

## Illustrated construction manual: The Steam Engine

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<https://michelswunderland.de/solderiron/steam.html>



The kit contains numerous individual parts.



Basic equipment of adhesives and tools:

- Solvent-based adhesive for most bonding applications
- 2-component adhesive Stabilit, gap-filling
- Steel ruler - for measuring and guiding the craft knife
- Needle nose pliers
- Scissors - a decent pair !
- Key file and 600 grit sandpaper - to work on hardened glues on open edges
- Sharp craft knife
- Tweezers for handling small parts
- Drill - instead of dubious instruments for creating holes
- Cordless screwdriver - for the drill bits...

A temperature-resistant 2-component adhesive is required for the boiler, Stabilit cannot be used here.



Additional equipment of tools and aids:

- Weight for pressing adhesives
- Adhesive film - actually belongs above to the basic equipment
- Superglue for special cases...
- White lacquer, black felt-tip pen and gold lacquer pen for painting open edges
- Paper towel for instant removal of blobs...
- Toothpicks and needles for the targeted application of adhesives
- Spatula for large-scale spreading of glue (base plate)
- Clamp for pressing glue

## Stage A: The base plate



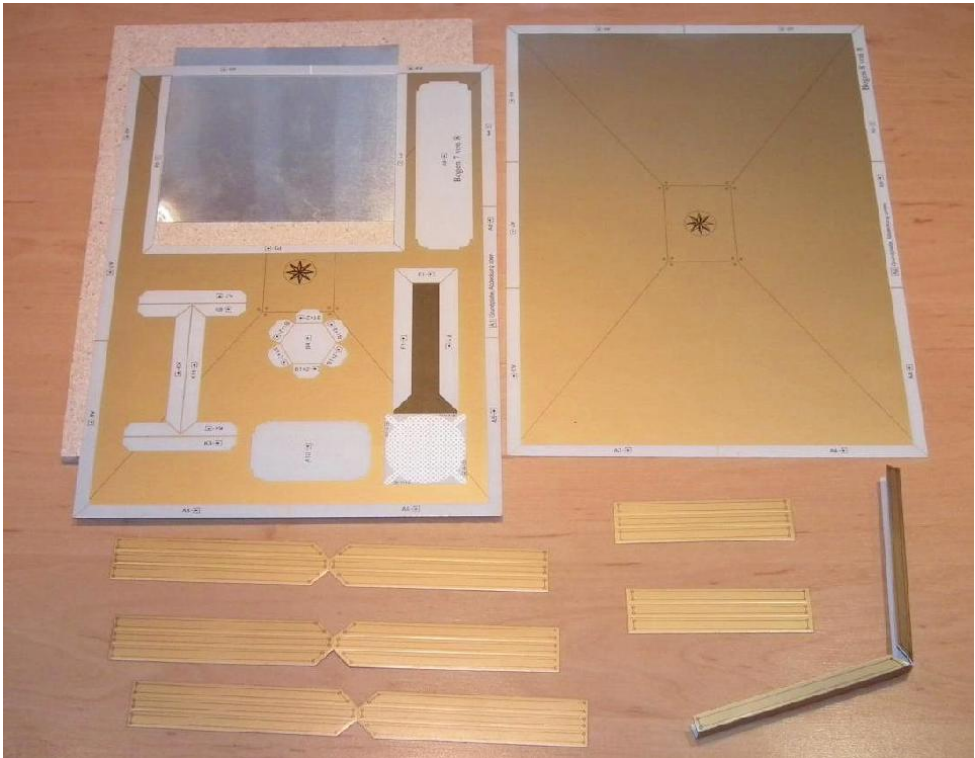
The white square must first be cut out of the top cover for the base plate. The easiest way to do this is to use a steel ruler and a sharp craft knife.



Fitting the aluminium sheet into the square cut-out of the top cover - mark and cut out.



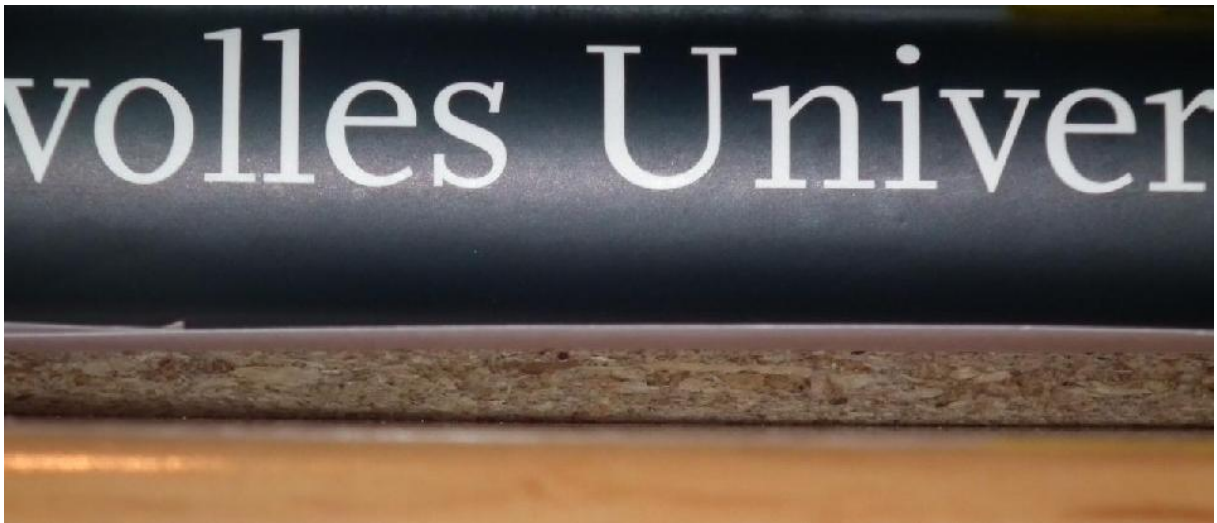
Folding the cardboard parts is particularly easy if you use a sharp edge to help you.



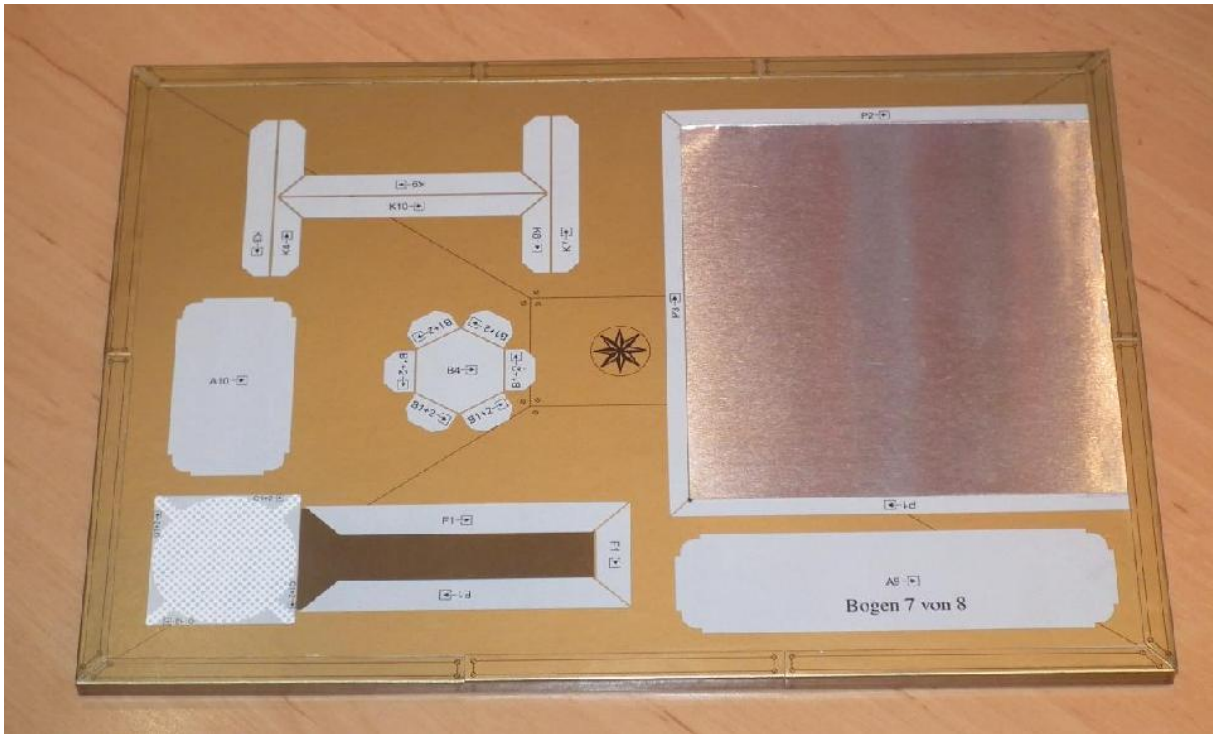
After folding the remaining edge trim, the parts are glued together according to the instructions. For the edge trim, superglue turned out to be the method of choice.



In order to achieve an even and plane bonding of the covers to the base plate, it is recommended to distribute the adhesive generously with a spatula.

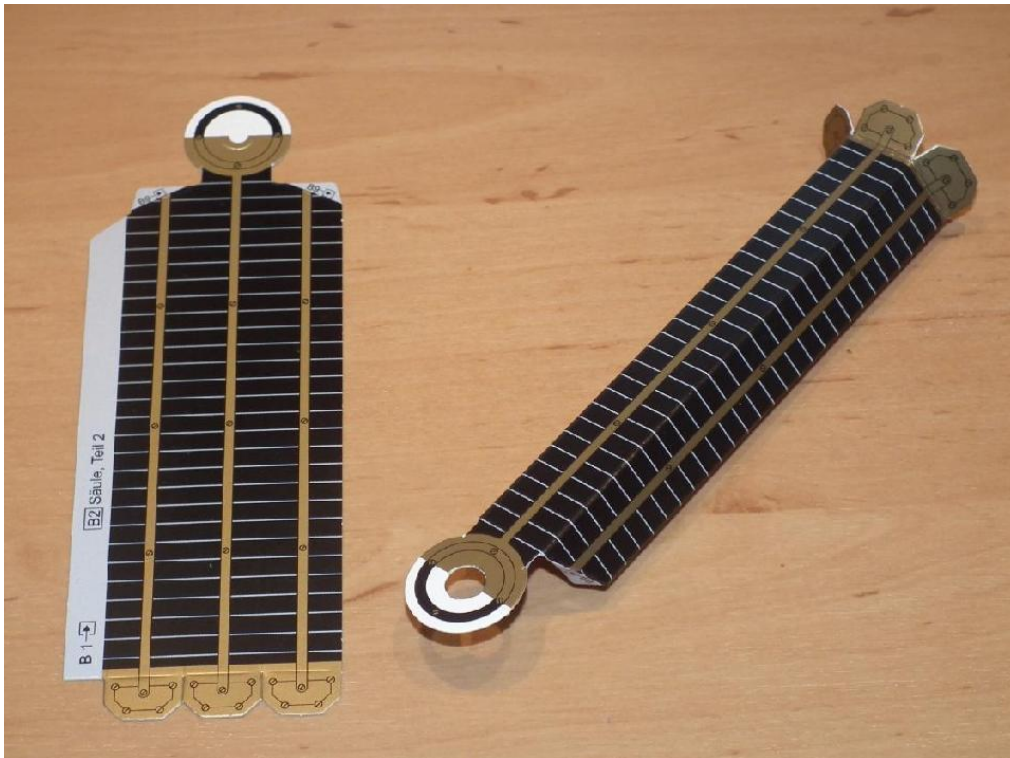


Pressing the glue between the covers and the base plate by means of a stack of books ensures an even, flat glue joint. A sheet of white paper between the books and the base plate protects the bottom book against possible adhesive leakage.

