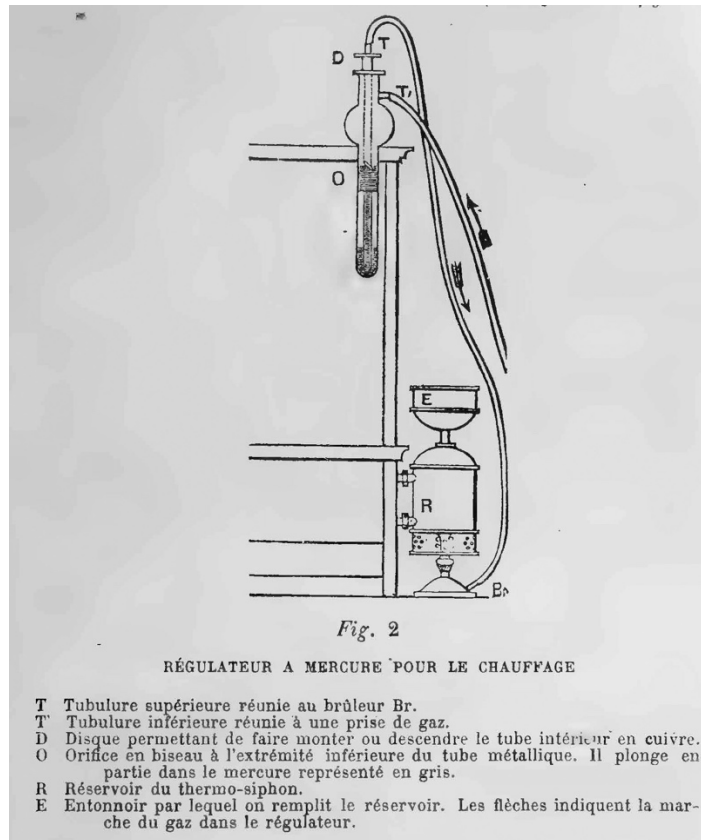


Fig. 2

Mercury regulator for heating

- T Upper tubulure connected to the burner Br.
- T' Lower tubulure connected to a gas outlet.
- D Disk for raising or lowering the inner copper tube.
- O Bevelled orifice at the lower end of the metal tube. It dips partly into the mercury, shown in gray.
- R Reservoir of the thermosiphon.
- E Funnel through which the reservoir is filled. The arrows indicate the path of the gas through the regulator.

which is to tell us the interior temperature. Care must be taken that its bulb be at approximately the same level, in the same horizontal plane, as the infant's mouth and nostrils, in order to be sure that the temperature indicated

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is indeed that of the air that will enter the respiratory apparatus; it is evident, in fact, that layers of air well below the level of the thermometer bulb will be colder, and the layers above it appreciably warmer.

To the right and left, in the corners behind the movable frame, are two vertical tubes in which slide the counterweights C P, intended to balance the weight of what constitutes the door of the incubator.

Also on the left wall is a sponge, which must be *kept moist* to provide a certain quantity of water vapor to the air that will be breathed. Then comes the alarm Av. (*fig. 3*). This is nothing other than a metallic thermometer with a hollow curved plate, which makes it very sensitive. The changes that variations in interior heat produce in this metal plate are transmitted to a needle with a platinum point, which moves over a dial graduated in degrees centigrade. On each side of the indicator needle is another needle, of copper, likewise ending in a platinum point but bent at a right angle, so that the middle needle, moving in one direction or the other, strikes the contact needles with its point. These contact needles can be moved by means of a pivot passing through the glass face of the alarm. They can therefore be brought as close as desired to the indicator needle, so that the slightest variation in temperature, up or down (1° , even $\frac{1}{2}^{\circ}$), will make contact, close the electric circuit, and set off the alarm bell. For the electric cells, alarm, switch, and bell are connected to one another by copper wires covered with insulating material.

