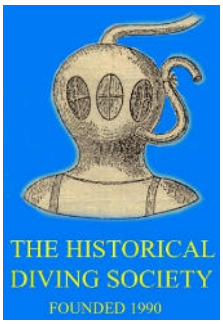


Reconstruction of Peter Kreeft's Diving Machine

Lecture given at the 28th Annual Conference on the History of Diving at the Royal National Lifeboat Institution College, Poole, on Saturday the 3rd November 2018.

By Franz Rothbrust

HDS Germany

Förderverein Deutsches Meeresmuseum

Deutsches Meeresmuseum Stralsund

On behalf of the Maritime Museum in Stralsund, members of HDS Germany replicated the diving equipment of Peter Kreeft and proved its feasibility with practical dives.

Peter Kreeft lived on the German Baltic Sea coast. He was born in 1739 in Wiek and died 1811 in Barth. He was merchant and captain by profession. During 1799 or 1800 he lost one of his ships close to the shore. Kreeft built a diving suit in order to salvage his load of copper bars from a depth of about 8 Meters.

Theoretical development

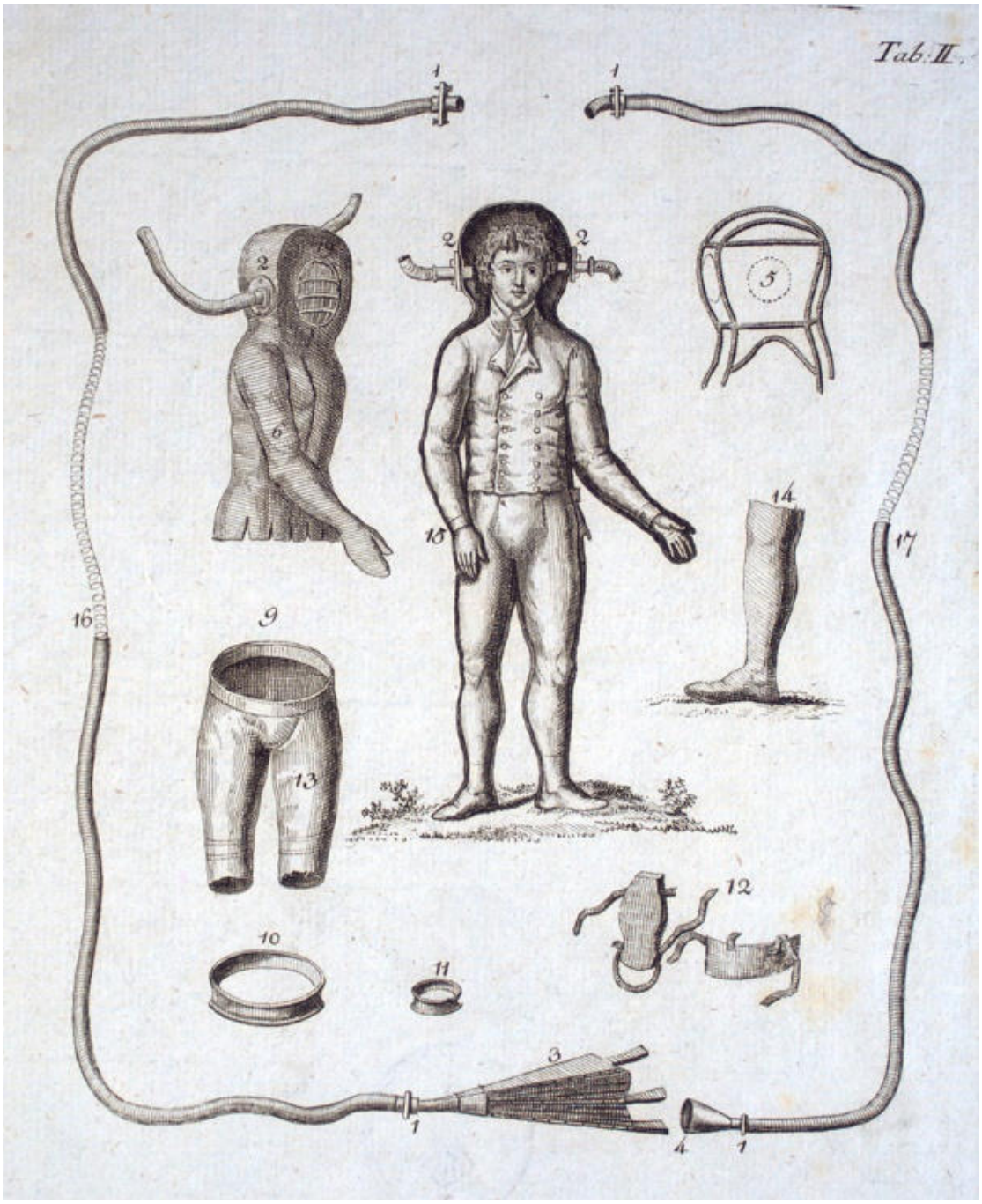
Method of approach

The most important basis for our reconstruction is a small book written by Michael Jung: *Der Meeresgrundwanderer*.

Besides two historical drawings and an eye witness report, construction references can also be found in John Bethell's patent (1835) on pages 34 - 39, which is known to be based on Kreef's ideas [1].

Tab I

Historical presentation around 1805 © Stadtarchiv Stralsund



Tab II

Historical presentation around 1805 © Stadtarchiv Stralsund

What does the artist show us in his depictions, what not? We look through a veil, of over 200 years with their other, different ways of thinking and acting.

Barth, the hometown of Peter Kreeft, was then part of Sweden, and it was not possible to patent inventions around 1800. In Germany, the patent system was first introduced in 1865. It was therefore common practice to protect an invention from copy, by not describing important functions, or by making misleading statements such as this for example: *The possible depth is "20 fathoms",* which is 36 meters. At that time, it was impossible to produce the necessary air pressure with bellows. Nor would it have been possible to dive that deep using a pressure resistant upper body shell. There are many more inconsistencies that will be discussed in more detail further below. The eyewitness account should therefore be interpreted with great caution.

Conclusions

If we were to build the diving equipment according to the information that is available to us, in modern terms it would not be diveable for the following reasons:

- Important detailed information, such as the air outlet design and diver weighting are missing.

- There is also every chance that certain design details were purposely kept secret, as they could not be patented.

- Many of the available design details appear to contradict one another. As such they offer divergent design paths which is not realistic.

- The drawings on offer are clearly stylised and as such lack in essential technical detail. As best they would appear be based on second hand information, by an artist who probably never saw the equipment and lacked in an appreciation of the technicalities involved.

Even so it has been proven that Kreeft dived 5 to 8 meters deep, his equipment must have met diving physical requirements. This is a very important statement and a crucial basis for the replica. It helps us to filter historical sources for realistic content.

On the basis of these findings, we have designed the replica in such a way that it complies as much as possible with the historical drawings and still satisfies diving and physical needs.

The sources are incomplete and ambiguous, so it will not be possible to make an authentic replica. To anticipate, there are several ways in which the equipment could have been constructed.

Source study source criticism

The leather helmet and it’s components

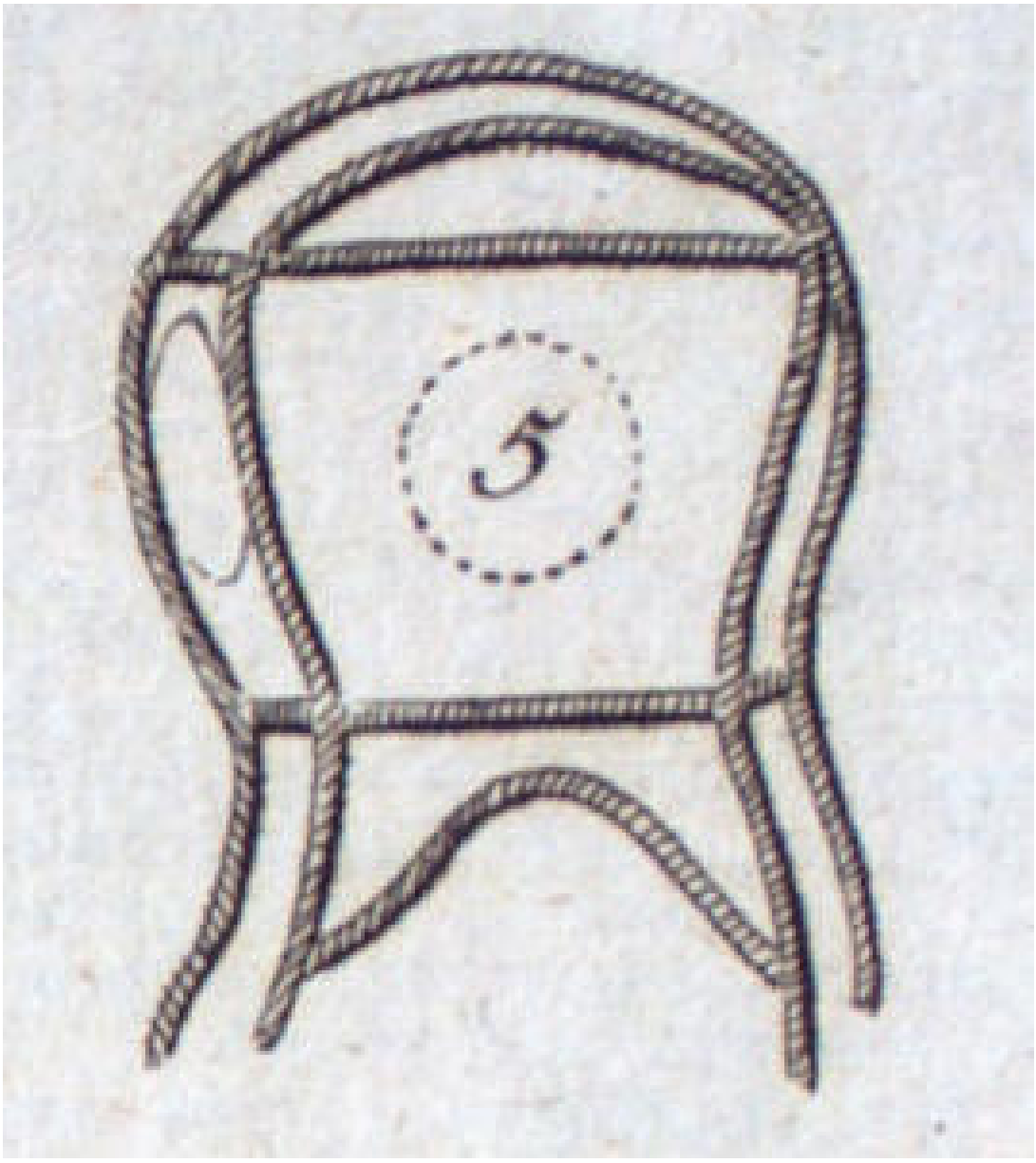
According to this drawing, the horizontal helmet cross section at half the window height is "square" with slightly flared sides. It seems to have been sewn together from four parts. The seams converge at the top center. The connection for the hose sits off-center, almost at the front of the window. How it was fixed is not clear. The window is oval, 11 to 12 bars protect the pane. It seems to have a narrow flange on the outside, fastened with many rivets.

This helmet is also square at half the height of the window, the front and back are seemingly flat. The oval window has 8 bars this time, there is no flange around, just a narrow ring, not wider than the bars. The seams do not converge at the top, but circle the window on three sides, correspondingly at the back. The lateral connection flange is fastened here with two rivets or screws.

The sectional view of the helmet fits reasonably with both of the above representations.