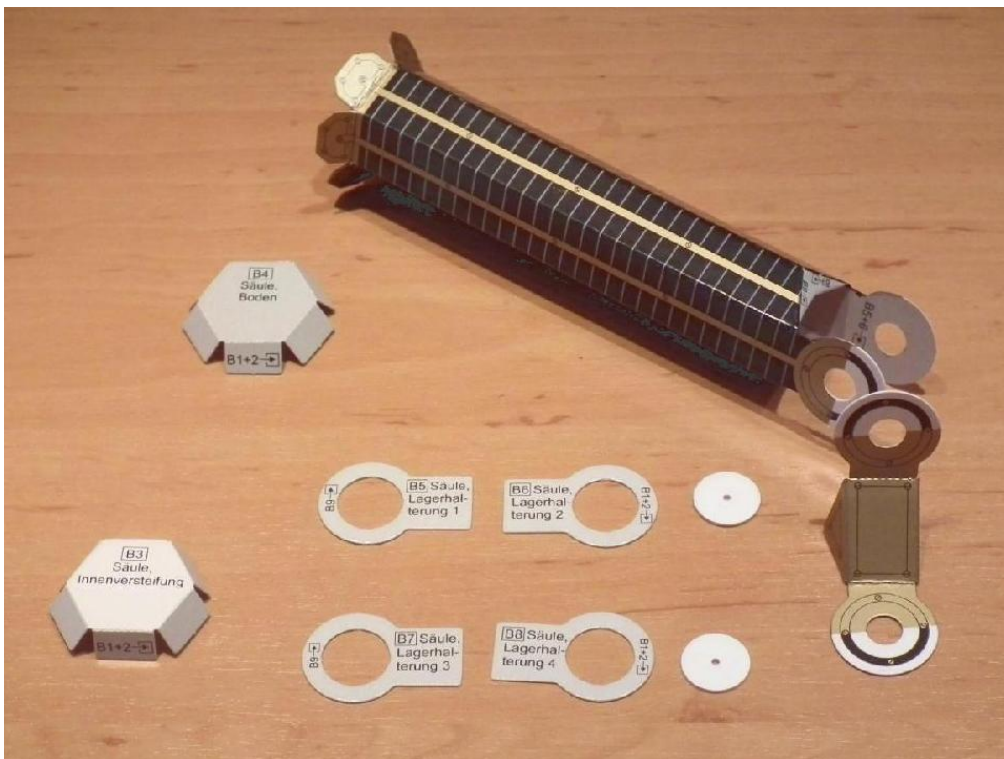


After the covers and the aluminium sheet have been glued to the base plate, the edge covers are glued on - and the base plate is finished.

## Stage B - The Pillar



Detached and folded - the main components of the column.



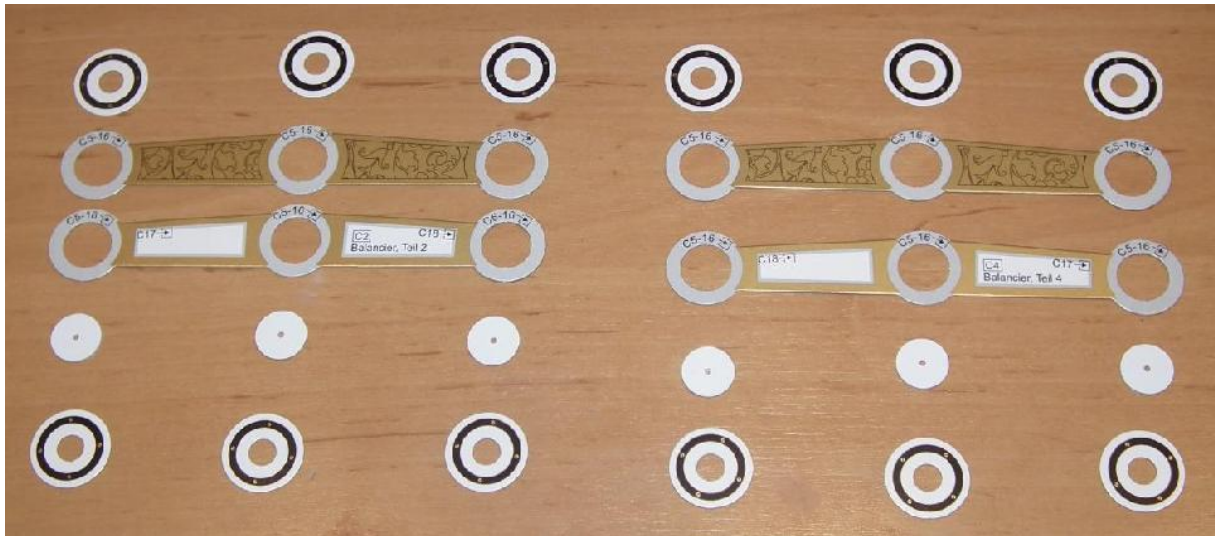
The column base, the stiffener and the bearing brackets are now glued together according to the instructions. The plastic bearing washers can optionally be fixed with superglue. Super glue is also recommended when fitting the cover (part B9).



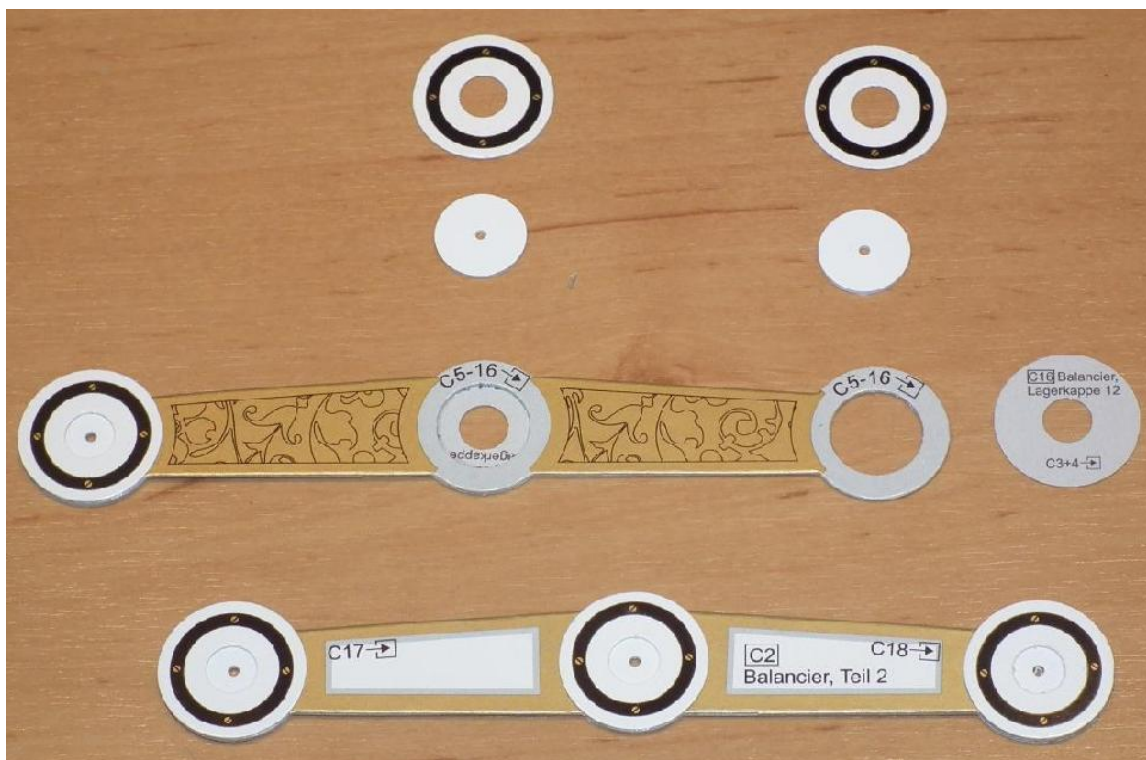


After assembling the column, its open cardboard edges were suitably coloured in with gold or white lacquer or with black felt-tip pen.

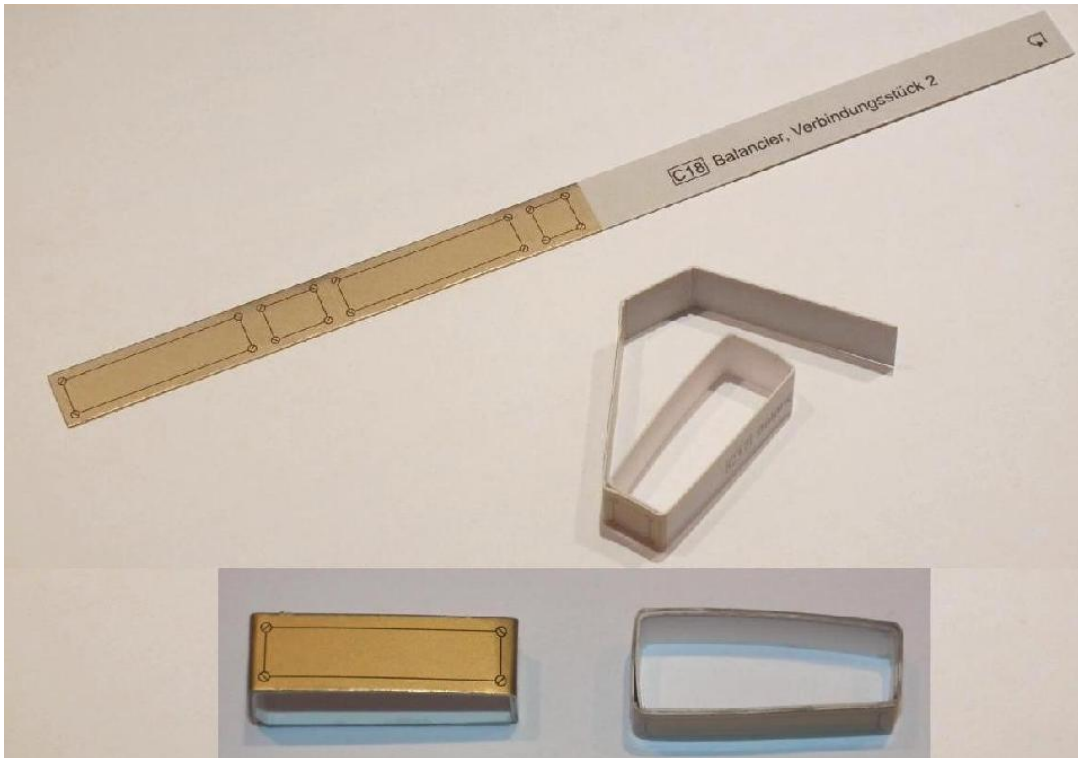
## Stage C - The Balancer



Assembling the balancer is quite easy when the parts are ready. The picture shows the parts needed in steps 12 and 13.



After joining the cheeks of the balancer, the bearing caps and bearing washers are installed (steps 12 and 13).



