

# Drebbel's Athanor and furnaces

Compiled for [www.drebbel.net](http://www.drebbel.net)

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## Bacon about Furnaces in New Atlantis

<http://www.bartleby.com/3/2/#note2.1.415>

“We have also furnaces of great diversities, and that keep great diversity of heats; fierce and quick; strong and constant; soft and mild; blown, quiet; dry, moist; and the like. But above all, we have heats, in imitation of the Sun’s and heavenly bodies’ heats, that pass divers inequalities, and (as it were) orbs, [14](#) progresses, and returns, whereby we produce admirable effects. Besides, we have heats of dungs; and of bellies and maws of living creatures, and of their bloods and bodies; and of hays and herbs laid up moist; of lime unquenched; and such like. Instruments also which generate heat only by motion. And farther, places for strong insulations; [15](#) and again, places under the earth, which by nature, or art, yield heat. These divers heats we use, as the nature of the operation, which we intend, requireth.

## § 2 - Ovens of different kinds

We know from various sources, that Drebbel invented very cleverly constructed ovens and furnaces. [De Peiresc](#) mentions '... also the admirable invention of furnaces, where, for instance, the fire can be kept at the desired temperature — more or less intense.' It was not until some time after Drebbel's death that the construction of these instruments became more widely known. The attention of the Royal Society was directed to them at a meeting, in October, 1662: 'Sir Robert Moray offered to the consideration of the society a way to compare the effect of heat and cold in rarefaction and condensation of air, with that of force of weight. Upon which Dr. Goddard suggested Drebbel's method of governing a furnace by a thermometer of quicksilver.'

Also Chr. Wren shows an interest in these furnaces. De Monconys, after he had visited Wren writes in his diary on June 11th 1663: 'He also told me his thoughts about making a furnace like that of Mr Kuffler's, to wit, one with a vat before the register, which was half in the furnace and half outside it and full of quicksilver, which last rose whenever the air in the retort, which is on the ashes, pushed it up and closed the register; for the little wall of the furnace is likeso a diaphragm, which divides the vat of quicksilver in two.' From this description we learn, that the regulation of temperature in this furnace was based on the same principle as that on which Drebbel's perpetuum mobile must have been constructed.

When the fire began to burn quicker, the ashes got warmer, the air in the retort expanded and pushed the quicksilver further up into the neck of the retort, whereby a damper, to which a spring was attached closed down on the surface of the quicksilver, so that as a result less air was admitted than before and the temperature of the fire and the ashes were once more reduced.

A form of construction reminiscent of the plan on which present-day thermo-regulators in a thermostat, are made, was used by Drebbel in his incubators. The following data are taken from a MS. by Drebbel's grandson, Augustus Kuffler, which is now to be found in Cambridge. This contains a detailed description accompanied by pictures, which greatly add to its clearness.<sup>4</sup> In these furnaces it was not, as in the case of the apparatuses previously mentioned, the expansion and condensation of a certain quantity of air in an enclosure which regulated the supply of air to the fuel, but alcohol was used for this purpose (nowadays toluene is used). When this alcohol, which was in a vessel inside the incubator, expanded, a tube of quicksilver was caused to move, whereby a lid in the incubator was raised slightly and consequently cold air was admitted. It was possible to hatch eggs in these incubators.

Cornelis van der Woude also mentions them: 'He was able, by means of a strange and amusing device, to hatch duck and chicken eggs all the years round, yes, even in the middle of winter, without using ducks or chickens for this, and everything went so punctually, that the young were born at the proper time, just as if they had been hatched by ducks and hens.'

These incubators are also mentioned in the Royal Society on February 18th, 1668. 'Mr Henshaw upon occasion mentions the way of hatching chickens by balneums formally used in the Minorities by Dr. Keffler's brother; the particulars of which he was desired to bring in writing, which he promised to do.'

De Monconys also describes ovens for baking bread in which the heat was made to circulate by means of smoke gases. This kind of oven is also mentioned in Evelyn's Diary, in August 1666: 'I went to Dr Keffler, who married ye daughter of ye famous chemist Drebbel, inventor of ye died scarlet. I went to see his iron ovens made portable (formally) for the Prince of Orange's Army.' the heat was made to circulate by means of smoke gases. This kind of oven is also mentioned in Evelyn's Diary, in August 1666: 'I went to Dr Keffler, who married ye daughter of ye famous chemist Drebbel, inventor of ye died scarlet. I went to see his iron ovens made portable (formally) for the Prince of Orange's Army.' (source: [G. Tierie's thesis](#))