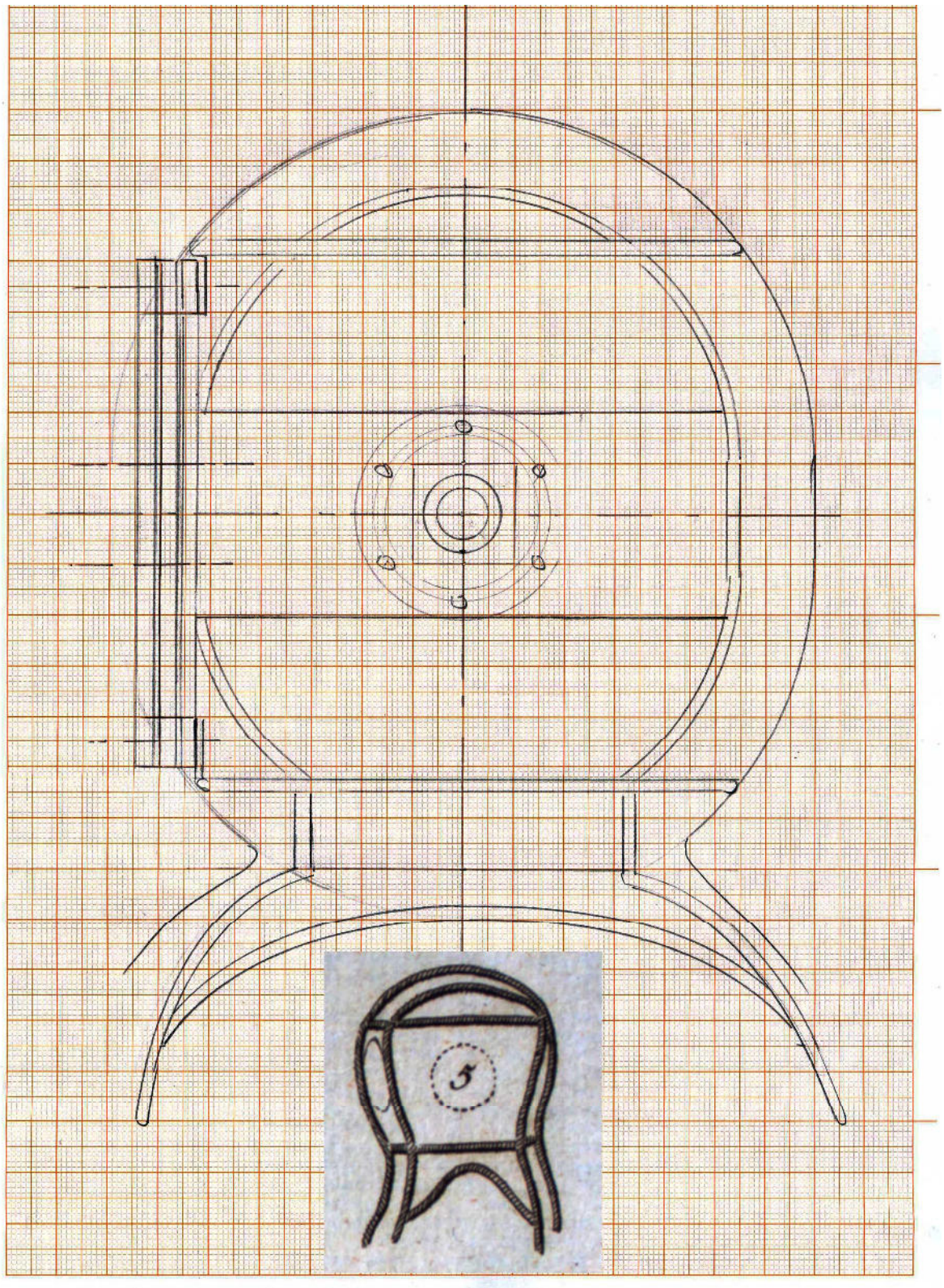
Both hose connectors seem to pass through the leather only. The leather bulges inward from the flange. On both sides, the inner equivalent to the outer flange is missing. This construction is completely unusable.

On the basis of divergent helmet shapes and the attachment of the flanges and the helmet window it can clearly be seen again that the artist was a technical amateur or he drew many details intentionally in a wrong way to avoid disclosing technical secrets.

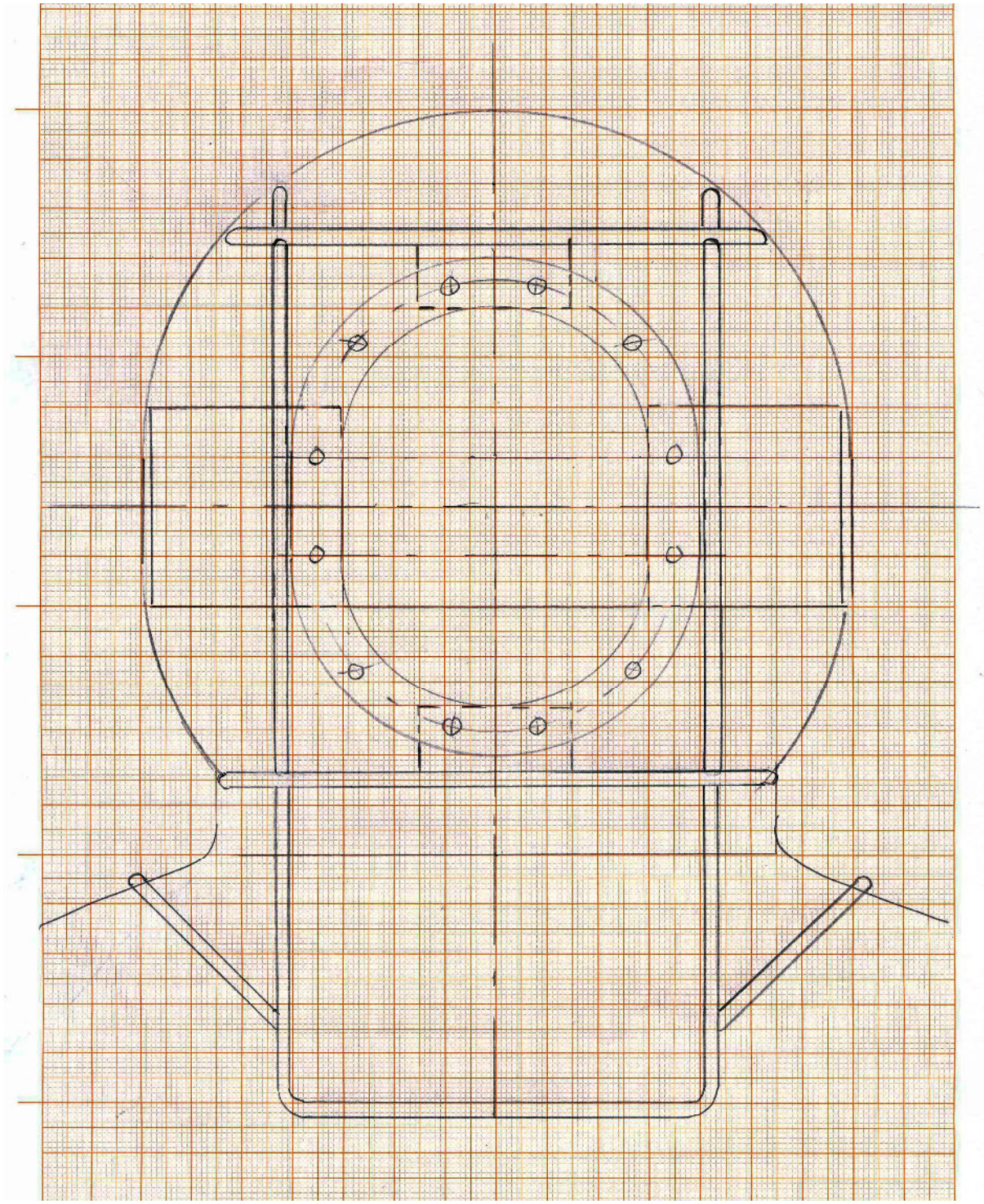


Inside the helmet there was a frame made of metal bars. Again, a rectangular cross section on the level of the neck and forehead. The vertically arranged bars run downwards into the void. Laterally, the framework is moulded onto the shoulders.
There is no indication as to whether and how the lateral hose connections or the window were fixed to the bars.

Construction



Side view



Front view

The inner helmet framework follows the detailed drawing in Tab II. The horizontal bars are stabilized horizontally at mid-height by means of a circumferential sheet of brass. To this the hose connections and the helmet window can be fastened.

Replica

Construction alternative

In connection with the frame, it was examined whether the diving suit was also equipped with an incompressible structure in the region of the upper body, the diver breathed air at atmospheric pressure.

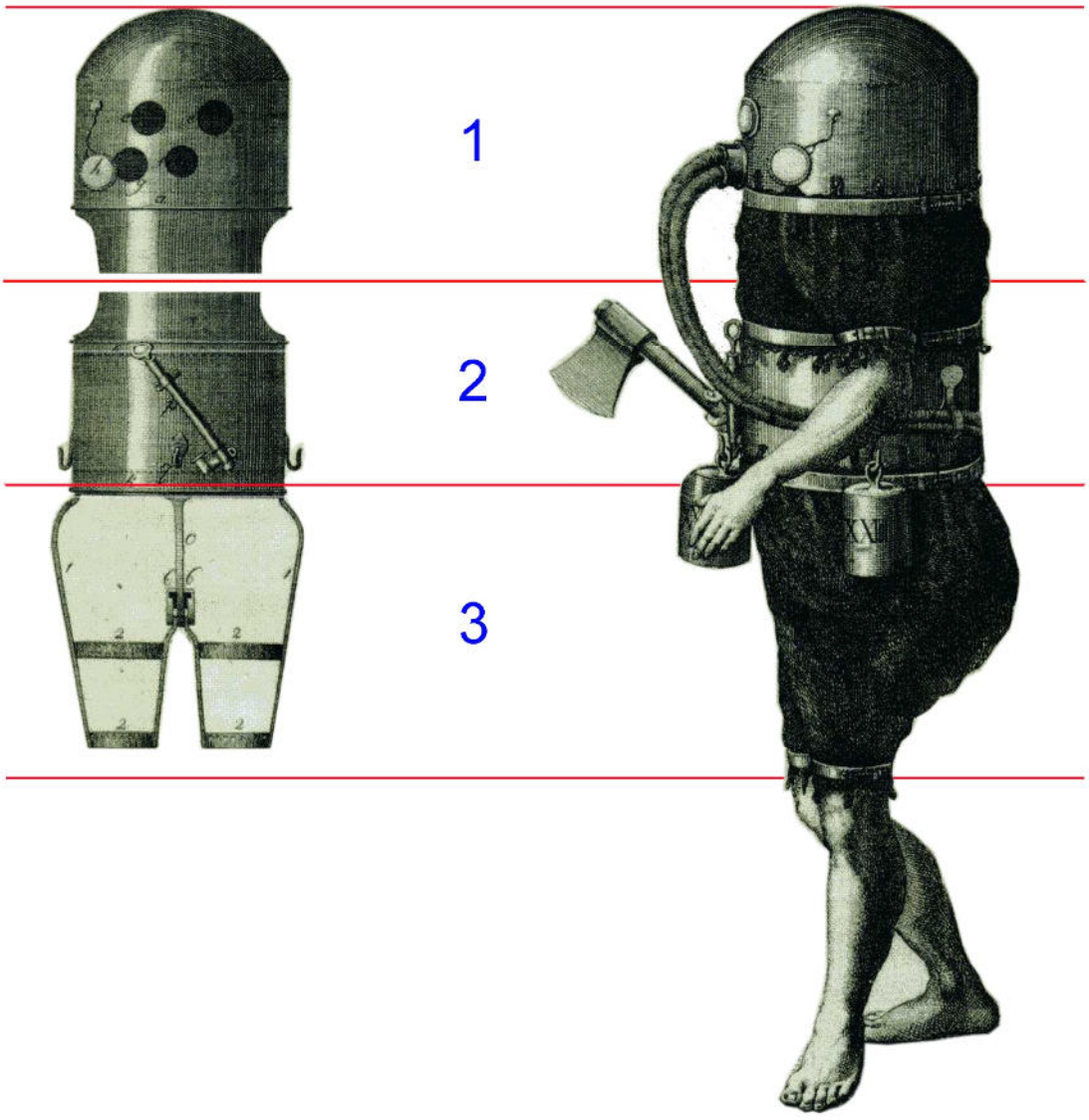
The following arguments would be for a framework in the suit shell:

- The relaxed pumping gentleman in the boat's stern operating a large bellows.

- The speaking tube from which, according to witness testimonies, breathing could be heard and the exhaling air exited.

- In the image showing the framework, the iron bars seem to lead downwards.

- The brass spiral in the voice hose to keep it open under water pressure.