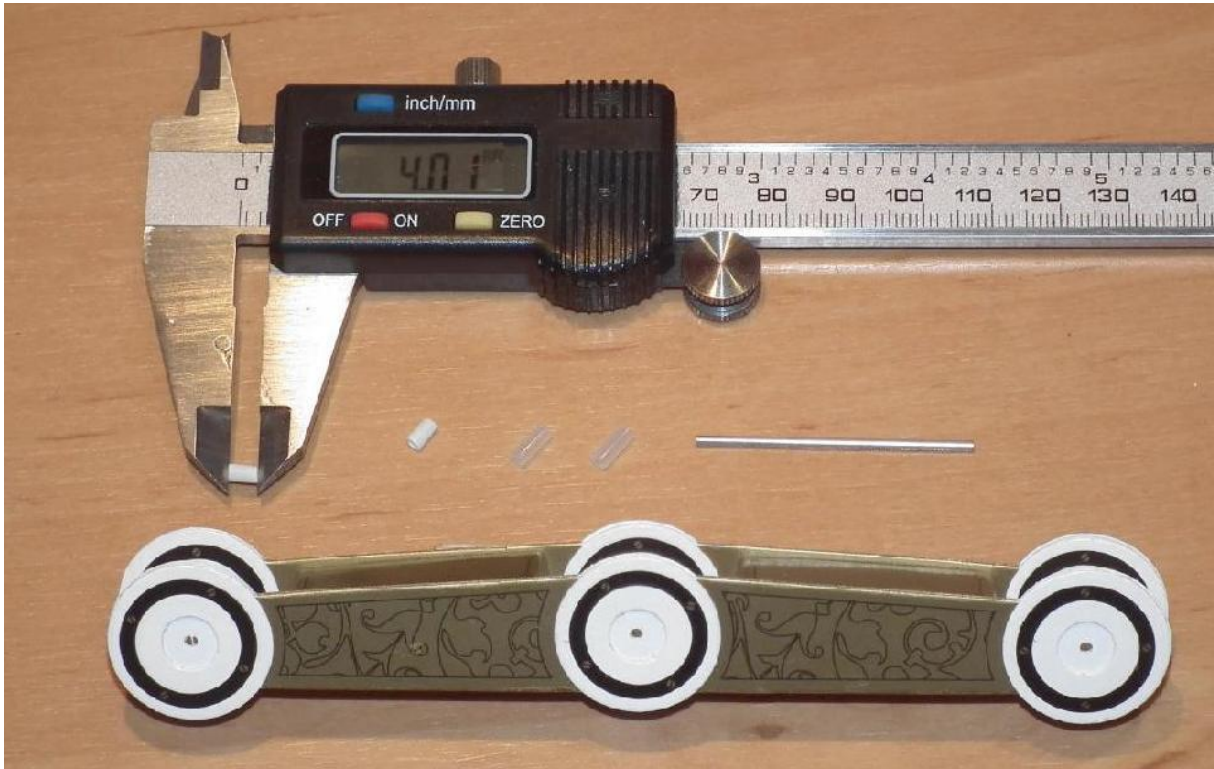
Superglue was used to make the joints according to step 14 of the assembly instructions.



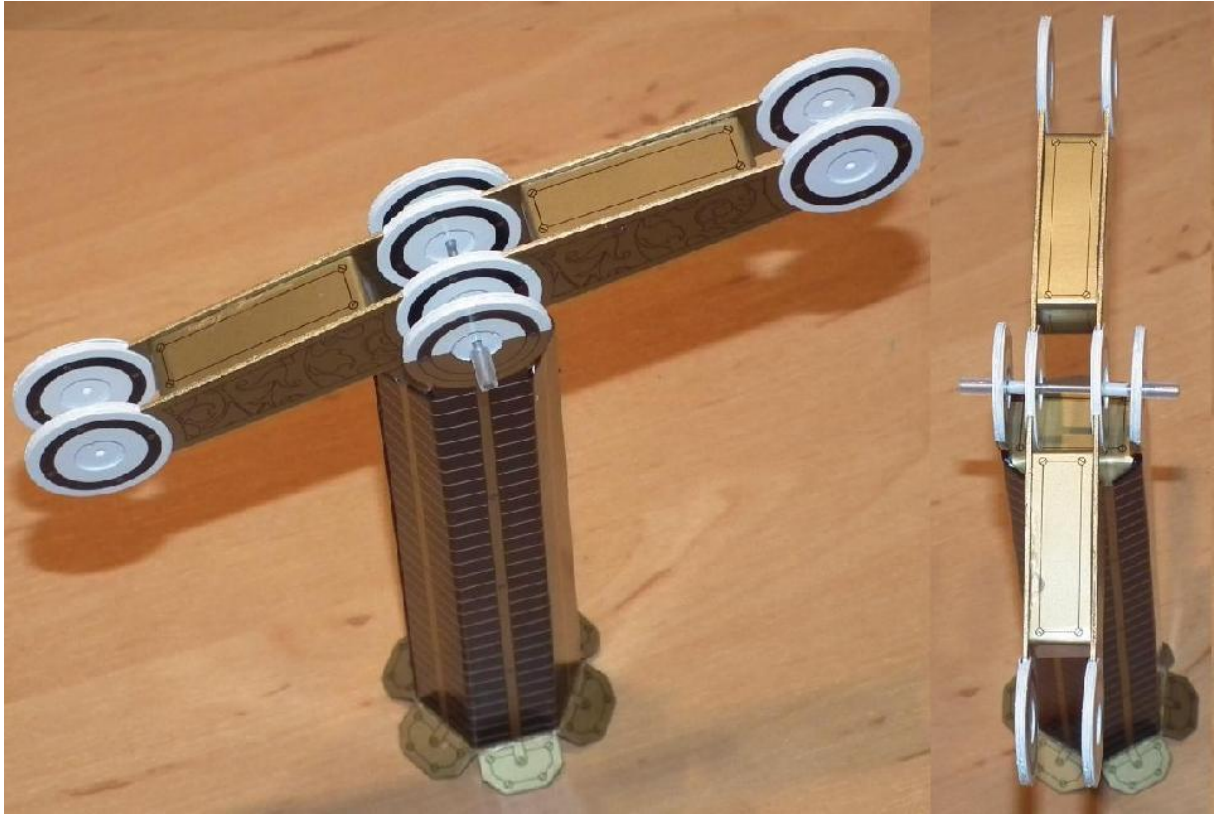
The bonding of the connectors to the stringers is described in step 15. The first fixation of the connecting pieces was done with superglue, a two-component glue ensures a firm connection.



The cheeks of the balancer must be aligned exactly with each other when glued to the connecting pieces to ensure that the axle bearings of the cheeks are aligned. A simple jig provides sufficient accuracy.

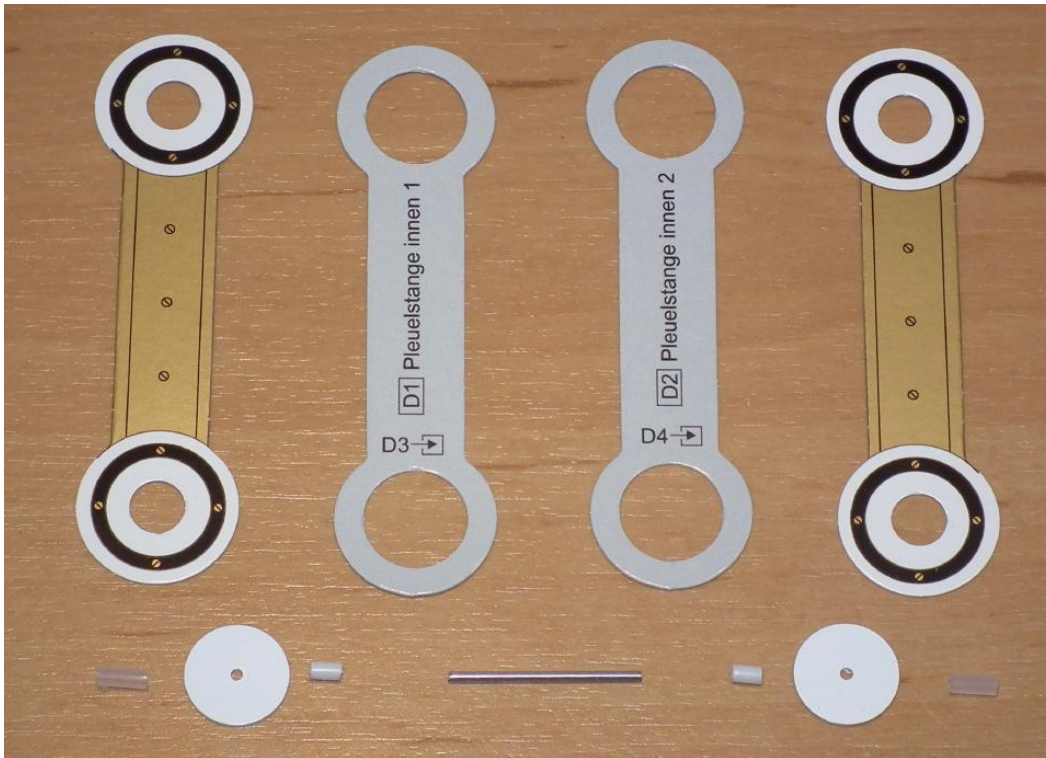


Step 16 - Make spacers from cut-off tube of a cotton swab (length 4mm) and locks from cut-off silicone tube (length 6mm). The axle is already included in the kit.

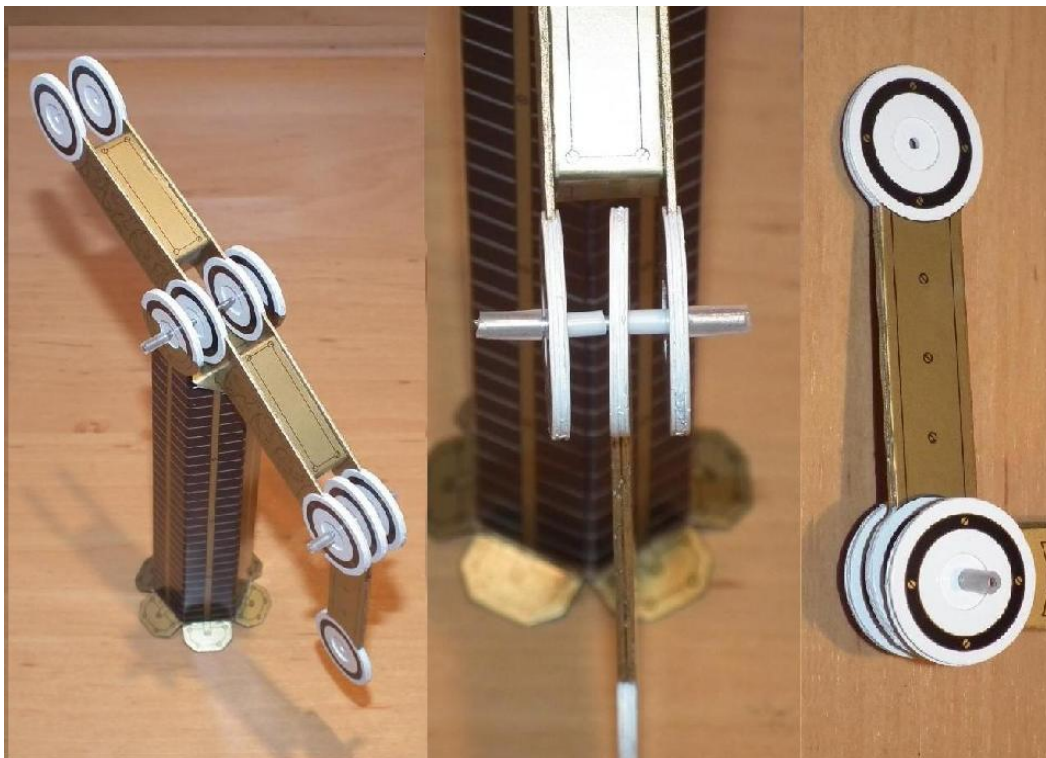


Step 17 of the assembly instructions describes in detail how to assemble the balancer. The locking and spacer pieces are pushed onto the axle one after the other - the required order of assembly is shown in the picture above.