Fig: 9

The forme of an Athanor which keeps  
An Equall Heate  
fig 1<sup>st</sup>

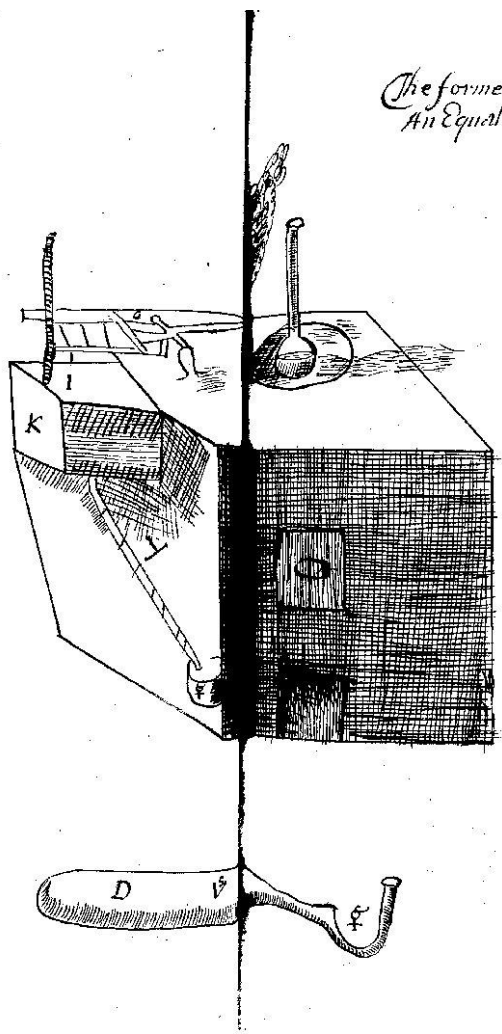


Figure 1 is a chymist's [sp] athanor with thermostat control and what seems to be a Drebbel type thermometer at the top - or that is possibly simply a flask being heated for an example of an experiment in progress.

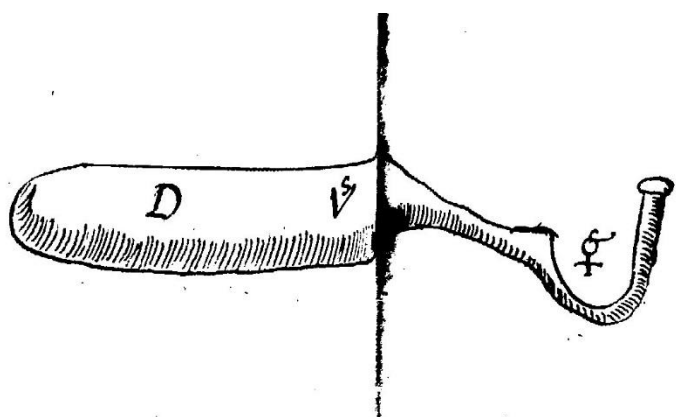
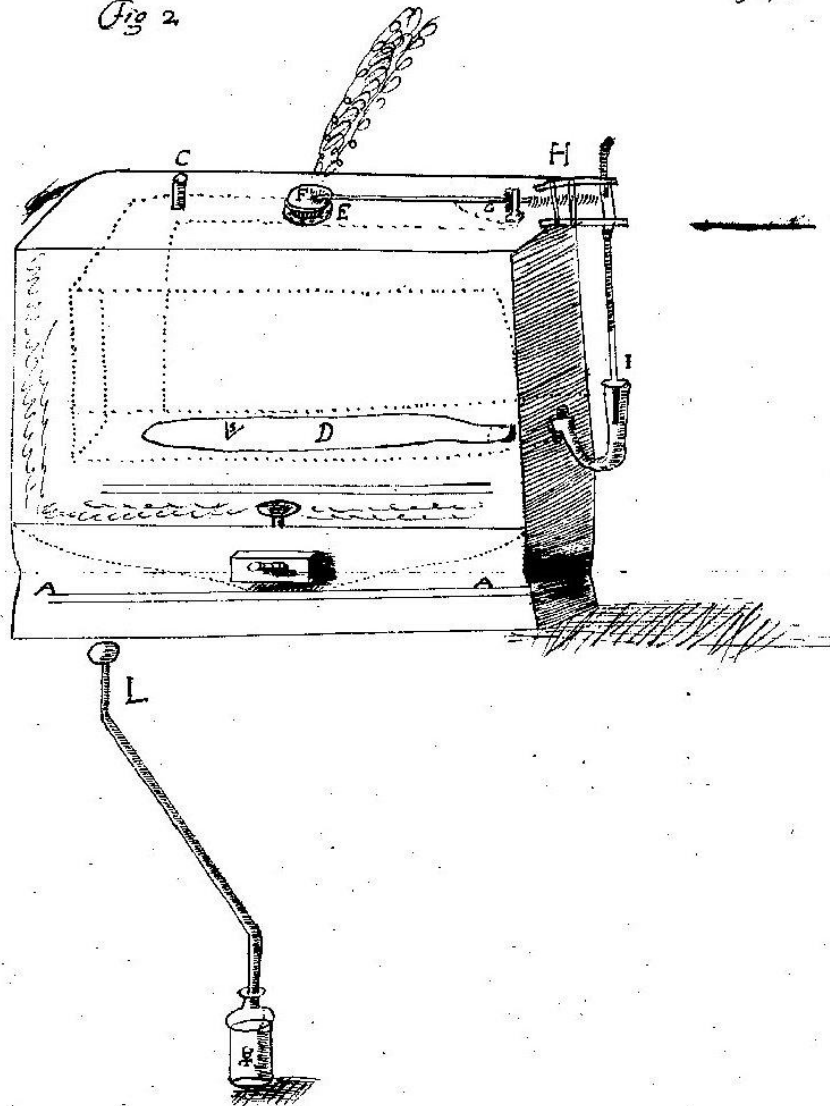


Figure 2 is a close up of the thermostat in figure 1, and installed in the incubator in figure 3. The "D" is the main chamber, the "V-S" symbol is for "wine spirits", or alcohol. At the curved neck you will see the mercury sign. The mercury would sit in this bend and trap the alcohol inside. As the alcohol expanded and contracted, it would of

course push this "moving plug" of mercury back and forth in the bend. Any rod floating on the mercury would then rise and fall accordingly.