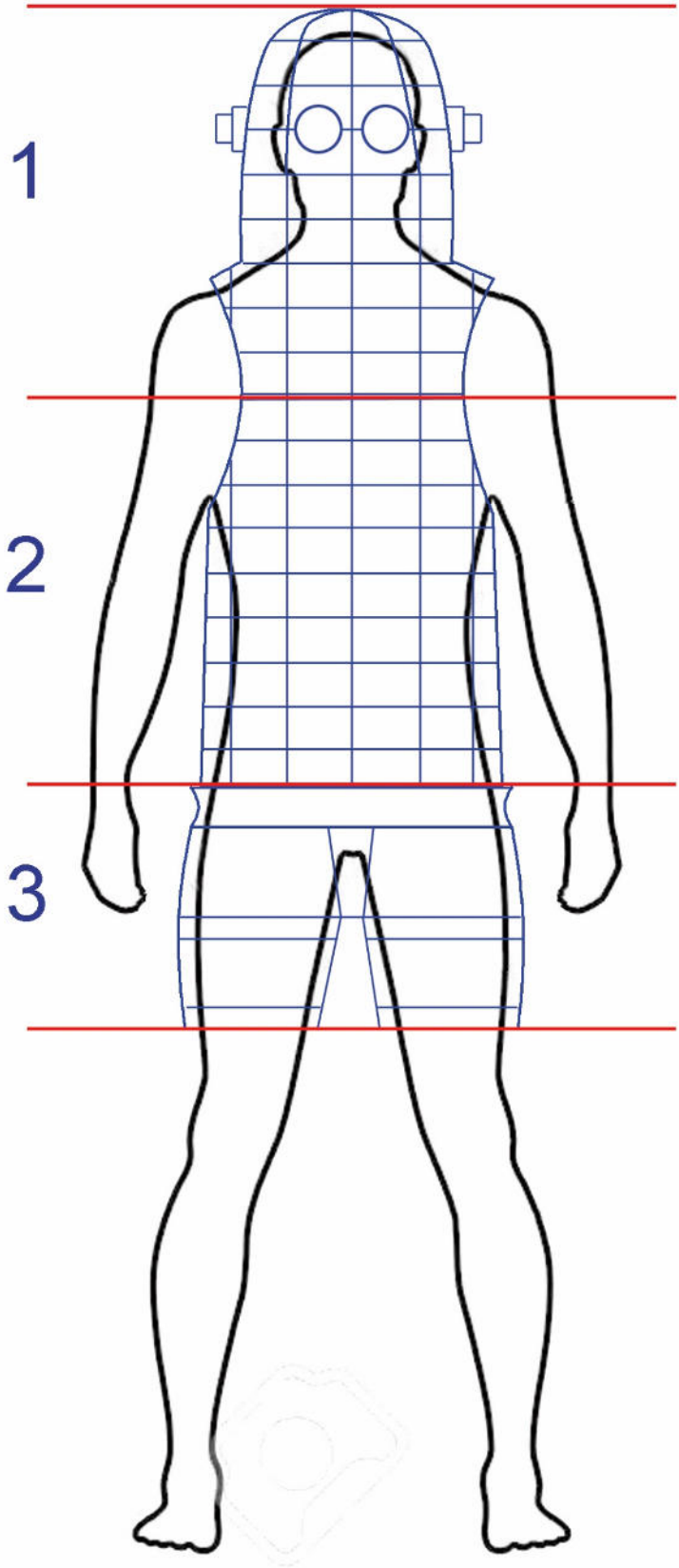


Suit with incompressible shell constructed by Karl Heinrich Klingert 1797

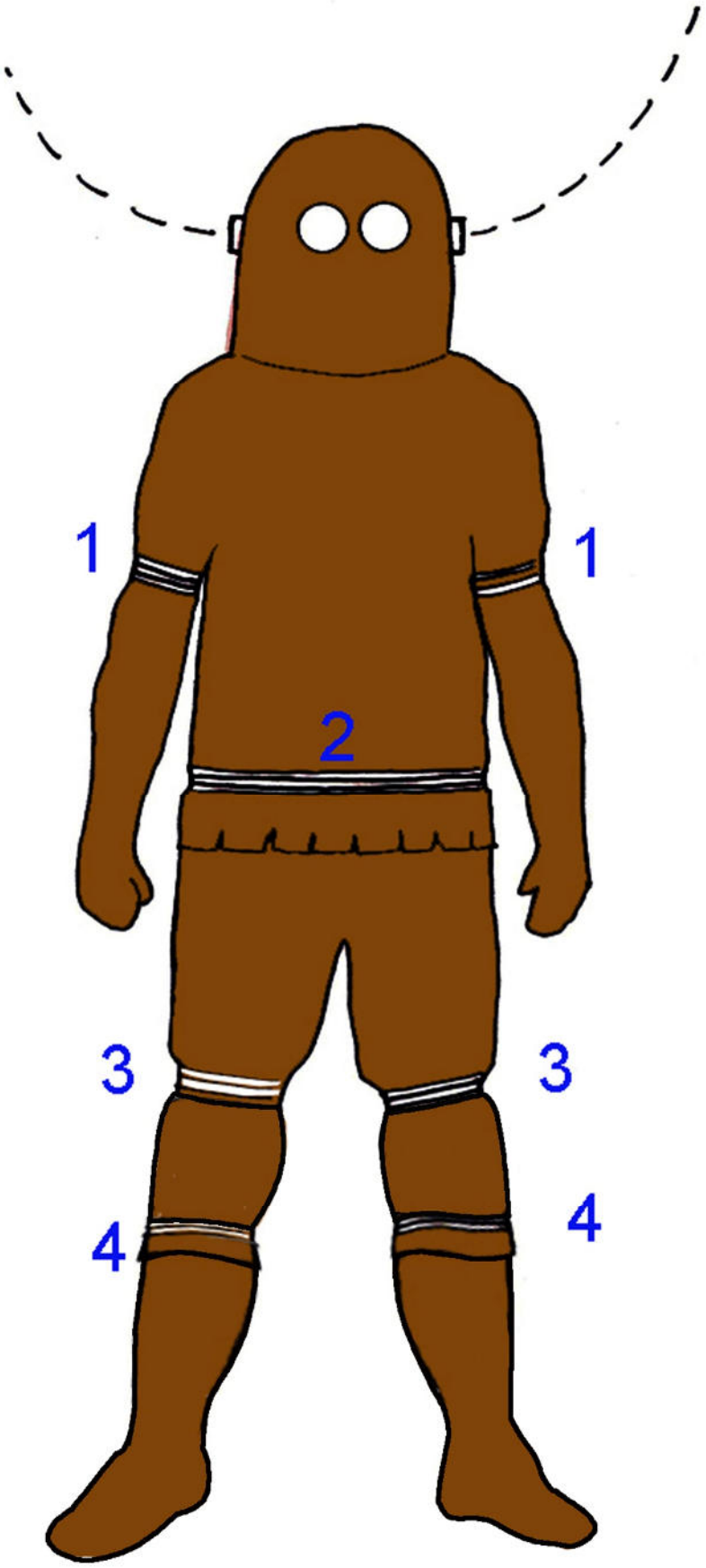
1) top part, head and shoulder cover

2) middle part, upper body cover

3) lower part, lower body and leg part



Peter Kreeft may have built his suit in the same way. However, his incompressible structure was not made of galvanized sheet metal, but of a metal bar framework. The helmet can be smaller than Klingert's to save buoyancy. Between the middle and lower part, a thimble is attached.



Would it all work that way? Anyway, the man in the rowboat can now use the big bellows and listen to the diver breathing.

Against the incompressible structure there are the following arguments:

- No indication in the text of the eye witness report.

- *Some thin bars* as written in the report would not resist water pressure.

- No representation of an incompressible structure in the drawings.

- No sealing cuffs on the upper arms and legs.

- The large window of 20 - 22 cm in diameter would not have resisted water pressure, certainly not in a depth of *20 fathoms*.

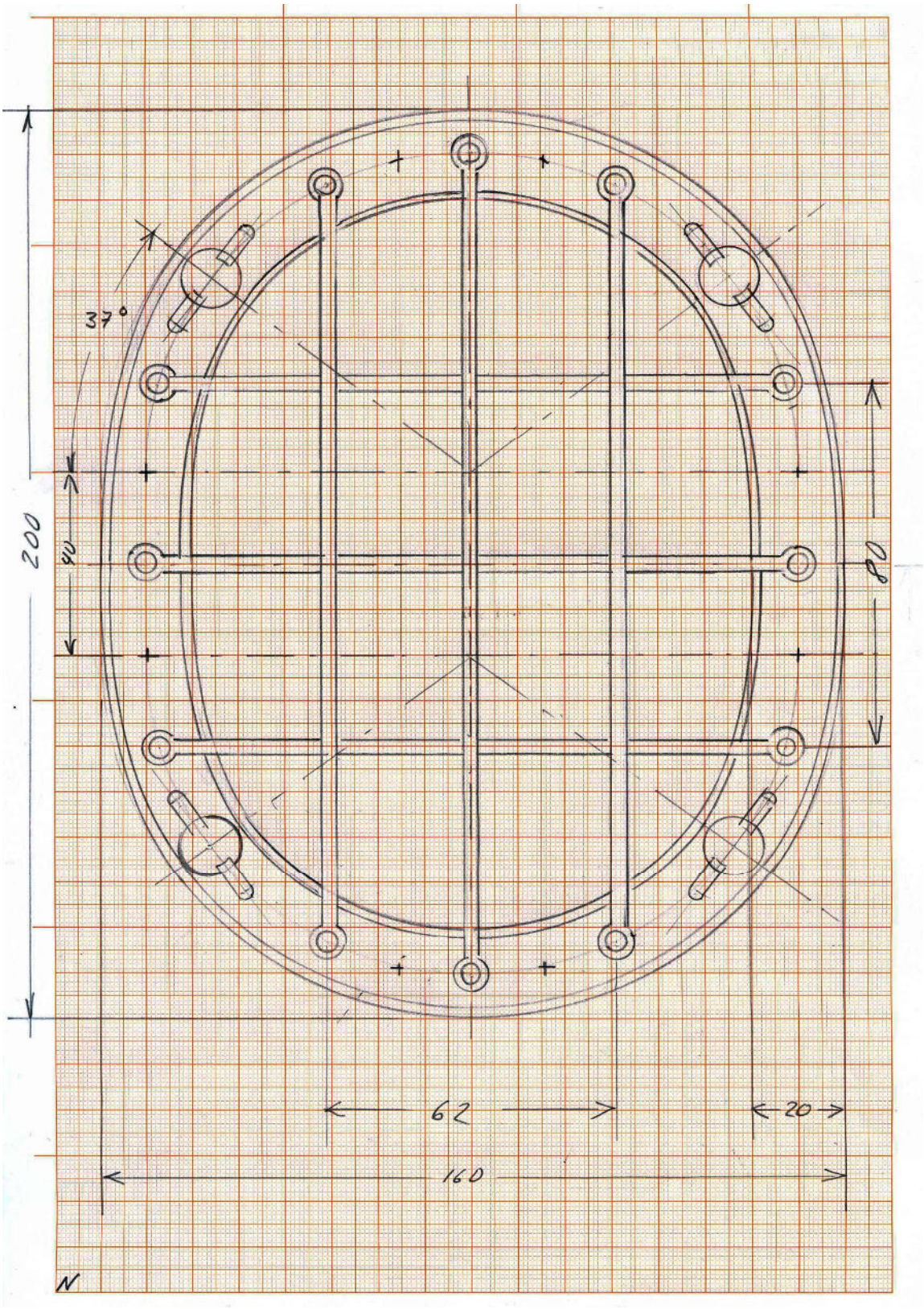
- No framework mentioned in the Bethell patent.

- Diaphragm-sealed voice tube in the Bethell construction.

- Compressed air supply according to the depth in the Bethell setup.

How the suit was actually built, whether with or without an inner framework will only be known for certain when further historical documents with a more detailed description can be found.