## Stage D - The connecting rod

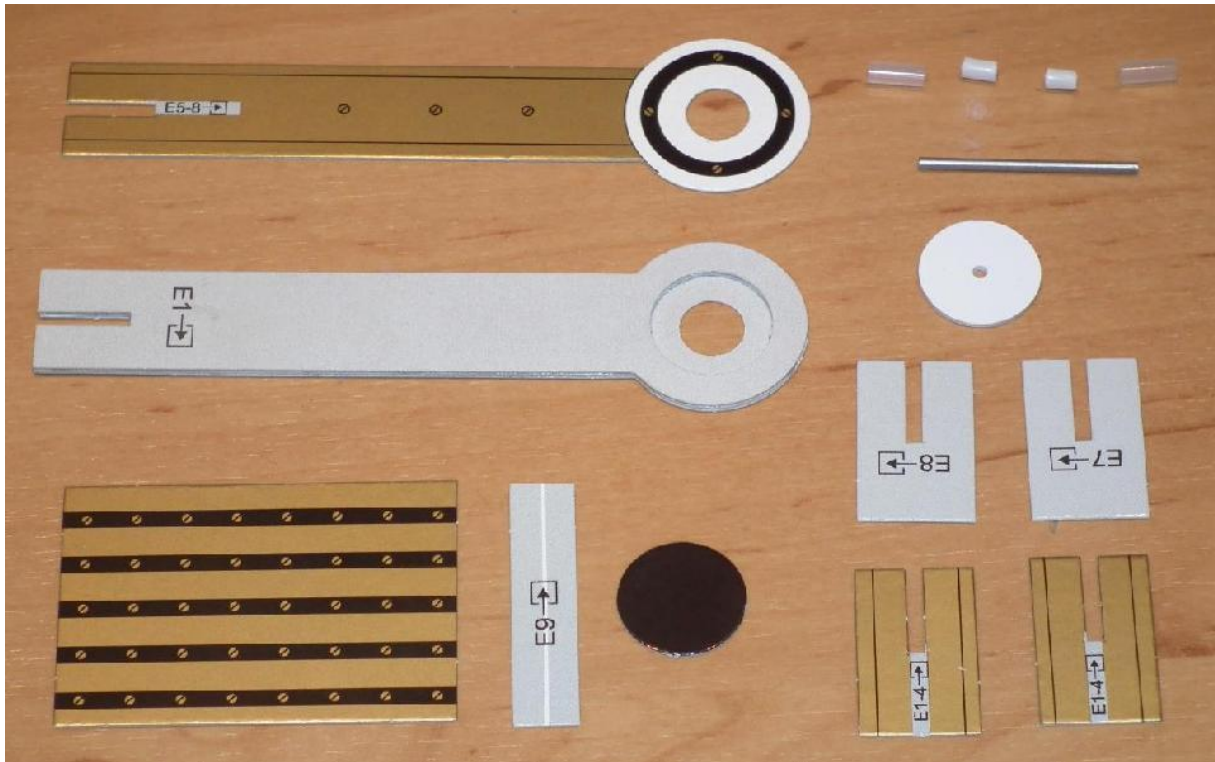


The connecting rod is assembled according to steps 18-20. First, the inner parts are glued together and the bearing washers are inserted. Then the outer parts are glued on. After they have dried, one end of the connecting rod is mounted on the balancer using the axle, the spacers and the locks.



The middle section of the picture shows the position of the spacers and the locks on the axle. The installation is described in detail in step 20 of the assembly instructions.

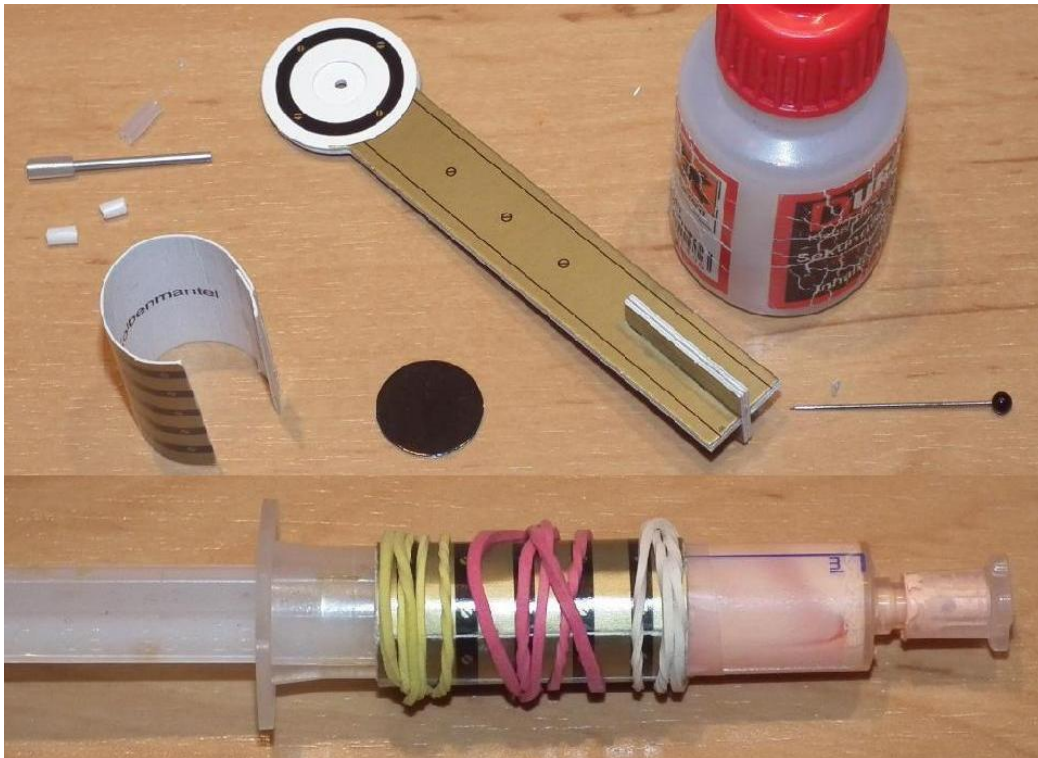
## Stage E - The Piston Rod and Piston



First, glue the piston rod together as described in steps 21 and 22 of the assembly instructions. Proceed in the same way with the parts for the piston rod holder according to step 23. Step 24 describes how to assemble the rod and the holder.



In order to achieve a bending of the flask jacket (see step 25) that is as crease- and wrinkle-free as possible, it is steamed over boiled water for about 5 minutes. It is advisable to cover the vessel during this process.

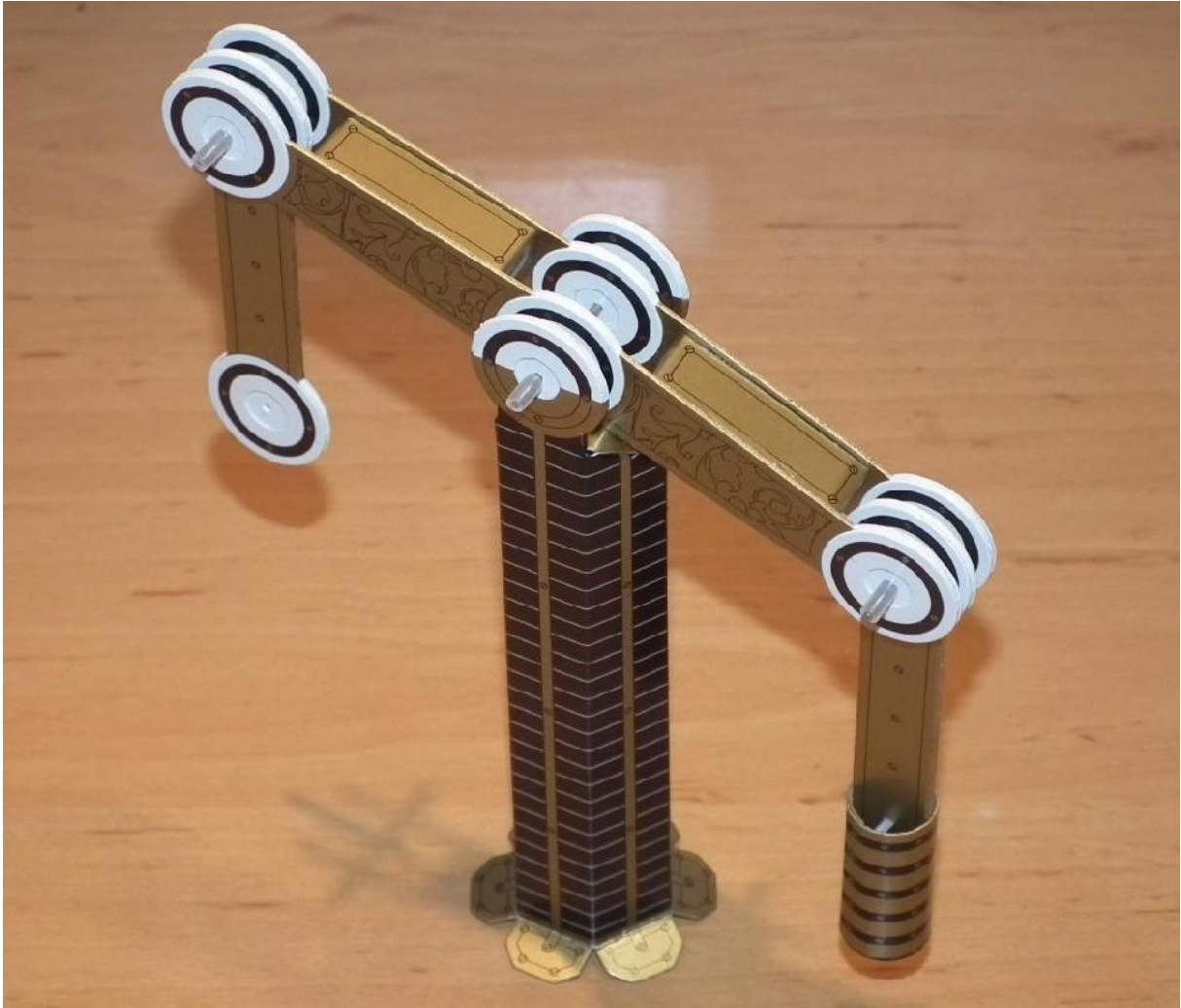


The picture shows the finished piston rod, which was built according to steps 21-24, and the production of the piston skirt, which was previously thinned for bending. Step 25 explains how to make the piston skirt. A 10ml disposable syringe and some rubber bands proved helpful here.



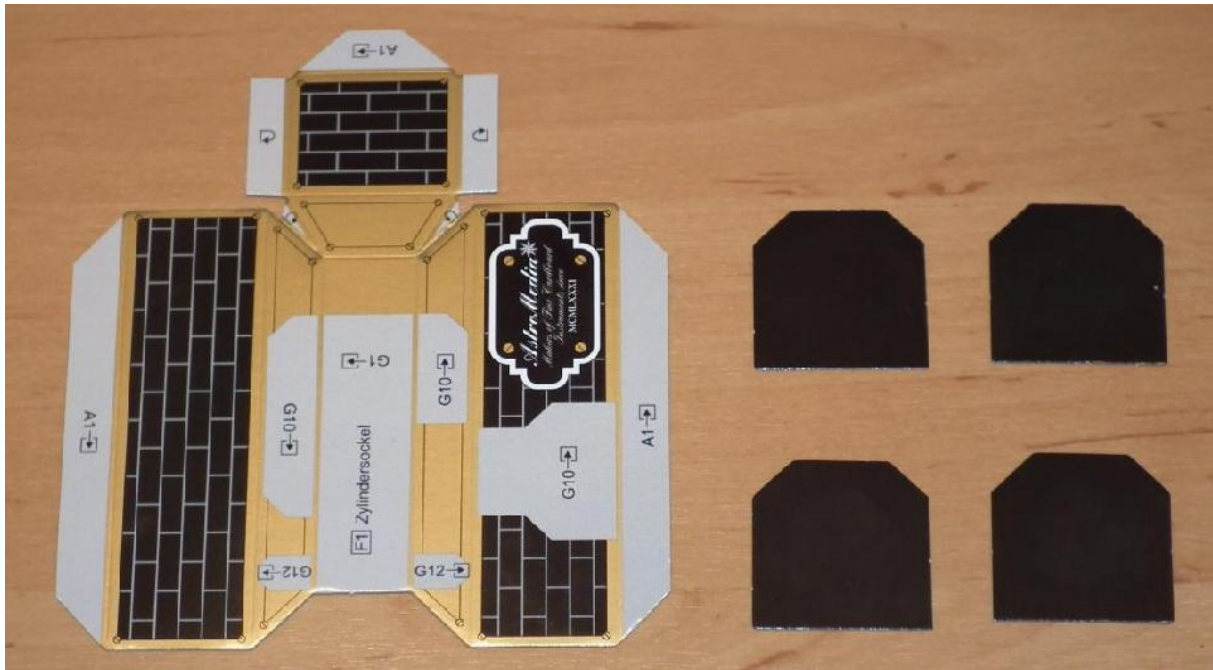
After the glue has dried, the open edges are dyed to fit. The flask is then fitted with the base and pushed onto the rod.