This bell will practically never sound once the burner has been adjusted for the desired temperature. For if the heat increased, the expansion of the mercury would cause

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its level to rise in the regulator and thus narrow the gas inlet orifice; the burner flame would diminish, and the heat in the apparatus would gradually diminish as well. If, on the contrary, for one reason or another, the interior heat were to fall, the mercury level, dropping in the regulator, would enlarge the gas inlet orifice; the burner flame would lengthen, and the original temperature would very quickly be reached again. But such variations hardly ever occur except when, after the infant has been taken out for feeding or cleaning, someone has neglected to close, that is, to lower, the glazed frame. For as long as it remained raised, a large quantity of cold air would enter the incubator, which the thermosiphon could not warm quickly enough to prevent the needle of the metallic thermometer from touching the lower fixed needle, closing the circuit, and activating the bell.

Let us suppose, which is quite exceptional, that the alarm bell sounds. One hurries over; what is to be done?

1. Look at the mercury thermometer, which will tell us whether the desired temperature has not been reached or, on the contrary, has been exceeded.
2. On the alarm, move slightly the pivoting needle that is in contact with the indicator needle, so as to stop the bell.
3. Or, more simply, operate the switch, taking good care not to forget to return it to its original position once the incubator temperature is again at the desired degree.

4. Finally, increase or decrease the burner flame, as the case requires, by acting on the regulator screw, and do not neglect to check whether the flame may by chance have gone out, either because the gas inlet orifice has been reduced too much,

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or because of a sudden variation in the pressure of the gas supplied by the city gasworks, or from a draft of air.

The *ventilation of the apparatus is amply assured* in the following manner. At the lower part of three of the side walls are twenty holes, each twenty millimeters in diameter, for a total of 60 holes and a surface of 188 square centimeters, through which the air of the room will enter the incubator. This intake surface is six times that of the Auvard incubator. The upper part of the same three walls likewise has the same number of holes, of the same diameter as the lower ones, giving a total escape surface for the warm air of 188 square centimeters. How far we are from the 10 square centimeters of escape surface of the helical tube in the Auvard incubator! Nothing is simpler than to verify that the ventilation is working properly: one need only hold a lighted wax match successively to the lower holes and then to the upper holes. In the first case (lower holes) the flame will be drawn sharply from outside inward; in the second case (upper holes), from inside outward; and this, whichever hole the match is held before. *The infant will therefore always breathe air that is always at the same temperature and always amply renewed*: has not the ideal set out in the problem we posed on page 9 been attained?

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Chapter III

ADJUSTING THE APPARATUS

When the apparatus arrives, the mercury regulator is empty. Ten to 15 cubic centimeters of mercury are poured in through its upper tubulure (the mercury comes in a small flask that accompanies the incubator); the lower part of the regulator then contains about two finger-breadths of it, the upper reservoir as much, and the inner tube connecting them is full (1). It is the air trapped in the lower reservoir which, expanding or contracting under the influence of variations in heat, will shift the level of the mercury in the upper reservoir, into which dips the orifice through which the gas must pass on its way to the burner.

The incubator is set in place on its stand, in a spot sheltered from drafts; the regulator is inserted through the hole prepared for it in the top wall; the thermosiphon reservoir is screwed onto the tubulures (right side wall); then the upper tubulure of the regulator is connected to the burner by rubber tubing, and the lower tubulure of the regulator to a gas outlet. The door-frame is lowered. The thermosiphon holds about 6 liters. If we

(1) If air bubbles become trapped in the connecting tube, small shakes given *in the vertical direction* will drive them out.

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are in a hurry, we fill it with boiling water by means of the small funnel on top of the copper reservoir. When the system is full, which is recognized by the funnel remaining full of water, the gas cock is opened, the gas is lit at the burner, and the regulator is set so that the flame is not excessive, but not too low either, for it would risk going out as the air in the incubator warmed; this point must therefore be watched. In less than 10 to 12 minutes the initial temperature of the incubator will have risen by 10 to 12 degrees; from then on the flame is reduced as the desired degree is approached, for very little flame is in fact needed to keep a volume of six liters of water at a constant temperature. The desired degree is thus reached. The regulator is then left at this level; *it is set for that temperature*. From that moment on, it will operate automatically.