Helmet window construction

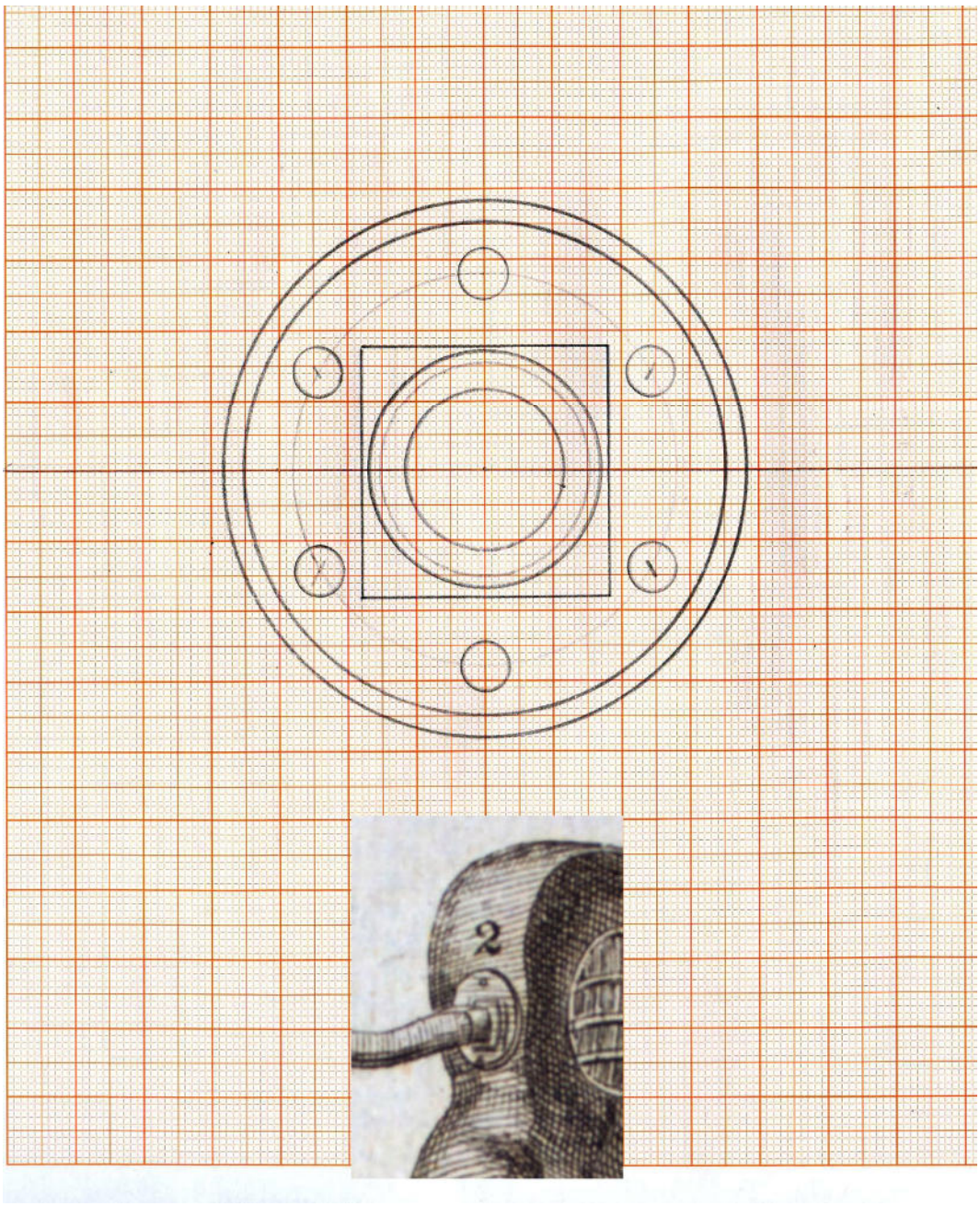


The window flange has been widened so that there is enough space for the grid attachment and the fixing screws. For safety reasons, the front window frame is detachable together with the window glass, 4 wing nuts must be removed.

Replica

Helmet with two hose connections, window and air outlet.

Hose connections construction

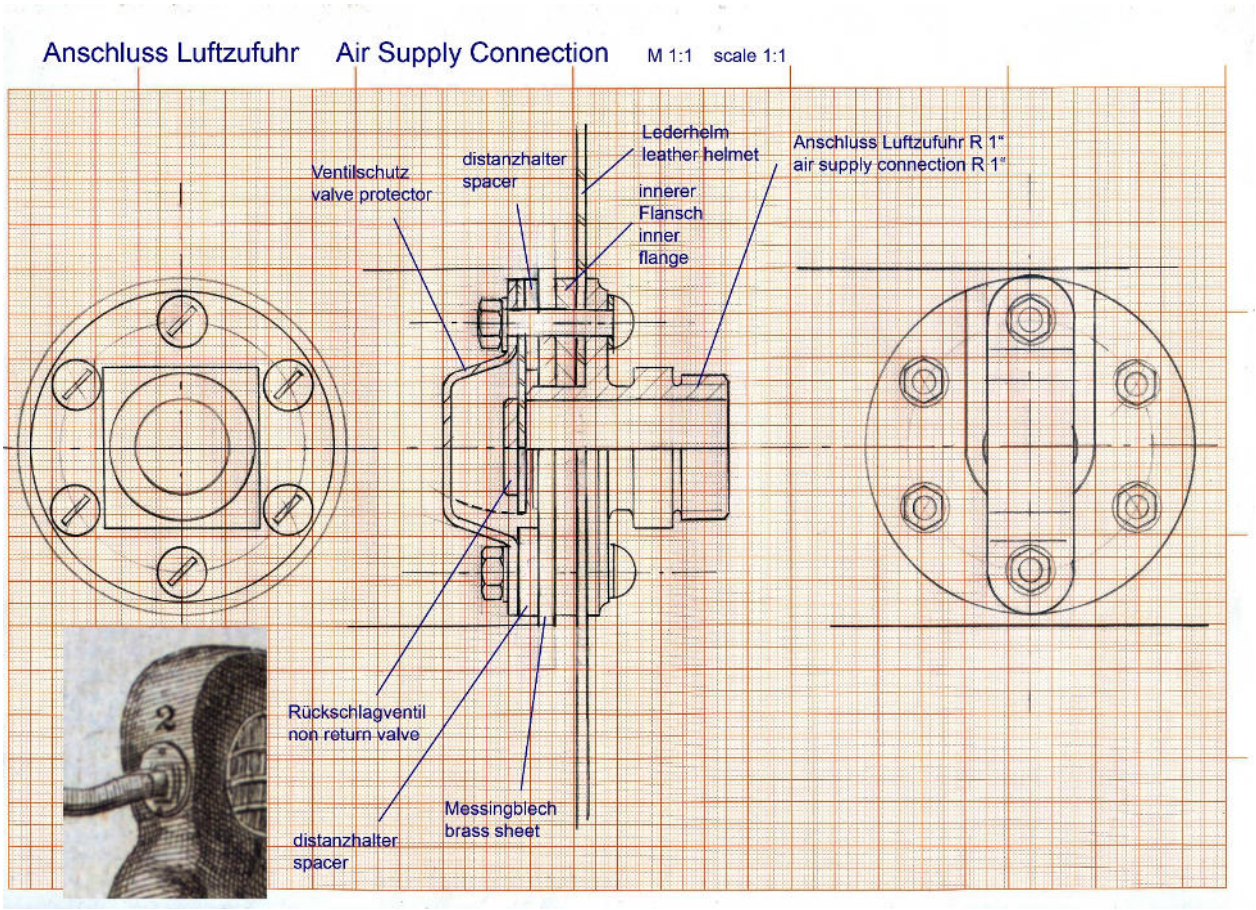


Exterior view

Replica

Hose connection on the helmet with a spiral of 2.5 mm brass wire as bend relief.

Air supply hose connection details

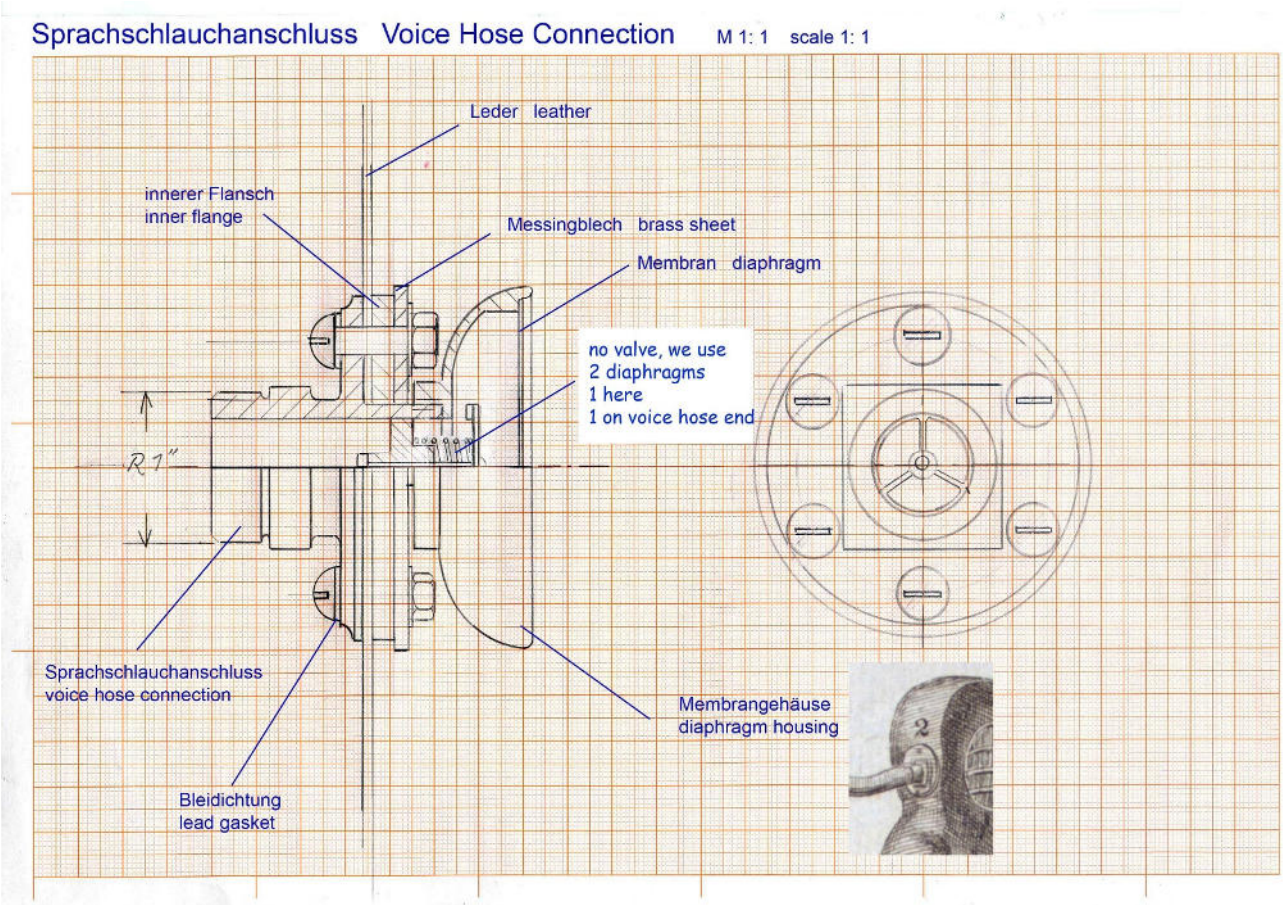


For safety reasons, we have provided a leather flap valve in the helmet. We do not know whether Peter Kreeft had done this. A one-way valve was probably only on the bellows. He certainly was not aware of the danger of pressure loss at that time. Only after a few decades did sudden decompression, the ‘squeeze’ become a known danger.