Fig 2

Fig: 10



The Barrowmeter To know what Degree of heate the Furnace is at, being a small Bolts Head with a Long Neck bent Crooked neere the Bowle, & the Bowle put into the side of the Furnace & the other Bent Crooked & put into a violl of  $\text{F}$  as the heate increaseth the aire will rarifye & the  $\text{F}$  will goe downe when you will sett it at any Degree of heate, as to make it hotter screw vpp the Pinns  $\text{I}$  & see the Spoon keeps the openner the Pipe of the Bolts Head guides you what Degreee it is at

Figure 3 shows the incubator for the "hatchin of Chickens", and the arraignment of the installed thermostat, rod and attached draft control. Below is shown a "barowwmeter", or barometer... but it is really what we know as a thermometer. It is mercury filled, and even if it is not entirely sealed, I'm sure the barometric pressure would have little effect in this case, and it would serve to show the temperature adequately... but that is my opinion. The description below should be readable in this copy... but it shows the use of Drebbel's thermostat clearly. As the air in the incubator heated or cooled, it would expand and contract the alcohol in the thermostat, then move the mercury to and fro, then move the rod "I" up and down. At "H" is the pivot, connecting rod "I" to the draft control lever. It appears the artist attempted to show a threaded adjustment here, but again that is just a guess on my part. "F" is the flap which closes and opens the draft, and "E" is the draft. It is also apparent that the heated air would not enter the egg chamber, but actually circulate around it.



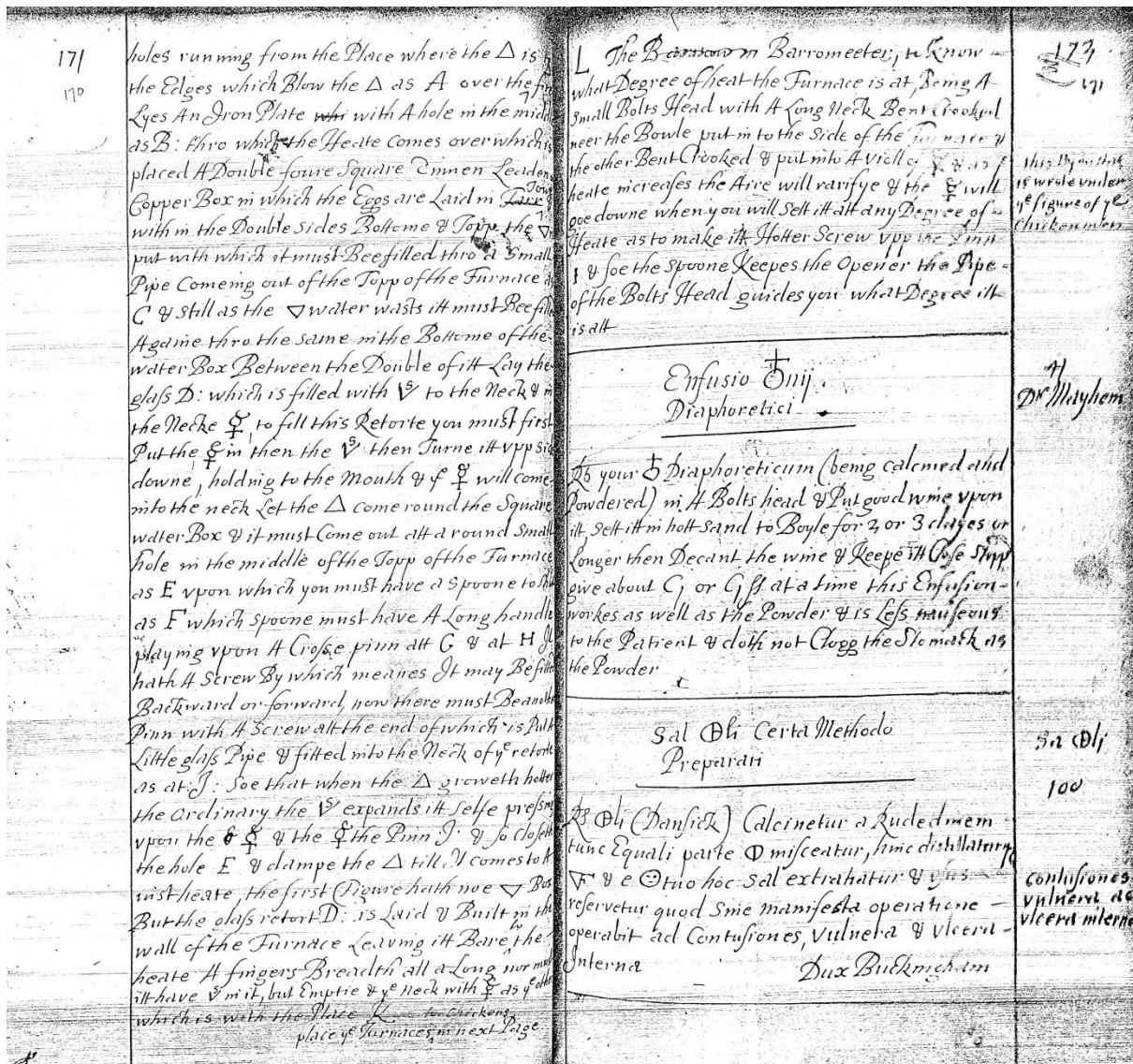


Drebbel's Athanor in a hand-written book with designs and recipes etc, made by Drebbel's son in law, Siberius Kuffler in app. 1666