The needle of the metallic thermometer, under the influence of the rising heat inside the incubator, has moved and shows on the dial the same degree as the indicator thermometer. Then, using the screw of their pivot, the contact needles, one to the right and the other to the left, are brought as close as desired to the middle needle, which alone moves under the influence of thermal variations. One degree above and below, or $1\frac{1}{2}^{\circ}$ in each direction, are limits that can easily be adopted. With such a margin, once the regulator is properly set, one will only exceptionally, not to say never, have occasion to hear the alarm bell.

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Chapter IV

MEANS OF LOWERING OR RAISING THE TEMPERATURE

The infant placed in the incubator soon grows stronger; from then on there is no need to maintain the same temperature, and it will have to be reduced progressively by 1° or even $1\frac{1}{2}^{\circ}$. Conversely, a complication may arise that calls for raising the temperature. We must therefore explain how to proceed with these operations.

To raise the temperature we have only one means: to increase the flame by turning the disk of the inner tube to the right, bearing in mind that for each half-turn of this disk the temperature will shortly (in about 15 minutes) be 1° higher than it was before, this very approximately. One should not conclude, however, that giving two full turns of the thread at once would produce a rise of 4° ; it would not, for the opening at the lower end of the tube through which the gas must pass is elliptical, so at each half-turn the newly uncovered surface will be somewhat different from that uncovered by the preceding half-turn.

To lower the temperature we can likewise reduce the flame by turning the disk to the left by $\frac{1}{4}$ or $\frac{1}{2}$ turn or more, according to the drop we wish to produce. Equilibrium will be established progressively. If we wish to act more rapidly, we begin by emptying the funnel on top of the thermosiphon, by means of the drain cock at the bottom of the hot-water reservoir. This done, we withdraw half a liter or three-quarters of a liter of hot water from the appa-

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ratus and refill the system by pouring in water at room temperature, in sufficient quantity for the water to rise into the funnel. But this is not enough: the flame must also be lowered a little by acting on the regulator; otherwise the slight drop produced at first by the change of water would soon disappear, unless the intensity of the heat source had been reduced at the same time.

If we need to act more rapidly still, we must add to the two preceding maneuvers a third, which consists simply of raising the door more or less for a moment, so that a greater quantity of cold air enters the apparatus. A moment when the infant is taken out should be used for this. While working in this way to lower or raise the temperature, it is well to come and check the thermometer from time to time, having first taken the precaution of setting the contact needles on the alarm within $\frac{1}{2}$ degree of the temperature to be reached, so as to be warned by the bell if one has overheated or overcooled.

With a little practice one very quickly learns to lower the temperature by $\frac{1}{2}^{\circ}$, 1° , even $1\frac{1}{2}^{\circ}$ at the first attempt, without the bell having to sound. In practice, we can assure the reader, all these manipulations are much easier than one might be tempted to believe from the foregoing.

Finally, to be complete, we will address an entirely secondary question, but one that might be put to us: how much gas is burned per day? At the Clinic we were able to determine this, for this pavilion has a meter of its own. We recorded the consumption from about 7 a.m. to 6 or 7 p.m., and throughout that time we were certain that no other gas jet was burning; we therefore had the exact consumption. To reach 30° , with the room temperature varying from about 20° to 22° , the burner consumed a little less than 1 cubic meter of gas per 24 hours.

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Chapter V

ADVANTAGES OF THE AUTOMATIC INCUBATOR

1. Setting up the apparatus is far from difficult; after one session of explanation, a servant, even of mediocre intelligence, is capable of doing it very well. This incubator can therefore be placed in private homes (1); a member of the family or the sick-nurse will quickly master its mechanism.

2. The regularity of the temperature, which remains virtually absolutely fixed, almost entirely eliminates the need to watch the apparatus as long as the alarm bell does not sound, *which is entirely impossible in theory and entirely exceptional in practice*. One will therefore have nothing to attend to but the feeding and cleaning of the infant, just as if it were in an ordinary cradle. The work of the staff or of the nurse will thus be reduced to a minimum.