Replica

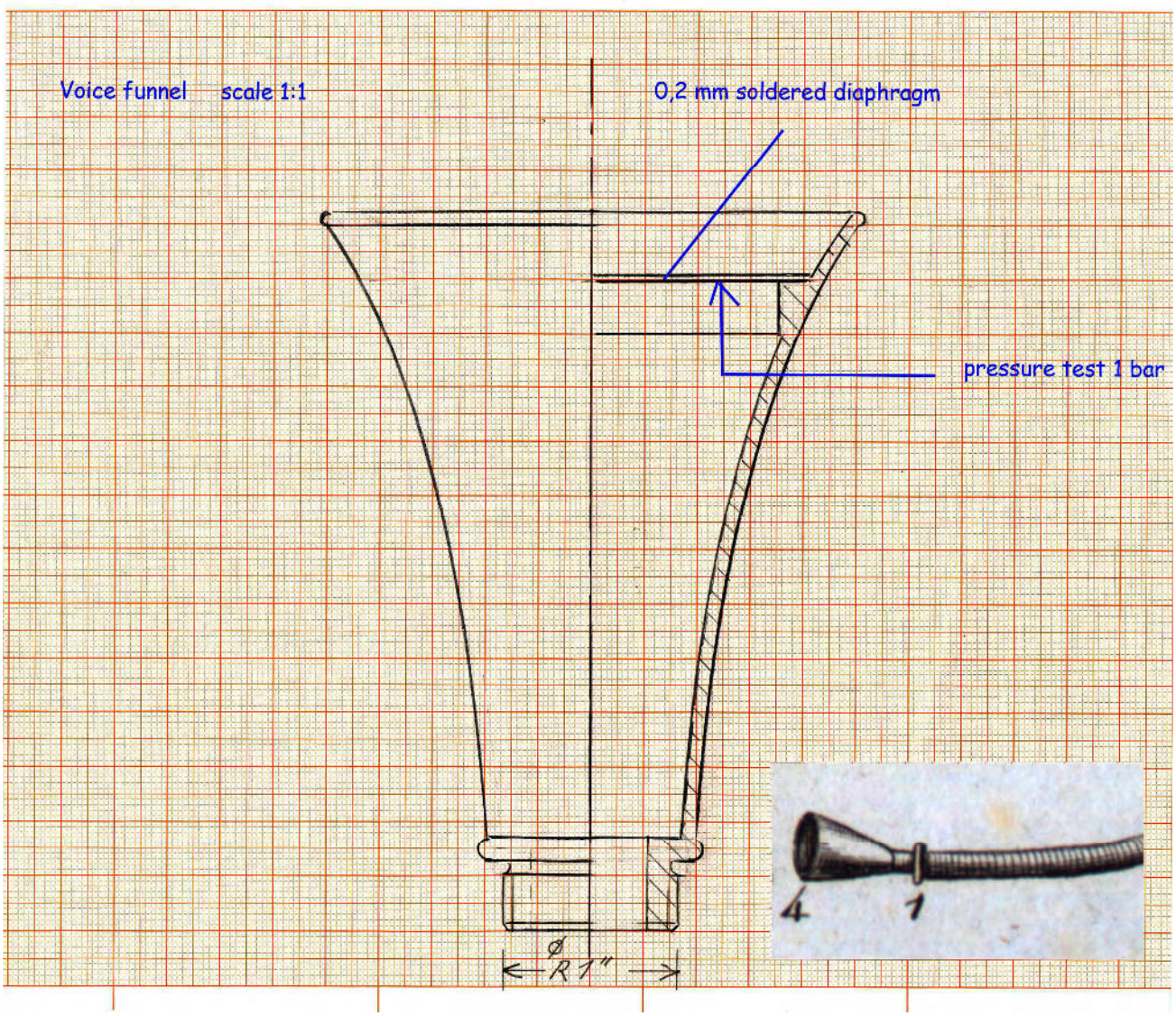
View on the air intake in the helmet with one-way valve. The simple leather flap valve works perfectly. This is of course dependent on position.

Voice hose connection construction



From the patent of John Bethel we know that in the helmet a membrane was installed to prevent pressure loss.

Over water speech tube construction



For safety reasons, a second membrane, in addition to that in the helmet, is installed.

Replica

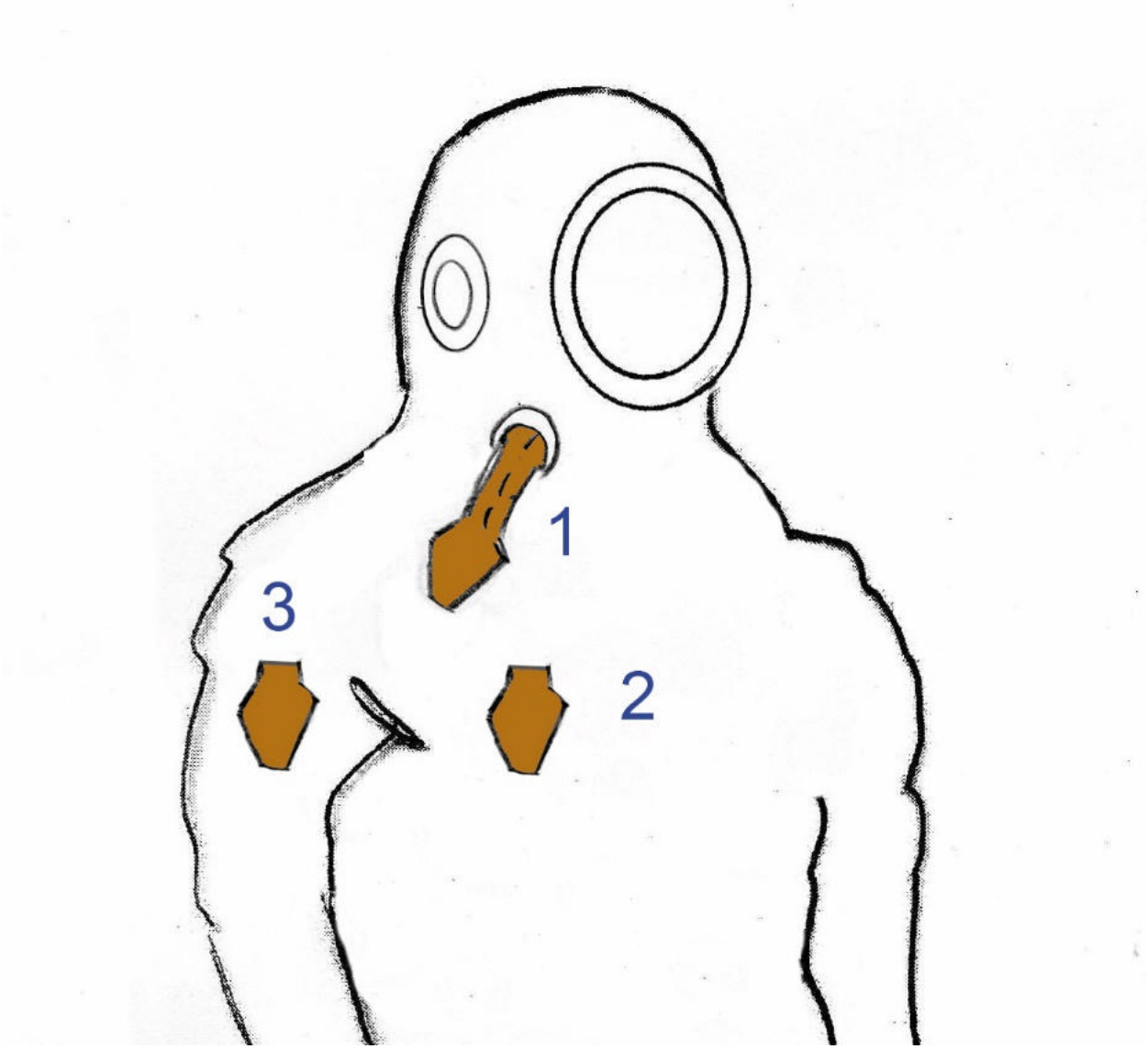
The voice or speech tubes, on the left for above water, on the right a smaller one for installation in the helmet. The membranes are cut from 0.2 mm sheet brass and soldered. Both tubes have been pressure tested..

In order to protect the sensitive membranes from damage during use, they have been covered with perforated sheets. In behind the front flange of the helmet window with protective grid.

The perforated plates can be removed for the exhibition in the museum. The problem with the sensitive membranes may have caused Peter Kreeft some headaches. Maybe he covered them in a similarly simple way.

Helmet, view inside onto the voice tube

Air deflation/outlet



There are no indications either on the illustrations or in the eye witness account. We have worked out three possible solutions:

1) Hanging hose below the helmet
The principle is described in Bethel's patent.

2) Beak valve at chest level

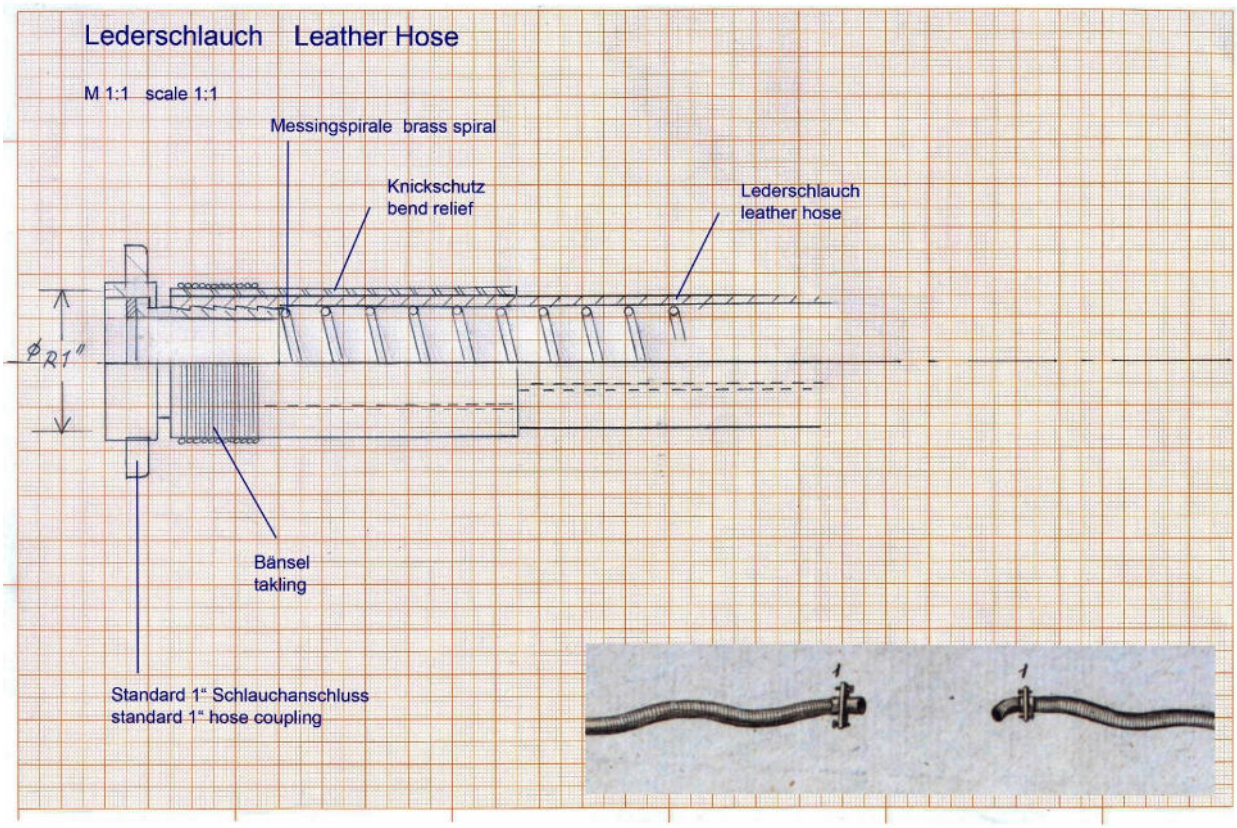
3) Beak valve on the forearm at chest height.

Replica

We have two different lengths to choose from. This enables us to control the volume of air in the upper suit. The leather duck bill valves work fine.

Air outlet hanging hose with duckbill

Hoses construction



Our construction corresponds to the historical sources. At the ends of the hose an additional buckling protection made of leather is attached. We have not found out how around 1800 screwed hose connections could have looked. We therefore use commercially available connections from a hardware store. Should we one day find authentic representations, the connections can be exchanged. Because of the low pressure, we decided for an inner hose diameter of 1 inch to ensure a good air passage.