*A very Good Collection of Approved  
Receipts of Chymical operations Collected  
By Augustus Kuffler And Charles  
Herretts Phylchymist Anno Domini  
1666*

Source: Handwritten book by **Augustus Kuffler** from 1666. August (1644 - 1690 London), son was a grandchild of Cornelis Drebbel (1572 - 1633) The famous innovator. .  
The original book is in Cambridge Library. Copies of the book are at the Drebbel Foundation, Bergen, and Archive Alkmaar, The Netherlands. For more info about Drebbel: [www.drebbel.net](http://www.drebbel.net)

<p>169</p> <p>A: is the still in which the Herbes are put which must Bee sett in A Pott of Booyling Water B: the Cover or Head shutting Close in A C: An Elbow or Crooked Pipe fitting Close to Head B D: the hole in the first Part of the Long Pipe to Let in Aire E: the ring as shuts the hole D 1 2 3 are three peeces of the Long Pipe shutting one in Another F: the Tunnell to Receive the fumes betwixt an Edge Turned Brick full of holes to Joyn the Leather Bagg too G: the Leatherne Bagg lined w<sup>th</sup> Canvas in which the Place affected is put to Bee sweated The Kettle A: may Bee about A foote over and something Deeper made of Copper or Tinne The Pipe which is of severall peeces as 1: 2: 3 may Bee about An Ell longe &amp; 3 Inches Diameter The Tunnell F may Bee as wide as the Kettle A or something more This Engine may Bee used att the Patients Bedd side to the Content of the Patient &amp; Profit &amp; Credit of the Physitian</p> <p>The Description of two Furnaces ruling them selves &amp; Keeping at any Degree of Heate the one for Hatching of Chickens</p> <p>The first p<sup>r</sup> Figure placed at page 171 is for the Curious Chymist the 2<sup>d</sup> figure page 172 75 for Hatching of Chickens &amp; must Bee tended with careate Circumspection &amp; difficultie this Furnace must Bee without A grate being 2 or 3</p>	<p>170 169</p> <p>apply after the sweating some proper plant etc according to the discretion of the Physitian</p>
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The furnace contained a retort, partially filled with the spirit of wine and partially with mercury, which touched upon a pin, upon which lay one end of a spoon, the other end of which covered an air hole. As the fire “groweth hotter the ordinary spirit of wine expands itt selfe pressing upon the mercury & the mercury the Pinn I & so closeth the hole E & clampe the fire till It comes to a just heate ...”. The liquid, expanded by the fire, pressed up on the pin, which pressed up on the spoon on one end, which pressed down over the hole on the other, thus limiting the flow of air. Since the fire required the occult properties of the quintessence of air to burn, as the air supply lessened, so too did the fire, inducing a continuing cycle of expansion and diminution of fire, spirit of wine, mercury, and air, according to a fusion of chemical and mechanical properties. The level of heat at which one wished to keep the furnace burning could be changed by adjusting the level of the pin.

(From DREBBEL’S LIVING INSTRUMENTS, HARTMANN’S MICROCOSM, AND LIBAVIUS’S THELESMOS: EPISTEMIC MACHINES BEFORE DESCARTES, Vera Keller, Hist. Sci., xlviii (2010) )