Step 27 - The piston rod with the piston is mounted to the balancer by means of the axle, the spacers and the locks.

## Stage F - The cylinder base



The cylinder base consists of only 5 parts, the assembly of which is described in steps 28-30. Since the actual base consists of only one part, the folding of this part is somewhat difficult.

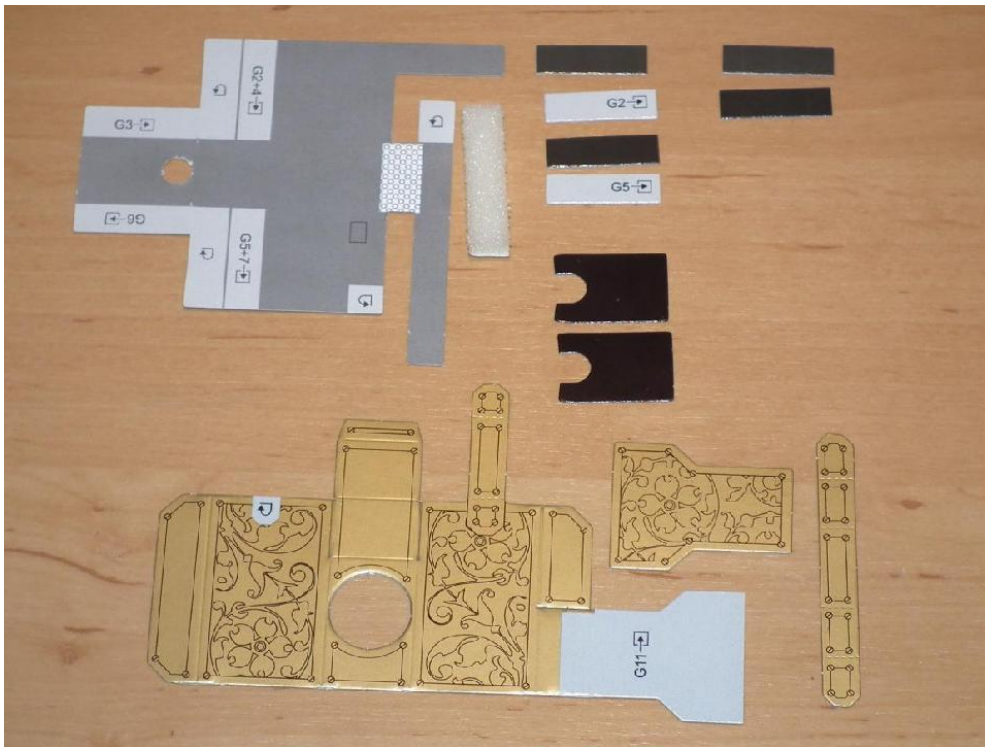


A clamp makes it easier to glue the tabs of the cylinder base, which is described in step 28. Step 29 explains the installation of the stiffeners.

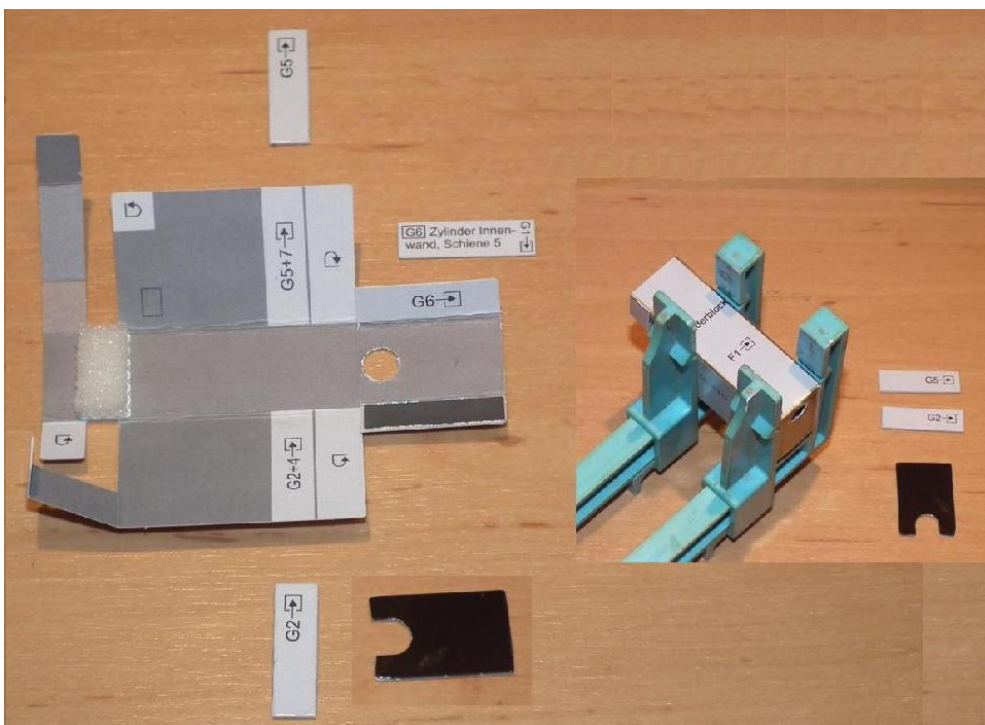


According to step 30 of the building instructions, the cylinder base is glued as accurately as possible to the base plate.

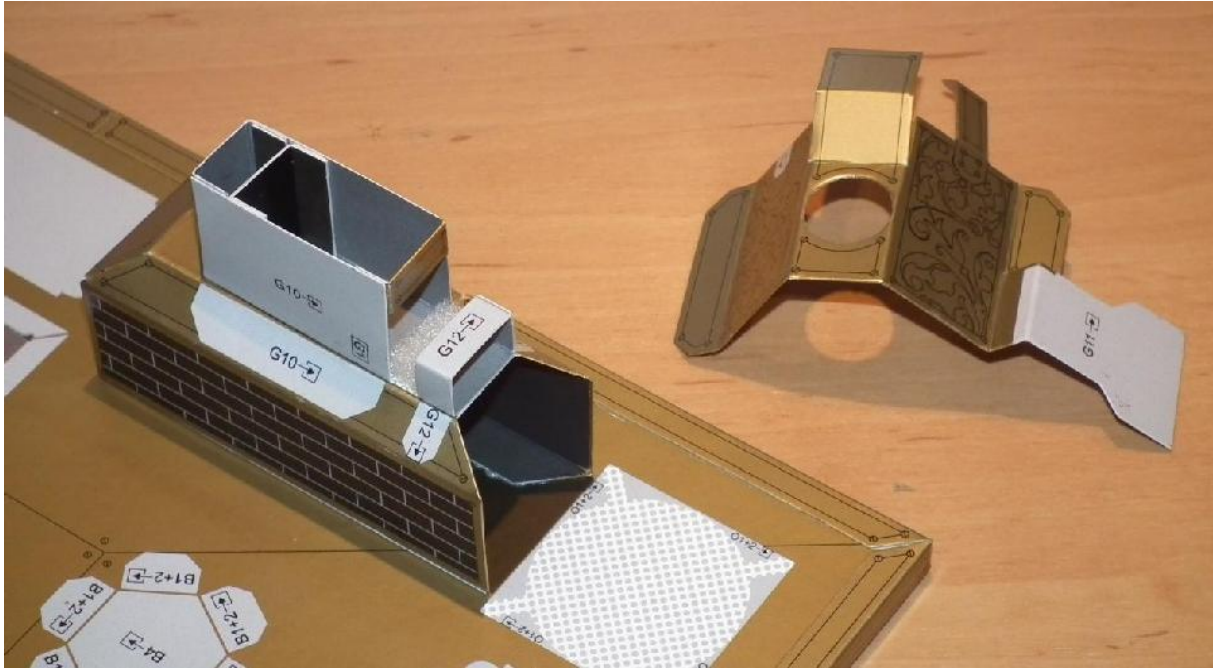
## Stage G - The cylinder block



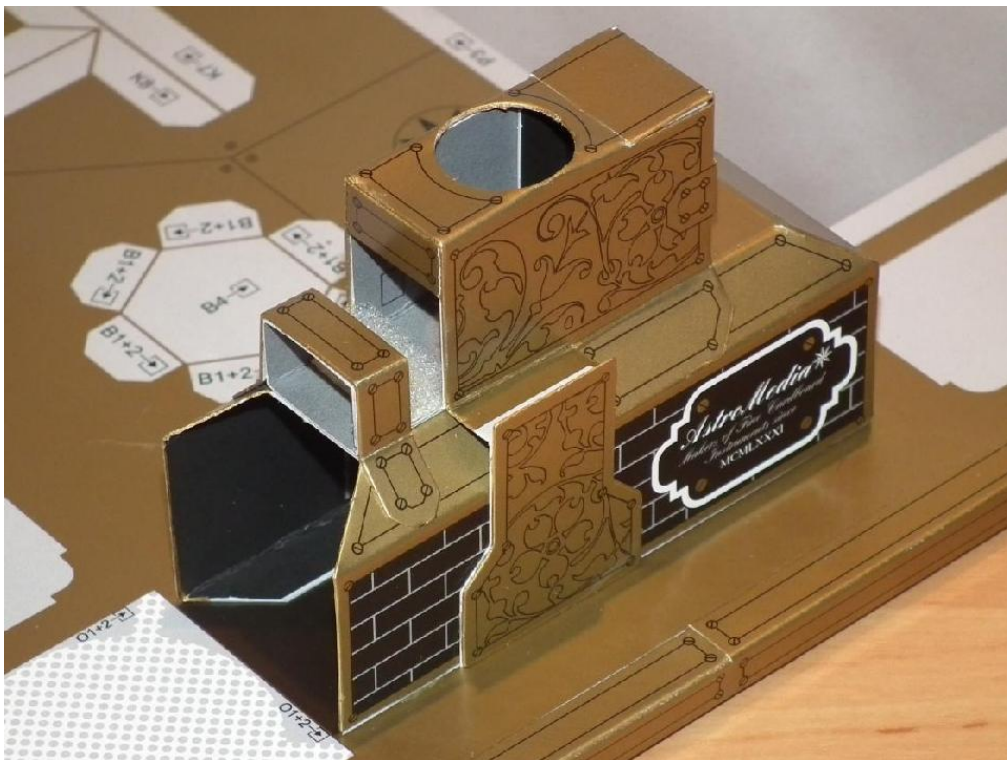
Steps 31 to 41 of the building instructions describe the construction of the cylinder block. First, the inner part of the block is made, whose predominantly grey and black parts can be seen in the upper part of the picture.