3. Ample ventilation, which will always function, given the number and size of the air inlet and outlet openings.

4. One need only moisten with water, two or three times per 24 hours depending on its size, the sponge intended to supply water vapor to the interior atmosphere, and from time to time pour a little ordinary water into the glass jars of the Leclanché cells, which, as is known, run for about a whole year without needing cleaning.

(1) Rental for home use at 50 francs per month. (Apply to M. A. Lion, Prado-Marseille, 101.)

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Chapter VI

HEATING THE INCUBATOR WITH PETROLEUM AUTOMATIC REGULATION

The incubator we have just described is heated by gas. Now, in large cities a good many houses are not equipped with this form of lighting; this is far more frequent in small towns, and it is the rule in villages. Must one then do without the automatically regulated incubator whose serious advantages we have just shown? No. M. A. Lion has devised the following method of heating with petroleum.

The heat source is the petroleum lamp known as the “universal lamp.” Its wick is cylindrical, and the center of the lamp is traversed from bottom to top by a wide channel through which air enters, activating combustion and consequently increasing the heat produced. The cylindrical wick can be raised or lowered by means of a screw near the top of the lamp reservoir. A further feature of this lamp is a solid disk, of slightly smaller diameter than the wick. Placed in its usual position, it leaves a small annular space between itself and the wick, through which rushes the air arriving by the draft channel. M. Lion had the idea of making the shutter disk D (*fig. 4*) movable vertically, so that the higher this disk rises above the level of the wick (within a certain limit, however), the more effective the air current will be, the more complete the combustion of the petroleum, and the greater the heat produced;

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if, on the contrary, this disk is lowered, it reduces the access of air, combustion is less active, and the heat diminishes.

The problem, then, was the following: to make the incubator itself

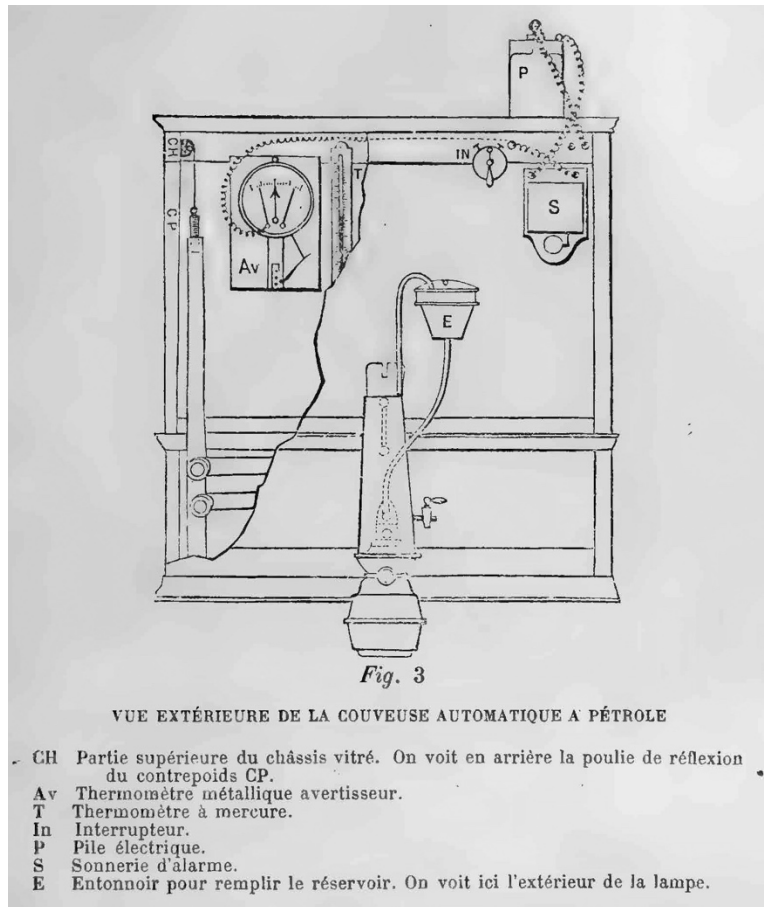


Fig. 3

Exterior view of the automatic petroleum incubator

CH Upper part of the glazed frame. Behind it can be seen the return pulley of the counterweight CP.