Fig. 3

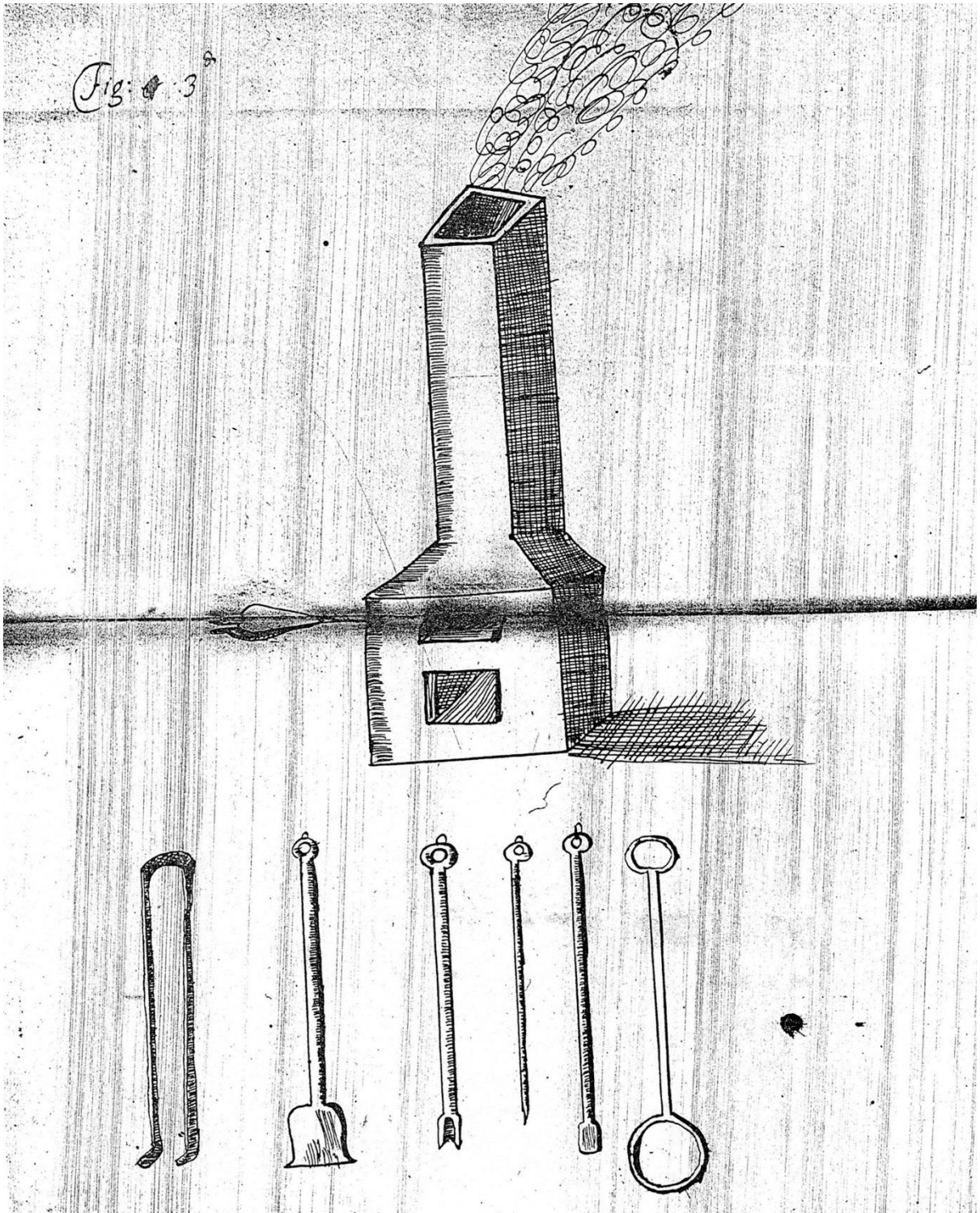