Replica

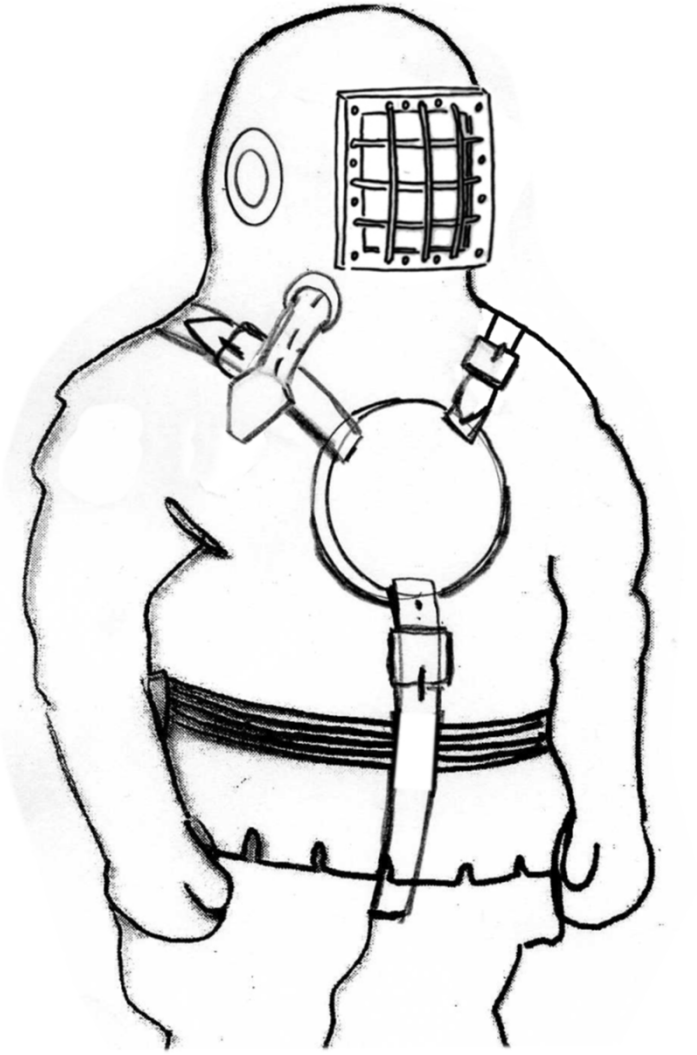
Leather hose with over water voice tube.

Leather hose with over water voice tube

Weights

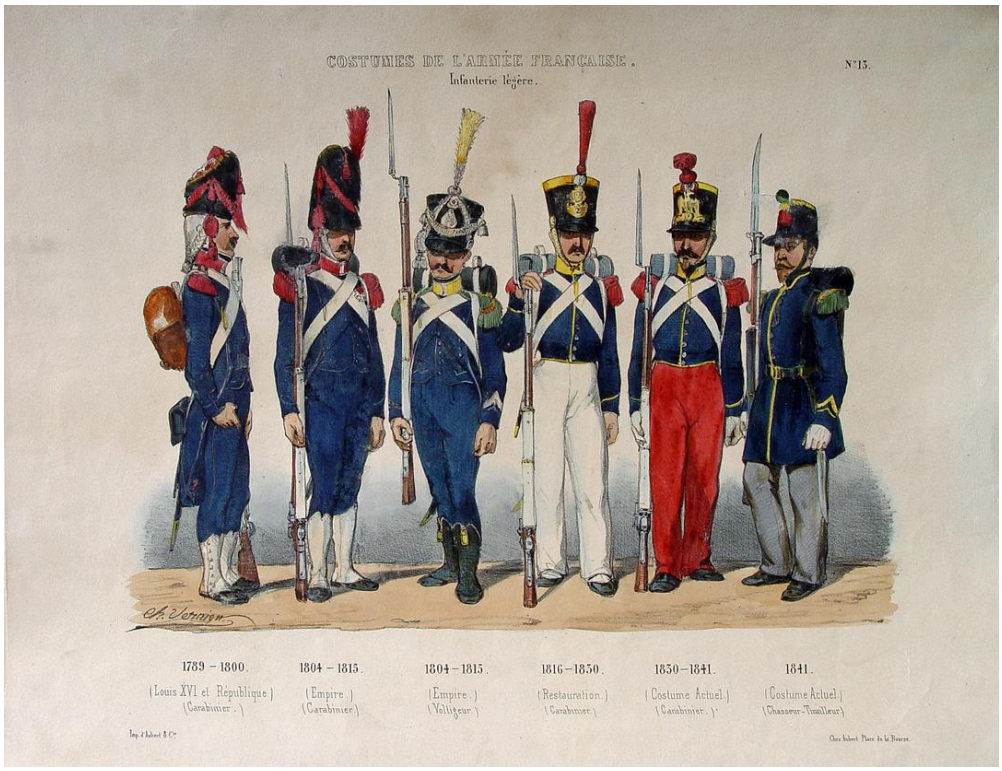
The diver was festooned with weights. How this was done in detail can neither be seen in the drawings nor in the eye witness account. There is no indication how these were constructed. We devised two different possibilities. Both are plausible, could come from the period and fulfill their purpose.

Harness in Y-shape

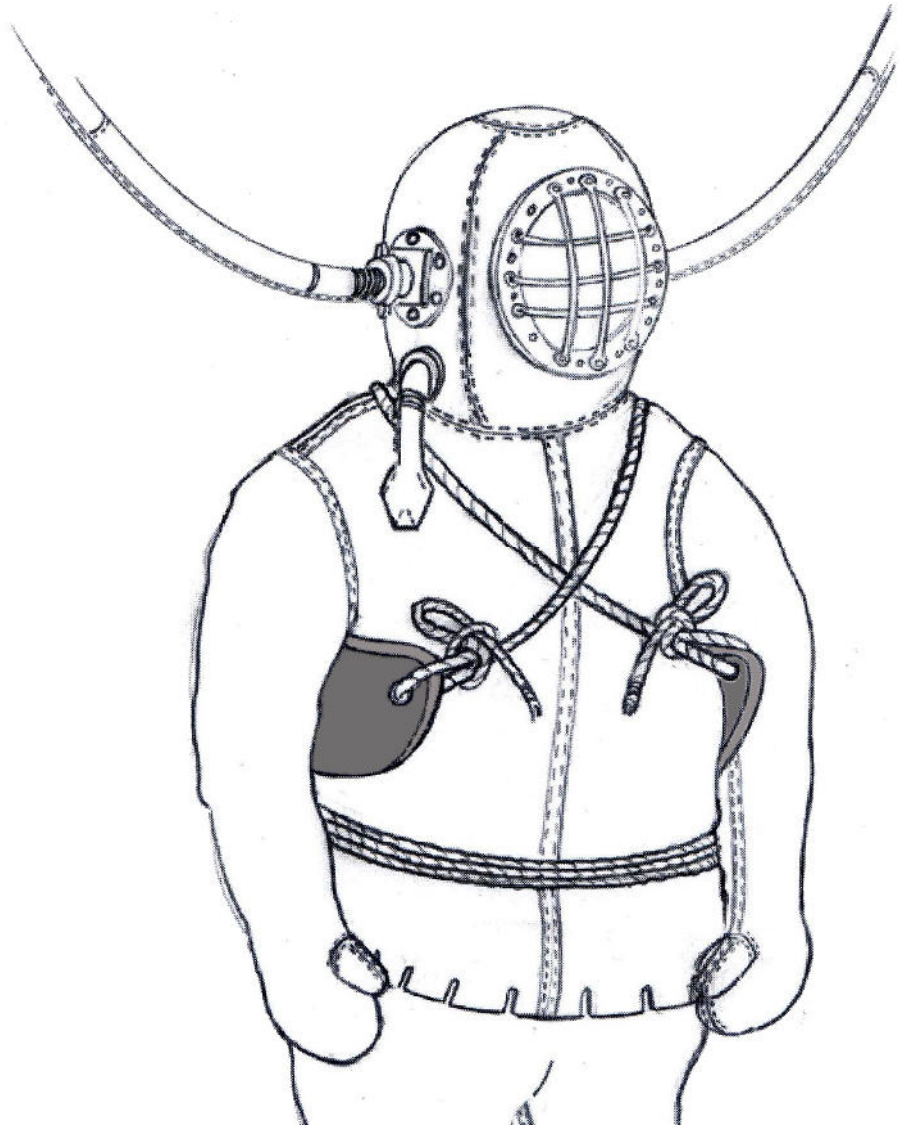


This construction has the advantage that the weights sit close up to the helmet, just as usual helmet diving chest and back weights. In addition, a crotch strap is available. A similar arrangement can be seen in the Bethell patent its weights are rectangular.

Harness in X-shape



Around 1800 soldiers carried their ammunition pockets on straps crossed over the chest to the side of the left and right at waist height.

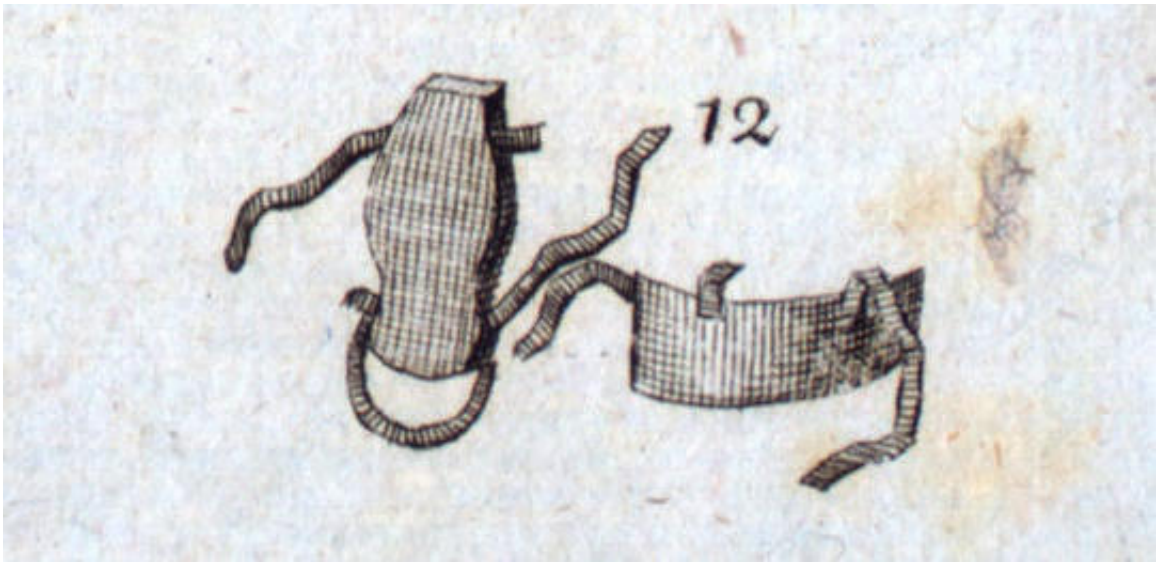


We decided for the X-shape arrangement using ropes to attach the weights. It has also been used by Deane, Rouquayrol-Denayrouze and Bikkers.