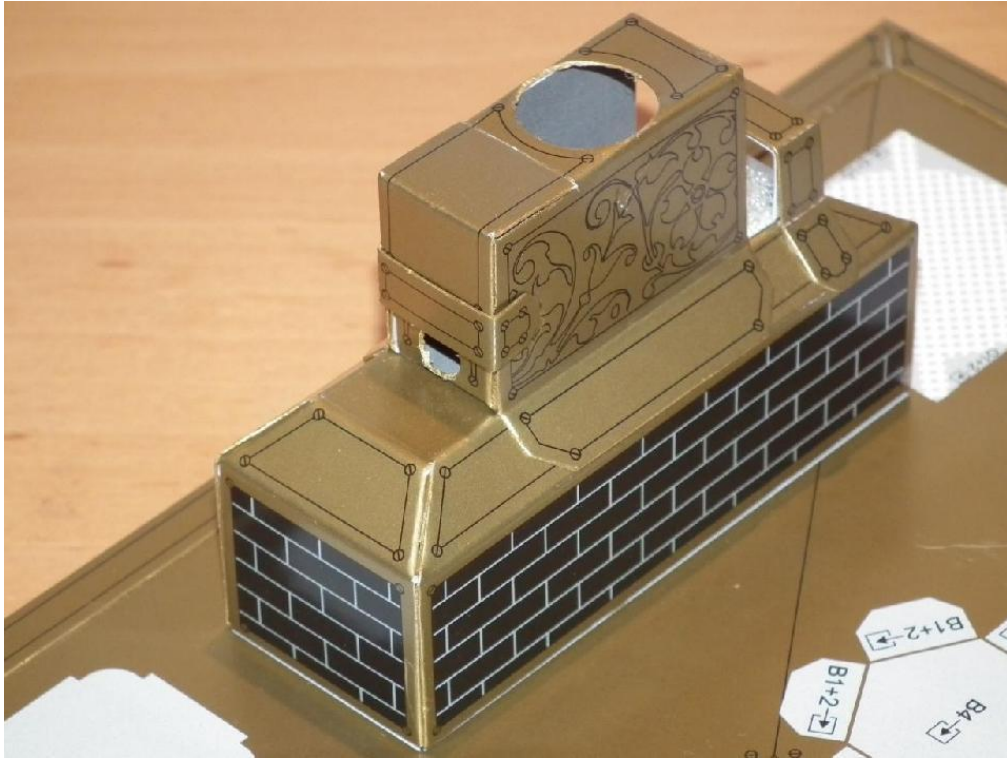
The left-hand side of the picture shows the folds of the inner part and the position of the valve abutment consisting of a piece of Tesa-Moll (steps 31 and 32). The inner wall rails are already prepared for installation according to steps 34 and 34. After the glue has set on the inner cylinder block (right-hand side of picture), the remaining inner wall rails are glued in place according to step 35 and the partition wall is inserted.



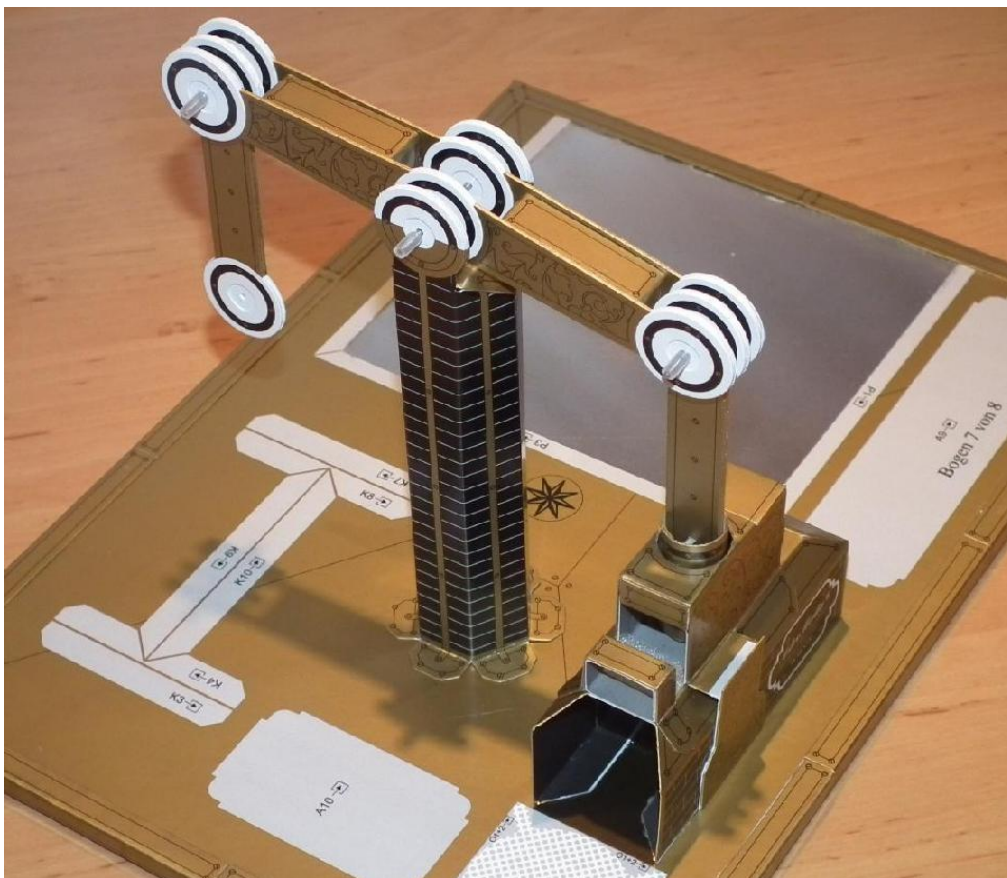
When the glues of the inner cylinder block are hardened, the inner cylinder block is glued to the cylinder block and the outer cylinder block can be folded. Steps 36 and 37 of the assembly instructions describe the procedure in detail.



According to steps 38 and 39, the lugs and side parts of the outer cylinder block are glued together. Step 40 deals with the assembly of the bracket for the exhaust pipe.

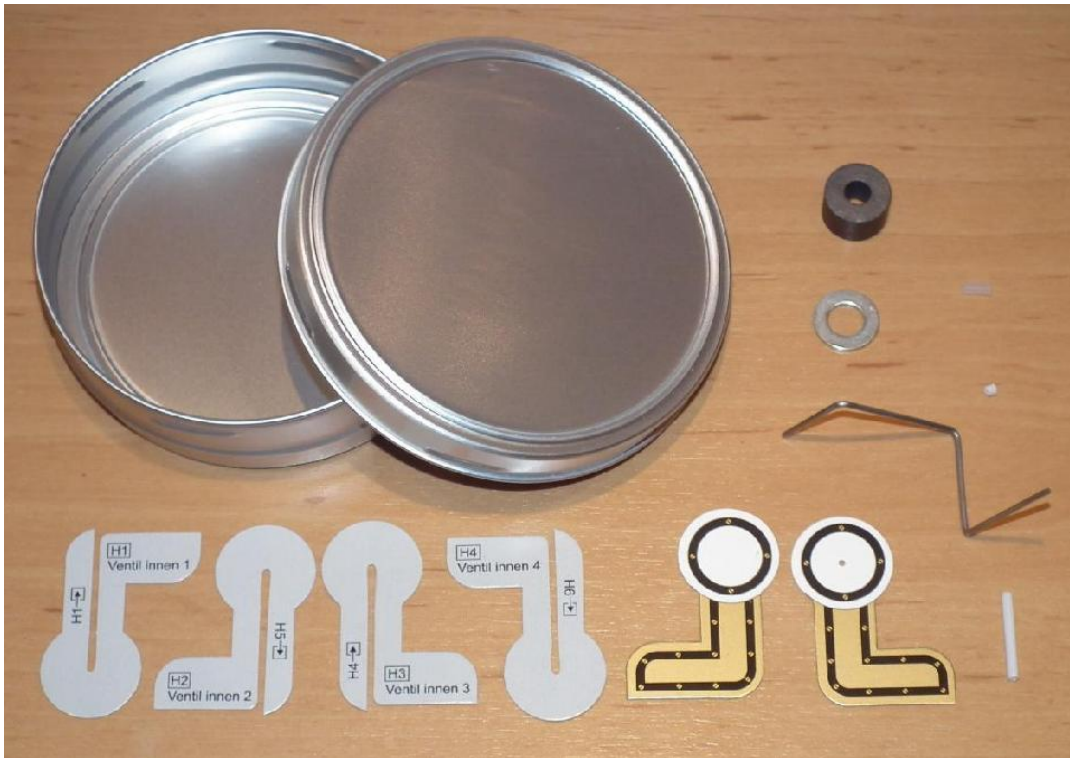


The same again - for the purpose of illustration - seen from the opposite direction.

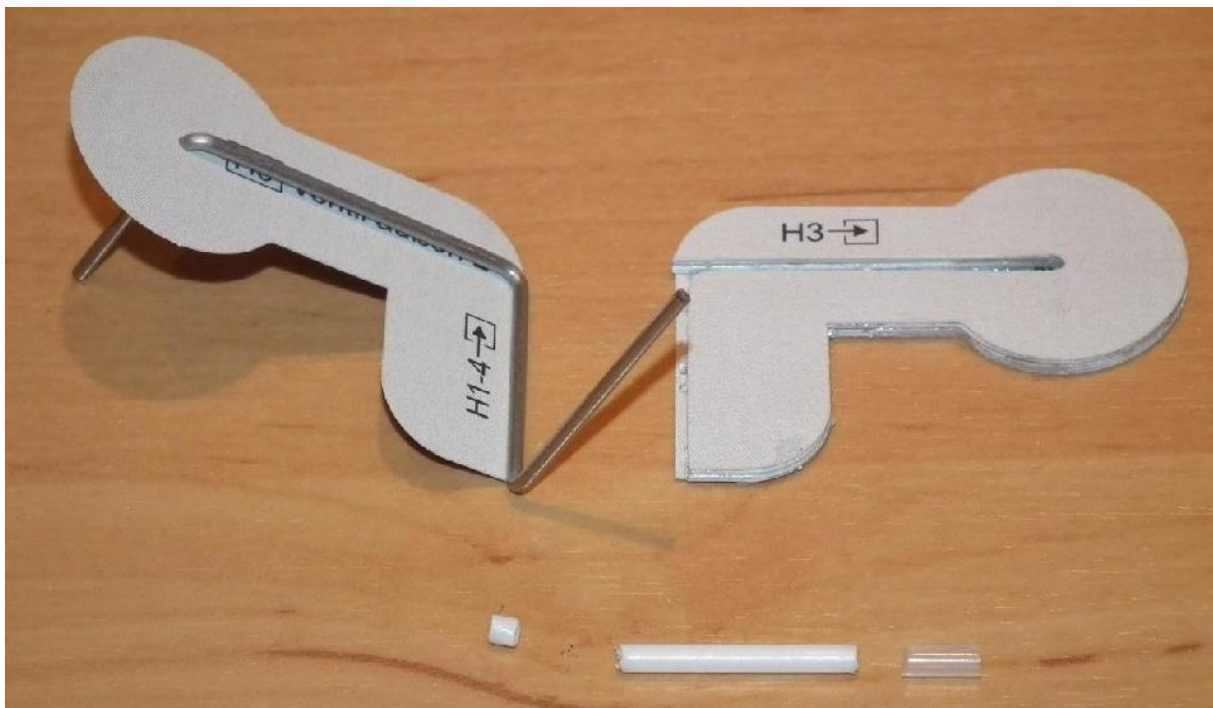


Once the glueing of the cylinder block has dried well, the column is glued on according to the instructions in step 41 - the balancer must be exactly parallel to the short side of the base plate.

## Stage H - The valve



At the beginning of this construction stage, the valve is created, the components of which can be seen in the lower and rightmost part of the picture. Then the parts of the steam boiler are machined and glued together.



In the already known layered construction method, the valve is built up according to steps 42 and 43. The picture shows the stand during step 43.



Condition according to steps 44, 48 and 49 - Finished valve and its bearing glued with 2C adhesive as well as the spacer and the locking device.



Step 45 - The centre of the cover is determined with a caliper. The radius to the groove is 48mm - The centre point is marked using the calipers of the gauge.