Av Metallic alarm thermometer.

T Mercury thermometer.

In Switch.

P Electric battery.

S Alarm bell.

E Funnel for filling the reservoir. The exterior of the lamp can be seen here.

carry out these risings and lowerings of the shutter disk automatically.

Here the shape of the thermosiphon reservoir is somewhat modified: it is traversed along its whole height by a central channel

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about 4 centimeters in diameter, which serves as a draft chimney for the lamp fitted to the lower part of the reservoir. The height of the reservoir is increased in order to use the heat as fully as

possible; it is about 34 centimeters. It is in this channel that the shutter disk moves, as we shall describe. A hole 15 millimeters in diameter, pierced at the bottom of the thermosiphon, allows the lamp flame to be seen when the lamp is placed under the reservoir. During operation this hole must be closed with a cork stopper.

On a small horizontal shelf fixed inside the incubator to its rear wall is firmly mounted a glass regulator-bulb of about 1½ liters capacity, which continues below into a glass tube bent into a U. The open branch of the U is quite vertical. A few cubic centimeters of mercury have first been poured in through this opening (the mercury is supplied in a small flask that accompanies the incubator); they fill the whole horizontal branch of the U, part of the branch connected to the bulb, and part of the open branch. The air in the bulb is thus trapped by this mass of mercury. If this air expands under the influence of heat, it will tend to push back the mercury and consequently raise its level in the open tube. If it cools, it contracts, and the mercury level will fall in the open branch.

On the top wall of the incubator is a lever which on one side supports the shutter disk of the lamp by a light metal wire, and on the other carries, attached by an ordinary thread, a *rather heavy float Fl* resting on the mercury in the open branch of the U. Consequently, when the mercury rises under the influence of excess heat in the incubator, the float is lifted, the lever tips toward the lamp side, the disk lowers onto the wick and reduces the heat source, and pro-

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gressively the temperature inside falls and returns to the desired degree. Cooling of the incubator makes the air in the bulb contract; the mercury level falls in the open branch, carrying the float down with it; the float in turn, weighing on the lever, tips it toward its own side, and the other end