Weights replica

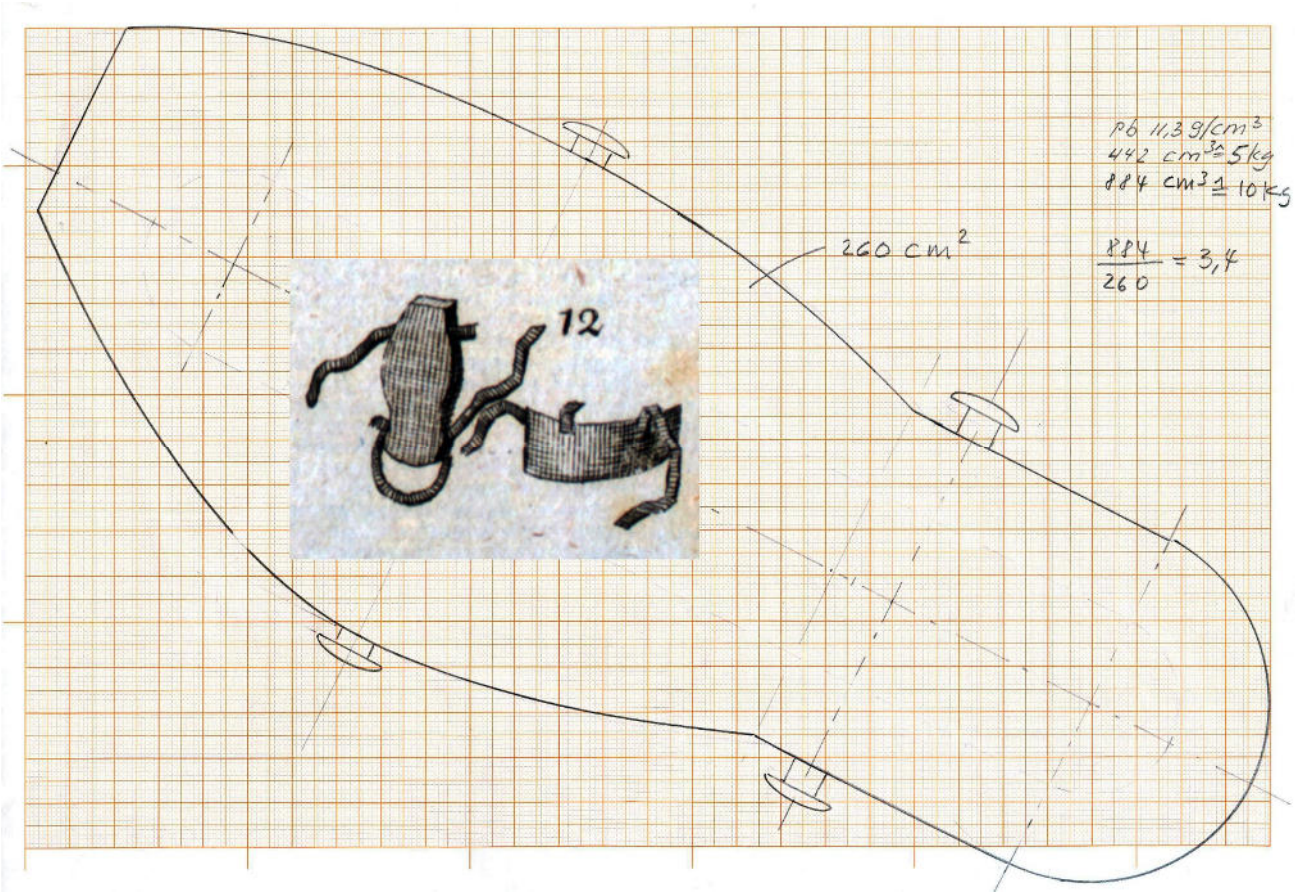
The weights have not been made up to now. We have to find out how heavy they must be during the next test dive.

Lead-soled sandals



They have thick convex curved lead soles, concave foot surfaces, foot fastening straps.
It is noticeable that the lead soles are very thick, in the middle almost half as long. With an assumed foot length of 30 cm, the sole would be between 10 and 15 cm thick and would weigh up to 20 or 25 kg, much too heavy for walking.
It was discussed whether the arched shoe bottoms could have been better under water on stony sea bed. That would have to be tried. On a rolling boat they would certainly be a disadvantage when walking.

Lead sandals construction



Our design is largely based on the historical representations. Each sandal will weigh 10 kg.

Replica

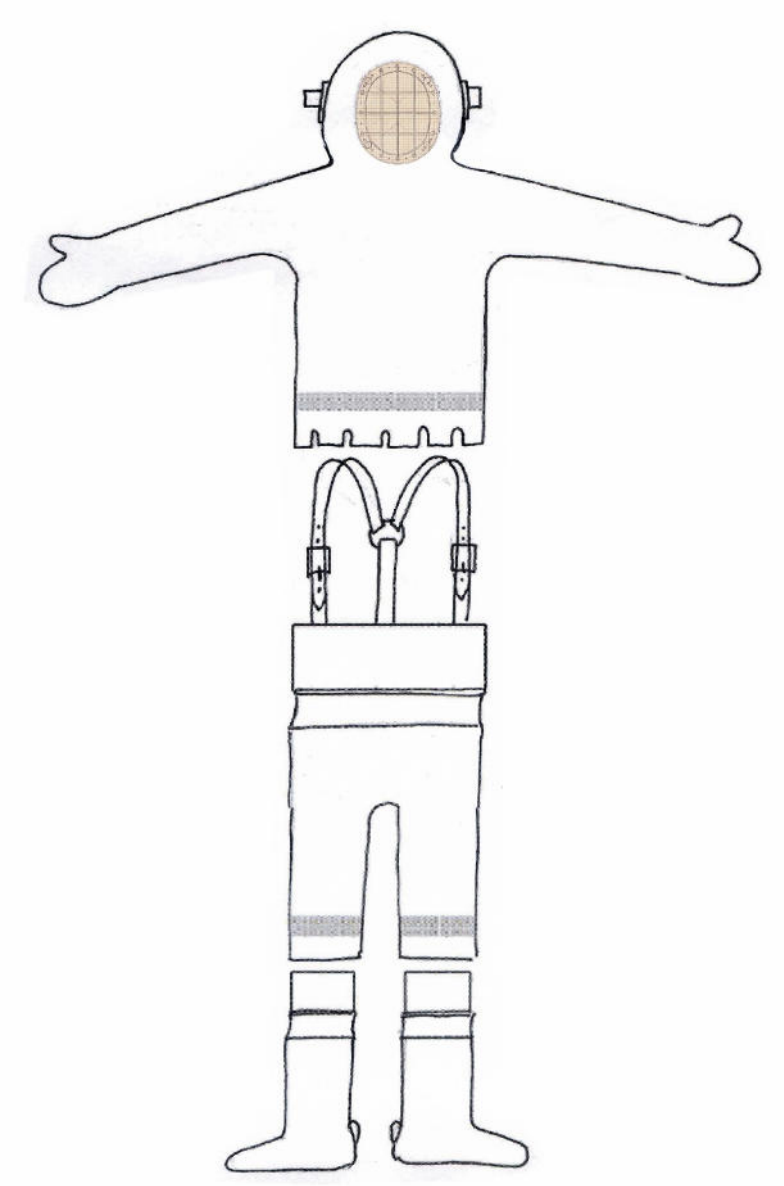
Lead sandals with leather straps and brass buckles

Lead sandal fixed to the diver’s foot

Jacket with helmet, trousers and boots

The jacket is in one piece with attached helmet, sleeves and gloves. The pants reach below the knees. There are built-in round thimbles at the waist and below the knees. to connect the single parts with each other. The connections are tightened and sealed around the outside by several strained thin ropes. The suit is cut very tight. Leather is not stretchy, as shown, you could not put it on or take off again.

The leather diving suit construction



Jacket with attached helmet and gloves, not too tightly cut.
Trousers reaching up to the chest with belly thimble and suspenders.
Boots with thimbles, reaching up over the knee (water catch).

Replica

The thimbles have been made of copper, forged by hand.

Isabella, presenting the trousers and boots.

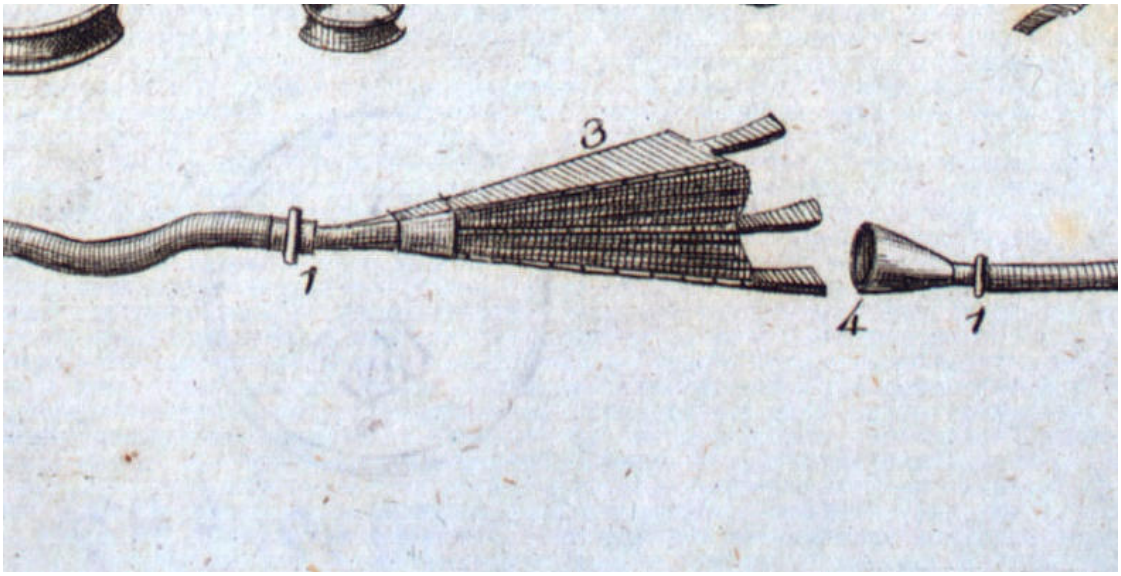
Our member Uwe Gläser in a complete suit, only the underarm weights are missing. The air outlet in the picture is too long, has meanwhile been shortened.

I would like to take a dive with this gear!

Bellows

There are two completely different representations, one large and almost circular, the other small and triangular.

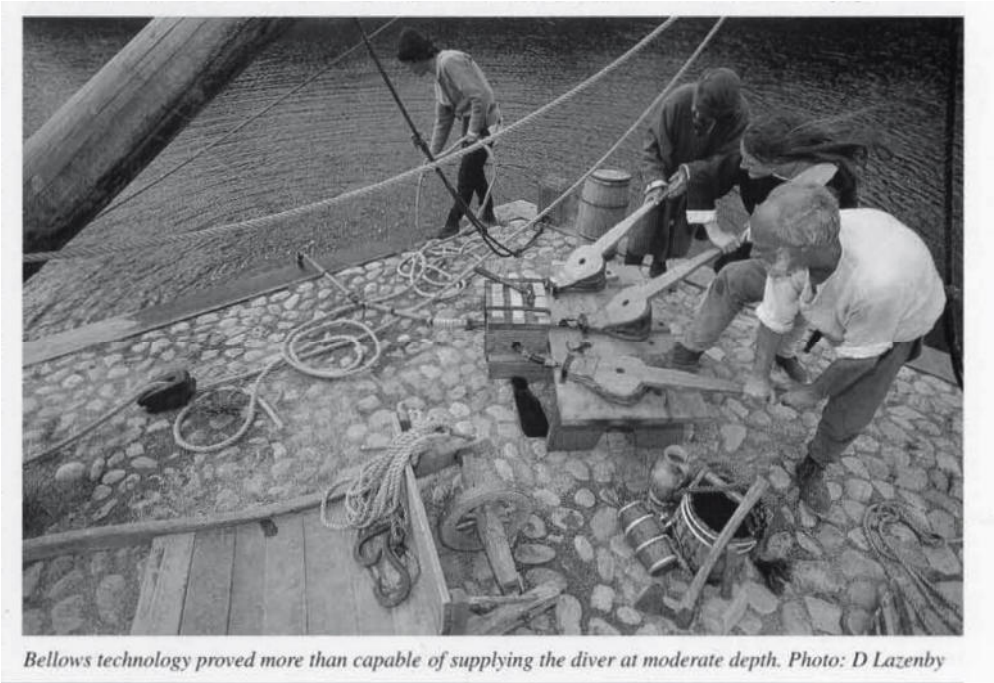
The bellows seen on the rowing boat is far too large. In order to produce a pressure of 0.8 bar for 8 meters diving depth, it would have had to be compressed with almost a ton. Such a large bellow could only have been used in combination with an incompressible framework.



The second bellows would be in the right size to deliver a pressure of 0,8 bar, but the levers are much too short.

Bellows construction

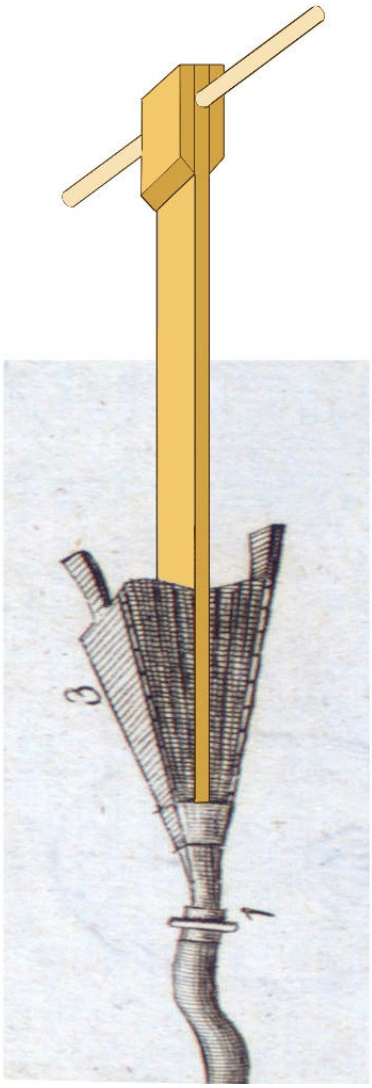
We have developed our construction by learning from the experiences of others.