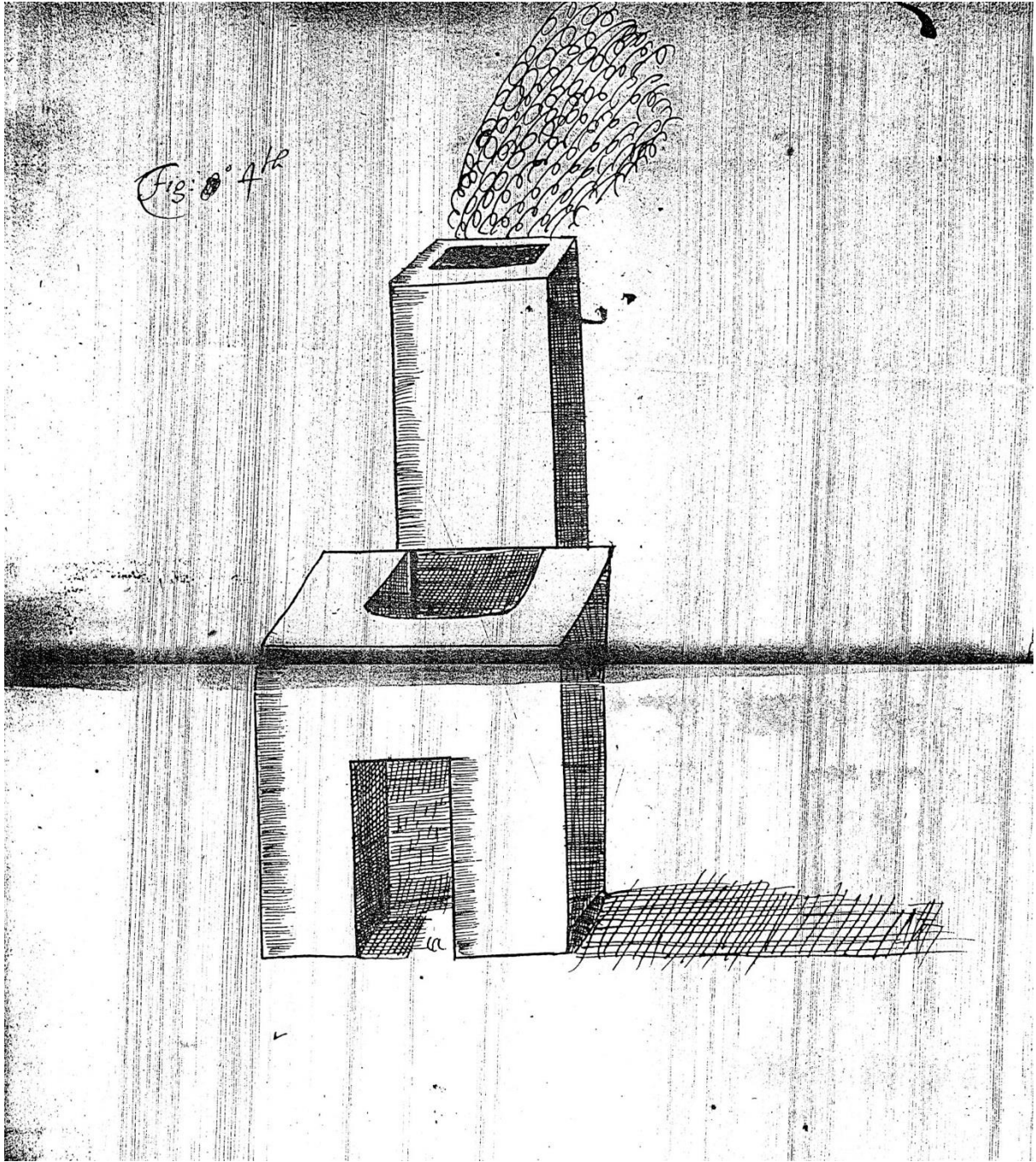
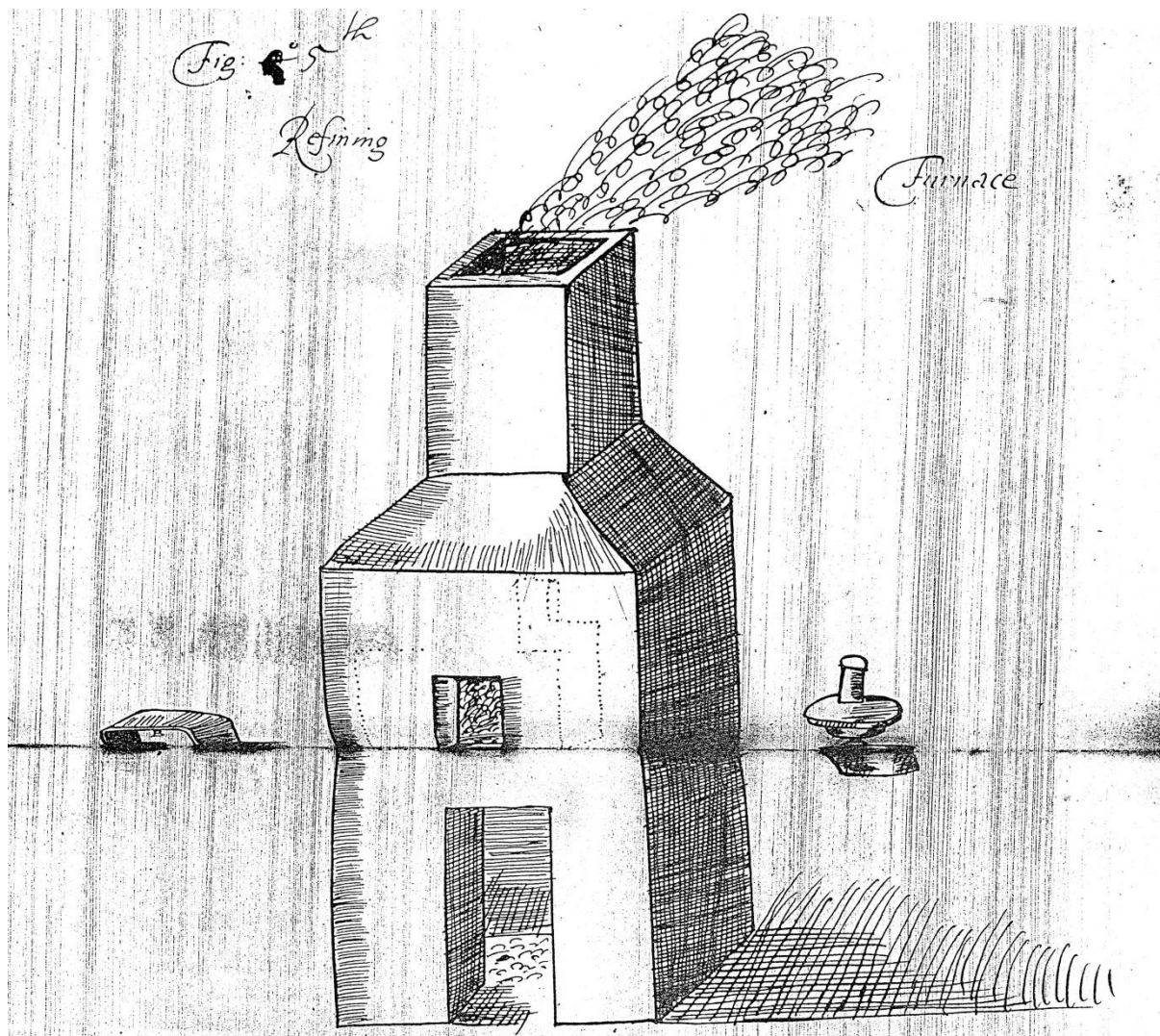