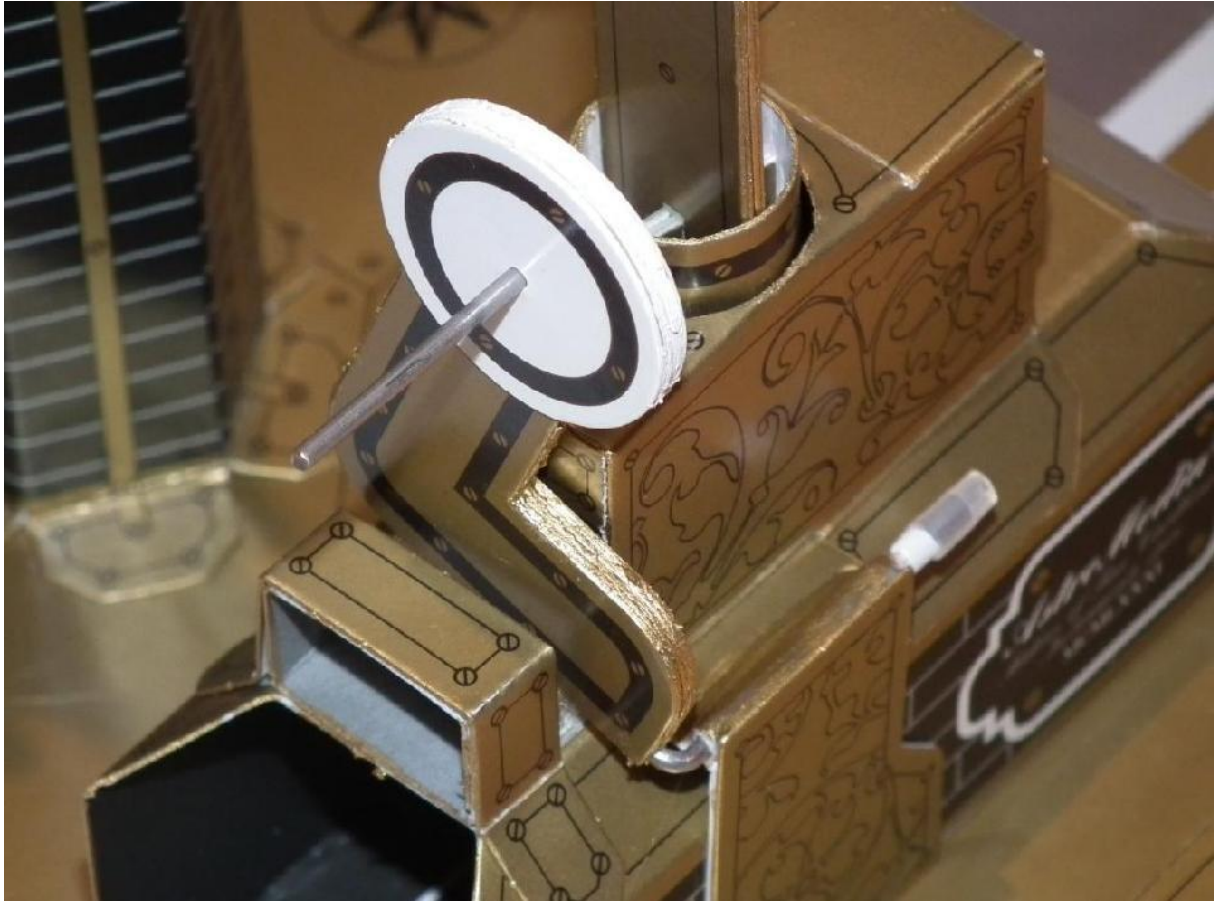




After drilling a 9.5mm hole in the centre of the lid of the can, the top and bottom parts of the can are glued together and the washer is glued to fit exactly on the hole just drilled. Before applying the 2-component adhesive (it must withstand at least 100°C, e.g. Stabilit Express is therefore not suitable!), the gluing surfaces should be cleaned (e.g. of grease residue from touching). Tampon print remover is best suited for this purpose, alternatively you can use a universal ink remover. **DO NOT USE WASHING LENZIN** - it contains oils, which is rather detrimental to the adhesive...

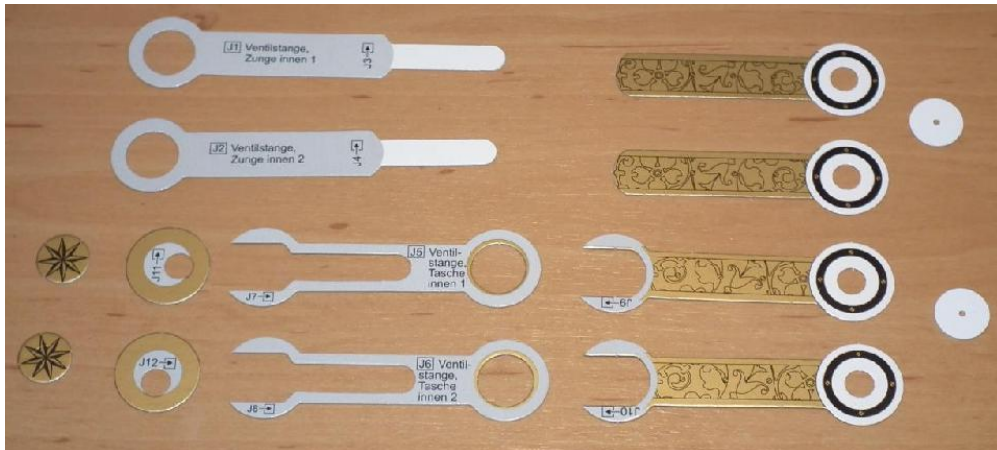


Ready glued parts of the future steam boiler. The simplified leak test by blowing into the boiler was successful!

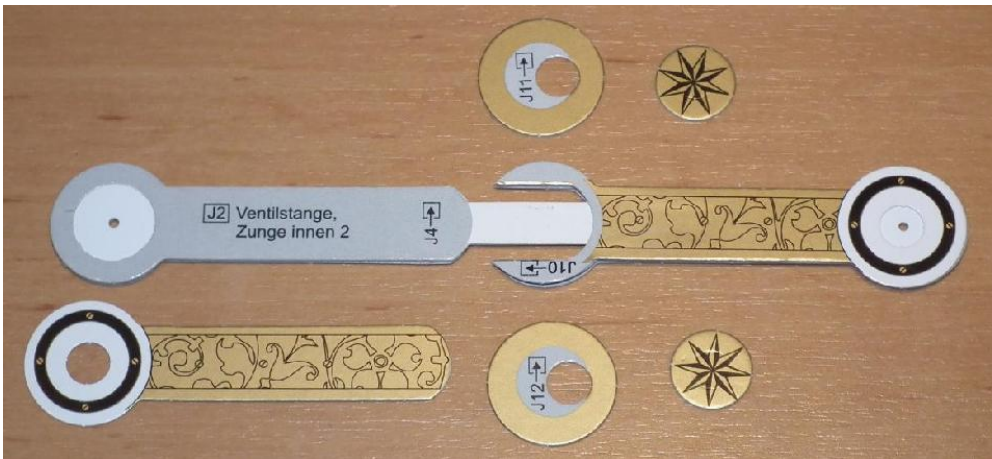


After the 2C adhesive has set on the valve holder, the valve is inserted as described in step 49 and the spacer and the locking device are pushed on.

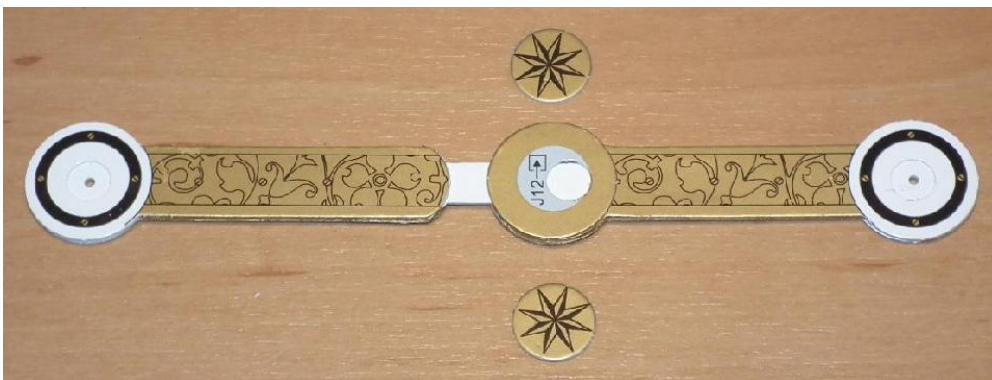
## Stage J - The valve bar



The valve bar is also made in the sandwich construction method. Due to the somewhat more difficult inner workings, thin super glue is used here, which does not tend to leak at the component edges.

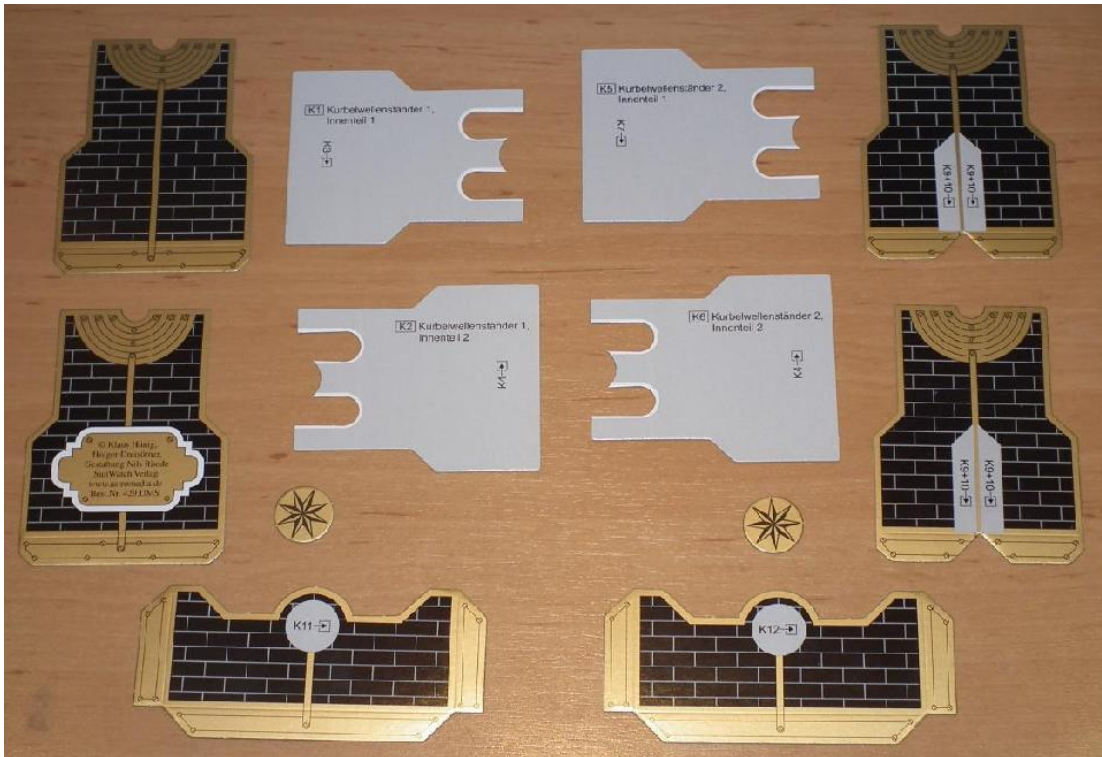


Steps 50 to 52 describe the construction of the valve stem and soon the above picture appears: The tongue of the left part (outer part not yet glued on) is inserted into the pocket of the right part. The not yet glued round covers with the small hole allow the addition of glue after adjustment during commissioning.