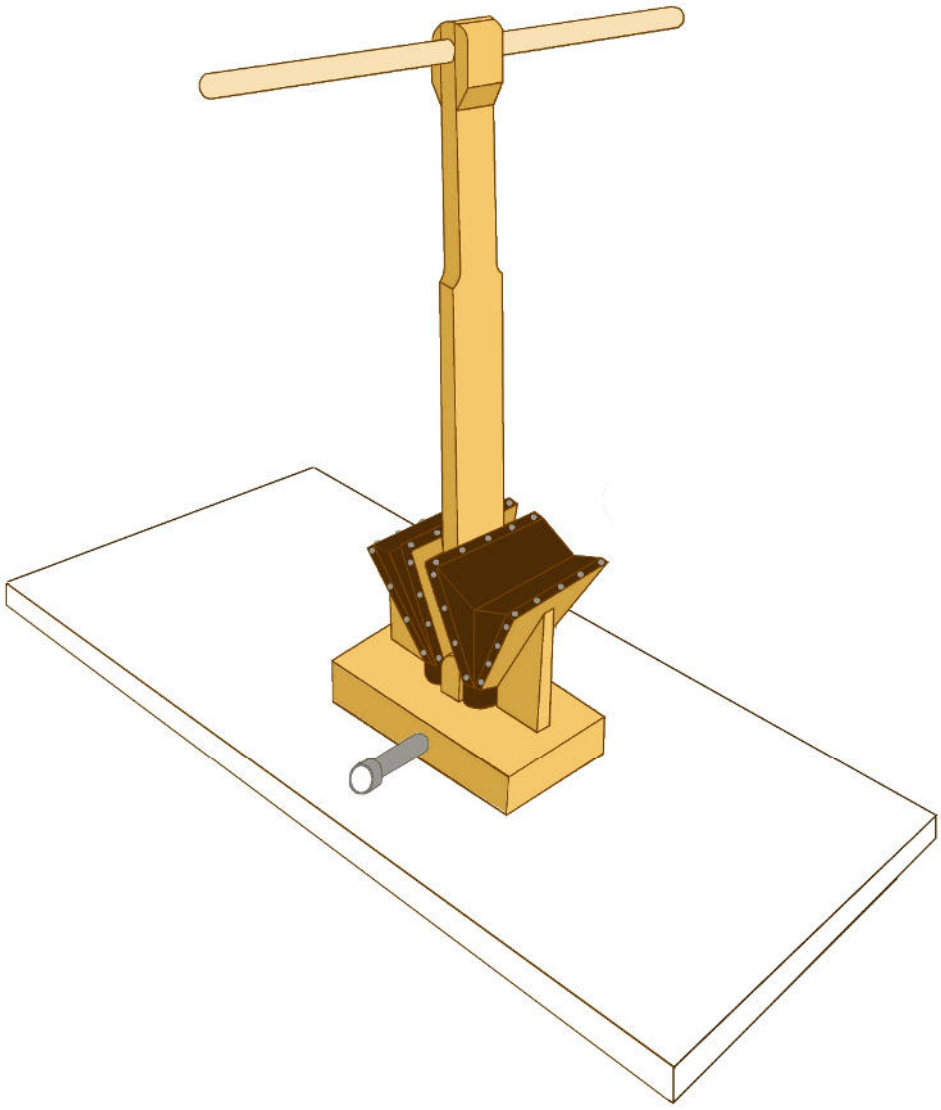
Bellows technology proved more than capable of supplying the diver at moderate depth. Photo: D Lazenby

The Danish museum “Middle Age Centre” had done a similar reconstruction in 1998. They had used three small bellows with longer levers mounted on a rack near the floor. Their operation was exhausting after a quarter of an hour.

Bellows construction



Bellow from Tab 2 in upright position with a longer lever.

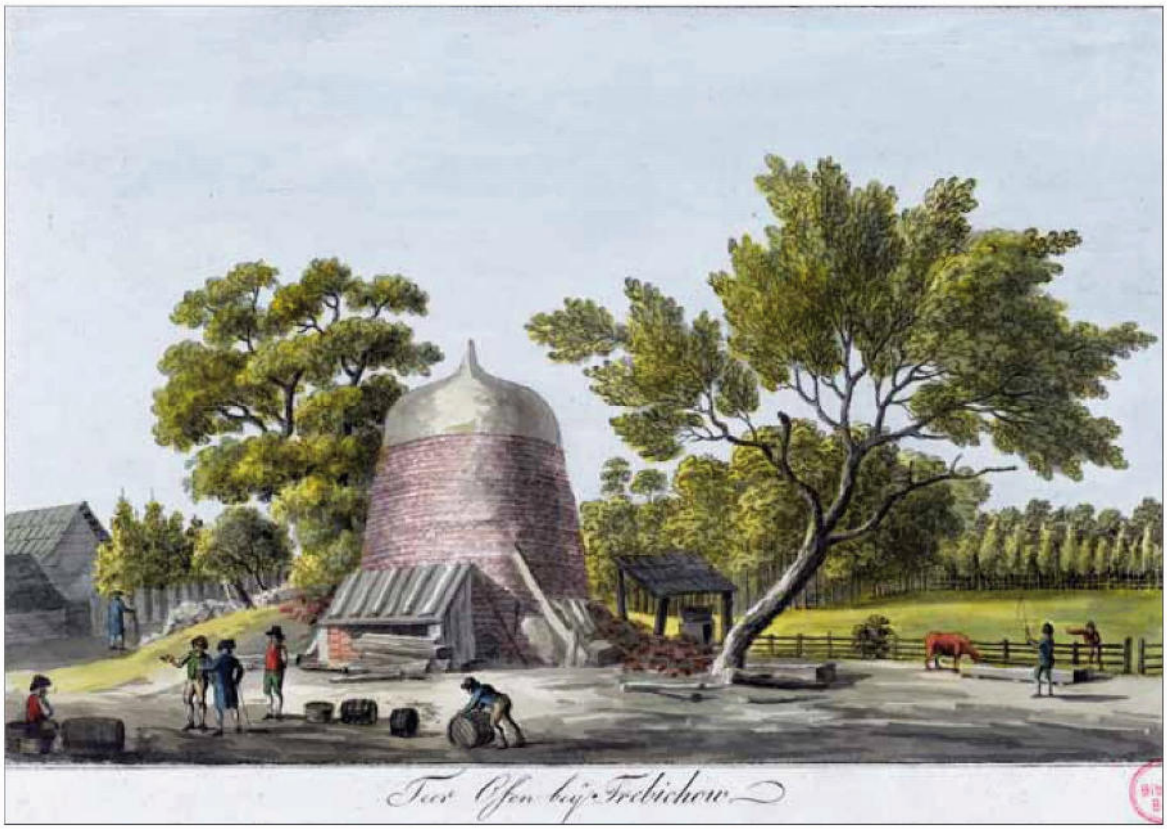


In a standing position, mounted on a rack, the bellows can be operated by two persons for a longer time.

Both bellows have only one fold, reinforced from the inside with wooden sheet and horse-tendons.

Air delivery 40 liters per minute at a pressure of 0.8 bar. Maximum leverage 10kg.

Next steps

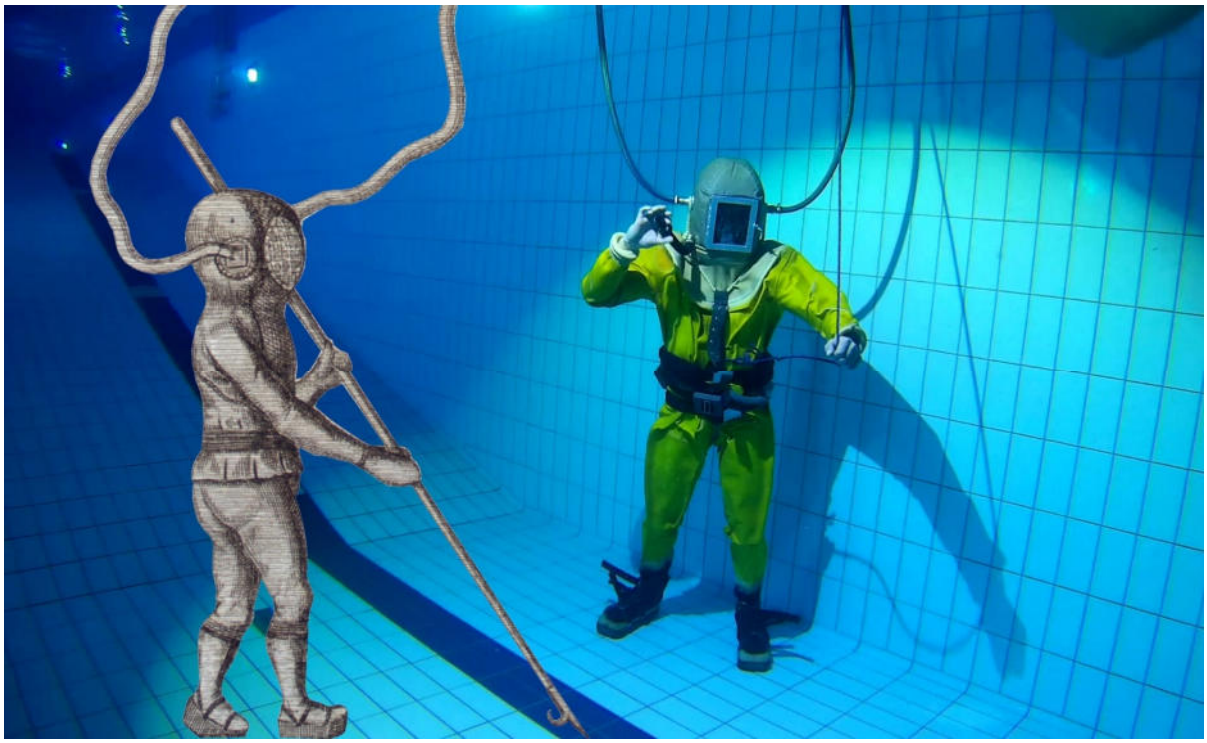


Historic tar furnace in Saxony Germany [3]

The suit and hoses will be impregnated and sealed in the next few weeks in Stralsund with authentic pitch and fat blends. Thereafter an immersion test will be carried out in a pool. Then followed by dives in the Baltic Sea next year.

The meaning of the replica

The invention of a well-functioning diving helmet with air supply from the surface is attributed to Charles and John Deane in England around 1830. Three decades before, a similar kind of diving gear was constructed in Barth by Peter Kreeft.



Our test diver down at 3.8 meters under water
Foto: Michael Müller

The replica also has a personal meaning for us. We all have learned very much and now have a sense of how to interpret historical representations and texts. The veil of 200 years has become more transparent for us.

Our special thanks go to:

For assistance on research and technical advice:
Historical Diving Society Denmark, Sven Eric Jorgensen
Historical Diving Society England, John Bevan, Peter Dick, Michael Fardell, Nigel Phillips and Richard Walsby.

Maritime Museum Stralsund
Dr. Thomas Förster www.meeresmuseum.de

Historical Diving Society Germany, Team Kreeft
Ulf Barthel, Norbert Gierschner, Uwe Gläser, Josef Helpenstein, Christian Horn, Gottfried Keindl, Volker Lekies, Michael Müller, Hans Joachim Richter and Franz Rothbrust

As well as Jörg Böttcher, documentary filmmaker, and the helpful team at the test dive in Leipzig.

Sources:

[1] Michael Jung: DER MEERESGRUNDWANDERER, Scheunenverlag, Kückenshagen, ISBN: 3-929370-65-4

[2] David Lazenby: FROM THE DEPTHS OF THE DARK AGE, The Historical Diving Times No. 23, 1998

[3] Carl Benjamin Schwarz, "Tar Furnace bey Trebichow" from the "Collection of some beautiful views of the Counts Finckensteinische goods located in Duchy of Crossen" circa 1793

All unmarked photographs and drawings are from the author.

Thank you for your attention!