Fig. 412

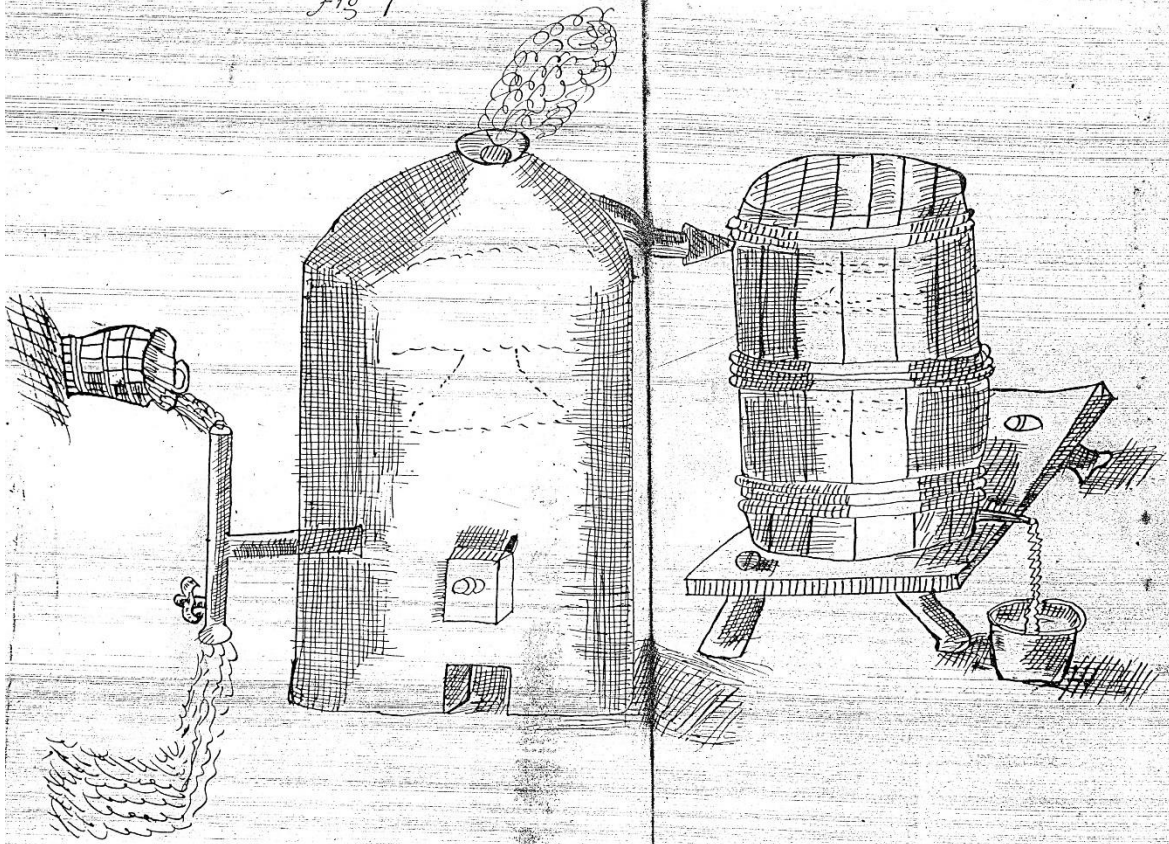




A A Mould of Brass for the making of Tests  
 B An Iron thing to sett over the Tests

The Best refining Tests are made of the Bones or Pithes of Hornes  
 Burnt, then Beaten & sifted & Knott hard in the abovenamed mould  
 In the beaten Ashes must Bee A little Moistneel with Beere  
 The Bone of A Sowe or A Boare, Burnt & A Test made of it Let  
 all the C runne in with the t