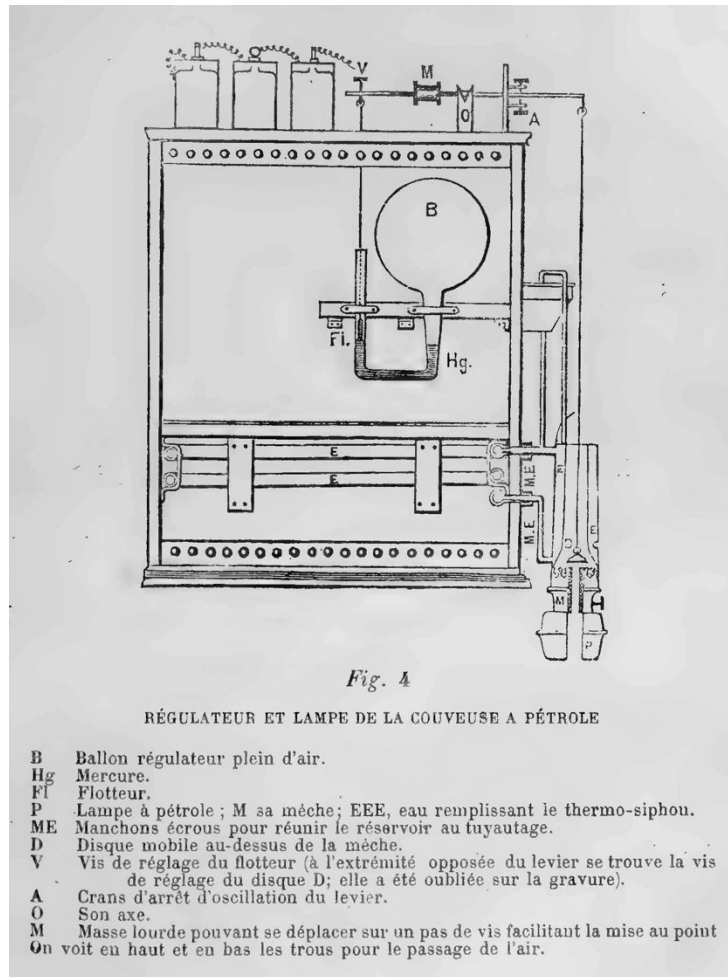


Fig. 4

Regulator and lamp of the petroleum incubator

- B Regulator bulb filled with air.
- Hg Mercury.
- Fl Float.
- P Petroleum lamp; M its wick; EEE, water filling the thermosiphon.
- ME Sleeve-nuts connecting the reservoir to the piping.
- D Movable disk above the wick.
- V Adjusting screw for the float (at the opposite end of the lever is the adjusting screw for disk D; it was left out of the engraving).
- A Stops limiting the oscillation of the lever.
- O Its pivot.
- M Heavy mass that can be moved along a screw thread, making adjustment easier.
The holes for the passage of air can be seen at top and bottom.

rises, and with it the shutter disk. The lamp flame, thus uncovered, is increased, produces more heat, and quickly brings the interior temperature back to the desired degree.

The principle set out, let us turn to its application. When the incubator arrives, the mercury in the small flask that accompanies it is poured into the U-tube of the regulator bulb. Keep the whole assembly vertical, and fix it by means of its support shelf at the place marked in the incubator, toward the back, at the top and to the right.

This horizontal support shelf is made in two parts: one fixed to the rear wall of the incubator; the other, smaller and removable, fits against the first by means of 2 large-headed screws. On their joining line, which is lined with rubber, are two semicircular notches which, facing each other, form two holes for the vertical branches of the regulator bulb: the left hole for the descending branch, the right hole for the open branch. With the bulb thus in place, care is taken to set the open branch truly vertical, so that the float and the thread supporting it, which are to be lowered into it through the corresponding hole in the top wall of the incubator, hang without friction like a plumb line.

The lever support is then placed so that its 2 notches engage the 2 screw heads that mark its position on the top wall of the incubator. Thanks to these notches, the support can be oriented so that, if imagined as extended in both directions, it passes on one side through the hole into which the float thread must drop, and on the other crosses the imagined upward extension of the axis of the water reservoir.

The lever is then put in place. The float thread is hooked to the end of the short arm, and the metal wire supporting the shutter disk to the end of the long arm.

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About 3 centimeters from the support is another upright carrying, at certain levels, two screws, likewise vertical, whose points can be advanced toward each other; they serve as stops limiting the oscillation of the lever, and consequently that of the shutter disk. This is of great importance, as we shall explain later.

Here comes the most delicate step in preparing the apparatus. When the mercury rises in the open branch of the U, the lever must tip toward the disk side. During this rise the mercury supports the float, which amounts to saying that the short arm of the lever is at that moment relieved of the entire weight of the float; the lever will therefore lean toward the lamp side, which is what we want. Conversely, when the mercury descends in the open branch the float must follow it, so at that moment the short arm of the lever must be heavier than the long one. The lever must therefore never be in equilibrium: *when the float is lifted, the system must lean toward the lamp side, and conversely, when the float is let go, the system must lean toward the regulator bulb side* (this is why our float had to be rather heavy). This result is obtained fairly easily *by means of a heavy cylindrical mass that can be moved along a screw thread cut on the short arm of the lever.*

With the lever adjusted, let us describe the regulation of the heat. Take, for example, a temperature of 30° to be reached.

The lever is set so that, when it rests against the upper stop, the float is about 1 centimeter above the mercury and the disk about 2 centimeters above the lamp wick. The thermosiphon is filled with cold water, or better, to save time, with water that is already somewhat warm. The lamp is lit, removing the cork stopper

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[to do so]. Heat begins to radiate from the lead pipes, the air in the incubator warms, and soon that in the bulb does likewise; it expands, pushing the mercury ahead of it, and the mercury will soon lift the float. From that moment on, if the heat continues to rise, the float will rise while the shutter disk lowers onto the lamp, reducing the heat source, and the temperature will tend to settle at some degree more or less close to the one desired.

If that degree is exceeded, it shows that the float was initially set too high above the mercury; one need only lower the float, which will lower the disk onto the flame and reduce it. This is easy, for the float and the disk hang from threads fixed to the tips of *long brass screws* passing through the ends of the beam, so their level can be altered by means of these screws.

If, on the contrary, the temperature reached were lower than desired, the float would have to be raised with its adjusting screw, which would lift the disk in the flame, increasing the flame and consequently the heat generated.

One could also act directly on the shutter disk by means of its adjusting screw, but this method is less advisable because it makes it necessary to reset the stops.

The stops are set so that, with the *lower side hole of the thermosiphon closed* by the cork stopper, the lamp does not smoke either when the disk is at its highest level or when it is at its lowest. These trials are made as soon as the lamp is lit, in order to fix the level of the stops once and for all.

If *not too much wick* is given, the universal lamp produces no smoke, even when the disk is at its lowest point, since the current of air reaching the inside of the wick is enough for all the hydrocarbons to be burned;

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when, on the contrary, it is raised to its maximum, this current of air is not strong enough to carry off the hydrocarbons before they have been oxidized. *Therefore, if the wick is not turned up too high, there will be no smoke and consequently no odor.*

With this automatically regulated petroleum heating, a constant temperature is assured just as well as with gas. One need simply trim the wick once in the morning and once in the evening, and make sure that the lamp reservoir is always sufficiently filled, which is in any case very easy.

Translator's notes

1. Couveuse, literally “brooder” or “sitting hen,” is rendered throughout as “incubator.” Avertisseur is rendered as “alarm”; interrupteur as “switch”; châssis vitré as “glazed frame”; disque obturateur as “shutter disk”; pétrole as “petroleum” (lamp oil, i.e. kerosene).
2. The figures in Chapter II check out: $0.75 \times 0.59 \times 0.63 \text{ m} \approx 0.279 \text{ m}^3$ (280 L); a 20 mm hole has an area of about 3.14 cm^2 , so 60 holes $\approx 188 \text{ cm}^2$.
3. The 1.15 m cradle height is the stand (66 cm) plus the cradle's position within the cabinet.
4. Gas model: a closed hot-water thermosiphon (about 6 L) heated by a Bunsen burner circulates water through a lead pipe looped twice around the interior. Gas flow is governed by a mercury regulator, with a separate battery-powered alarm thermometer that can be set to sound on a deviation of $\frac{1}{2}^\circ\text{C}$.
5. Petroleum model (Chapter VI): the same cabinet and thermosiphon, heated instead by a “universal” central-draft kerosene lamp under a taller (34 cm) reservoir with a central chimney. An air-filled glass bulb with a mercury U-tube drives a float, which tips a weighted lever that raises or lowers a shutter disk over the wick, throttling the lamp's air supply. This is a purely mechanical thermostat requiring no gas main.
6. Figures 3 and 4 both show the petroleum version, although Chapter II also refers to them for parts common to both models (alarm thermometer, counterweights, pipe circuits E E, sleeve-nuts M-E).
7. The heading on p. 25 is printed “Chapitre VI”; from the sequence (III, then V and VI) it is clearly Chapter IV and is so labeled here.
8. “En ville” (p. 27) is the period medical term for practice outside the hospital, i.e. in patients' homes. The footnote gives the rental terms: 50 francs per month, from A. Lion at 101 Prado, Marseille.
9. Gas consumption (p. 26): a little under 1 m^3 per 24 hours to hold 30°C against a room at 20 to 22°C , measured on the Clinic pavilion's dedicated meter.
10. P. 35: the pronoun in “quand au contraire il s'élève au maximum” is masculine and could grammatically refer to the disk, but the sense (smoke when it is raised too high) and the following sentence point to the wick; it is translated accordingly.