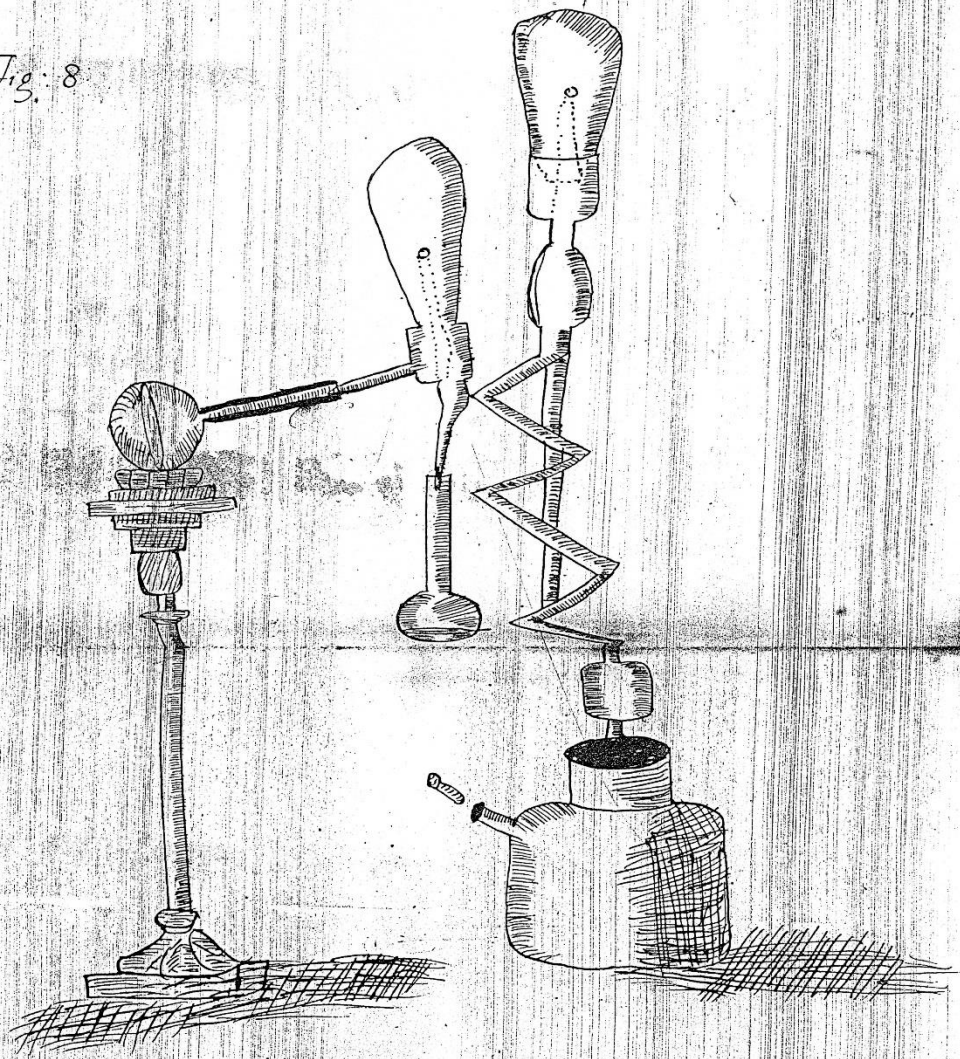
Fig 7<sup>12</sup>



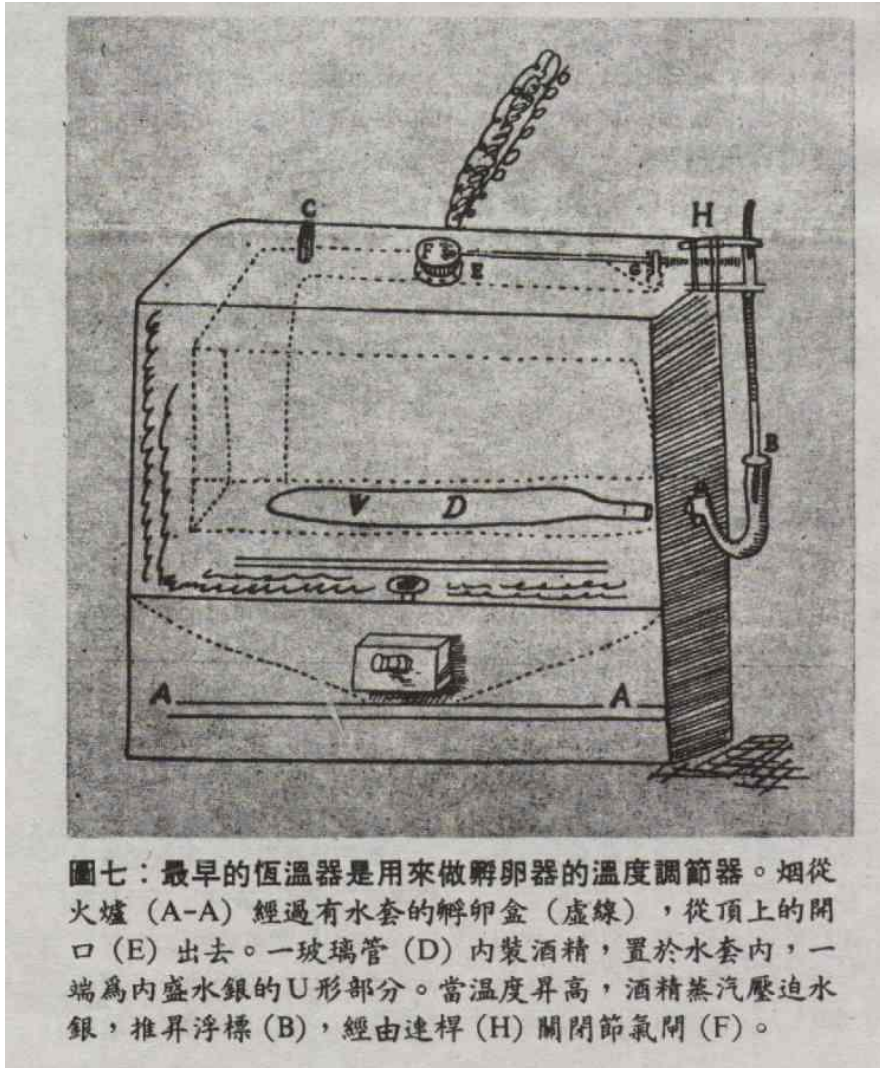


Avesell to Alcolize the  $\text{V}$  in the first distillation

Fig: 8







Drawings of Drebbel's incubator circulated all over the world, even in China.

## Literature

- [William White and an Atlantic World Perspective on the 17<sup>th</sup> Century Chymical Furnace](#)
- Origins of Feedback Control, O. Mayr, Scientific American Oct. 1970, **223**, 110 - 118
- Silvio Bedini, "Role of the automata in the history of technology", in his Patrons, artisans and instruments of science, 1600–1750 (Brookfield, 1999).
- Augustus Kuffler, A very good collection of approved receipts of chymical operations collected by Augustus Kuffeler and Charles Ferrers phylchymist, Cambridge University Library MS LI.5.8, 169–70.
- [DREBBEL'S LIVING INSTRUMENTS, HARTMANN'S MICROCOSM, AND LIBAVIUS'S THELESMOS: EPISTEMIC MACHINES BEFORE DESCARTES](#), Vera Keller, Hist. Sci., xlviii (2010)
- [Journal des voyages de Monsieur de Monconys, Volume 2, 1663 \(excerpts by FF\)](#)
- [Relation d'un voyage en Angleterre by Samuel de Sorbière \(excerpts by FF\)](#)