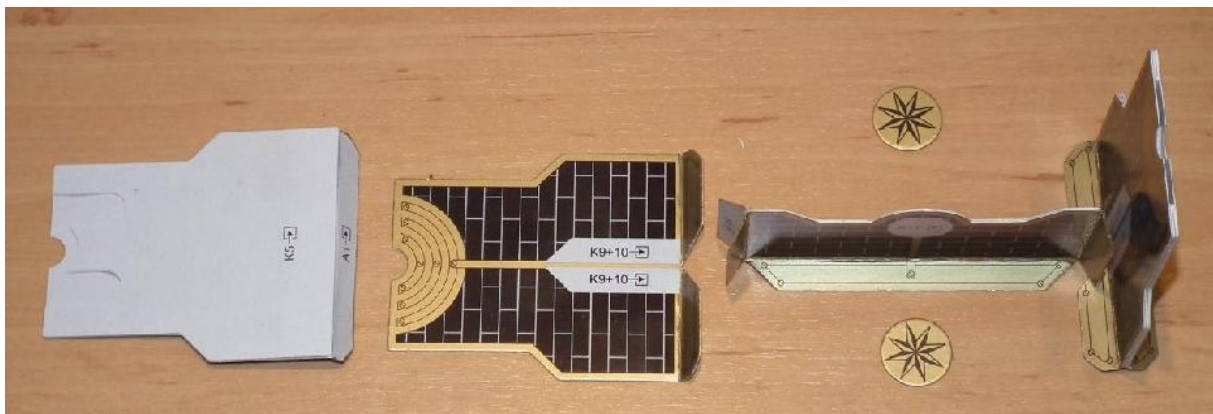


The result after step 52 - The ornament covers are glued on only after the bar length has been adjusted and the tongue has been glued in the pocket.

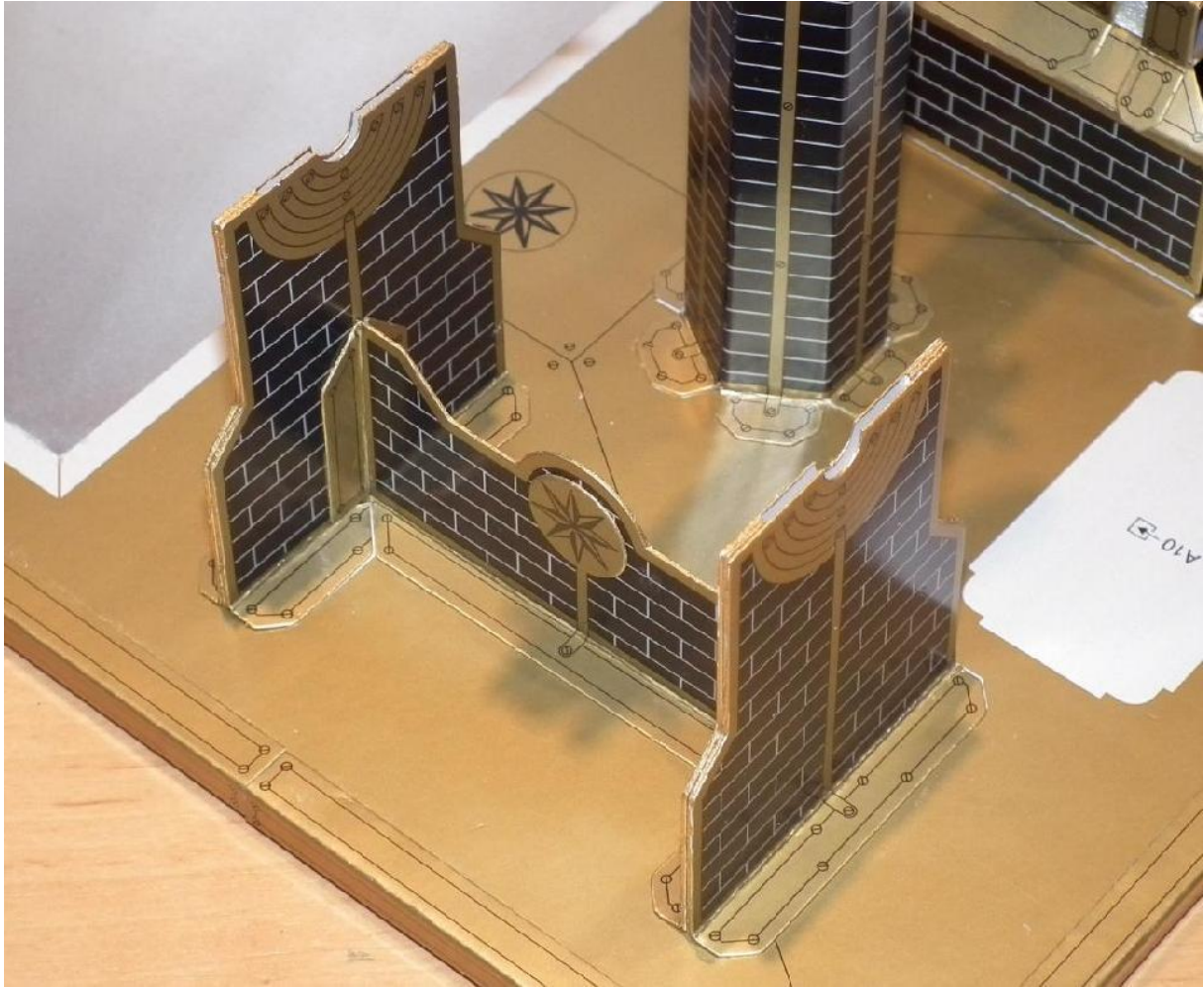
## Stage K - The Crankshaft Stator



The description for the construction of the crankshaft stator can be found in steps 53-59, which provide for the construction of the side parts first. Then the two middle parts are glued together.

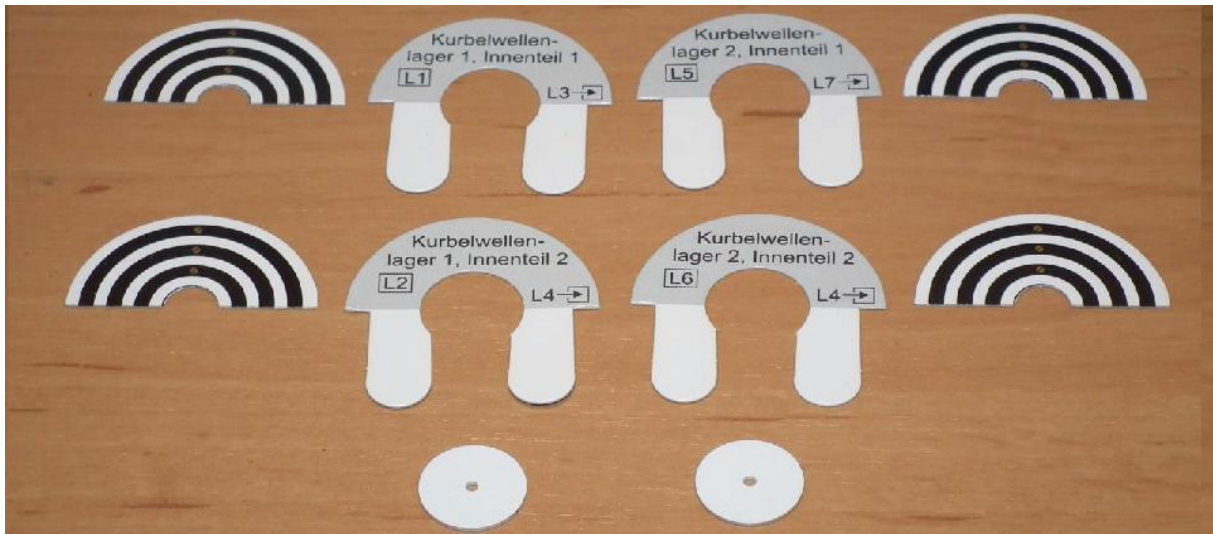


The picture shows the structure of the crankshaft stator. The side parts with the pockets which hold the bearings and the middle part which gives the stator the necessary stability. Steps 53-56.



The crankshaft stator glued to the base plate. Due to the light weight of the component, it is possible that the tabs will bend back a little before the glue sets. If impatience is latent, superglue should be considered for this gluing.

## Stage L - The crankshaft bearings



Steps 60 to 62 explain the manufacture of the crankshaft bearings, the tongues of which are later inserted into the pockets of the crankshaft stator.



Steps 60 and 61 - Gluing the inner parts, inserting the bearing washer and gluing on the outer parts.



According to step 62, the seat of the bearings in the stator is checked.

## Stage M - The flywheel



The construction of the flywheel is described in steps 63 to 66 and is already known from previous construction sections: Two inner and outer parts each and some applications. The 1 cent coins, which are glued into the circular recesses, are necessary for an increased weight to give the flywheel the necessary energy for the non-driving phase.



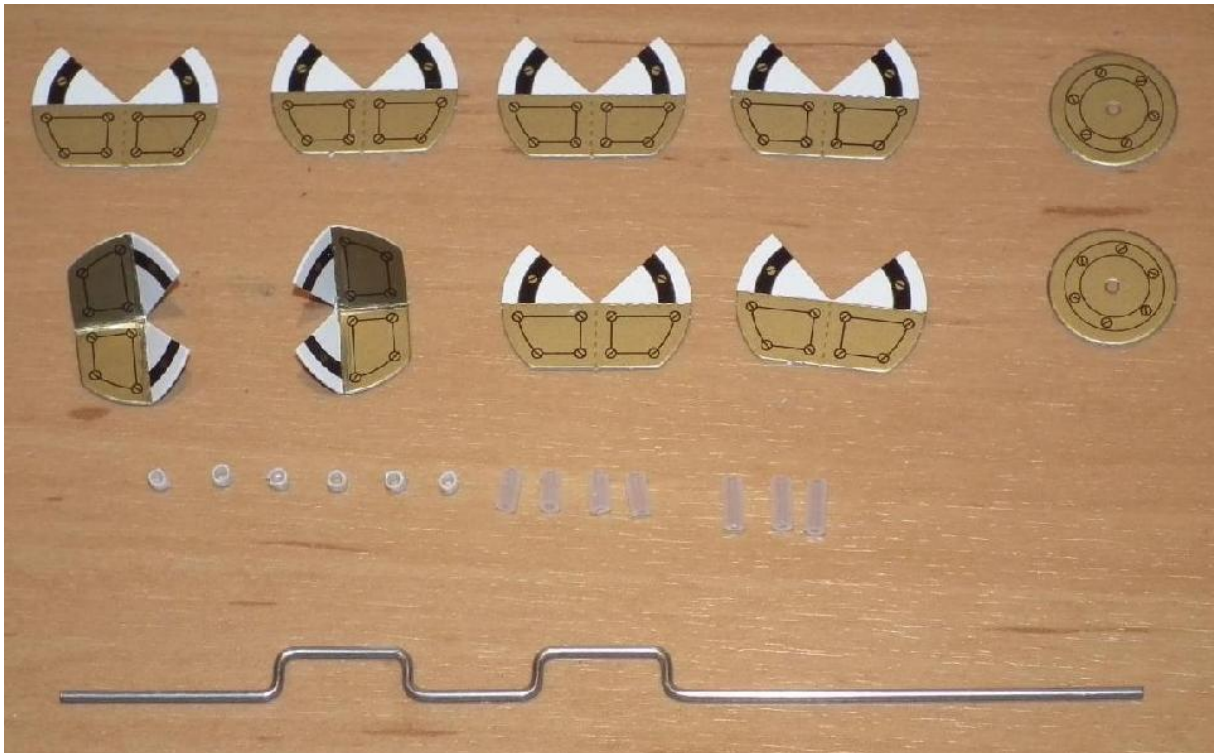
After the two inner parts have been glued together, the circular covers are glued on one side (step 65) and the 1 cent coins are inserted, which are fixed with a drop of glue. Finally, according to step 66, the remaining covers are attached.



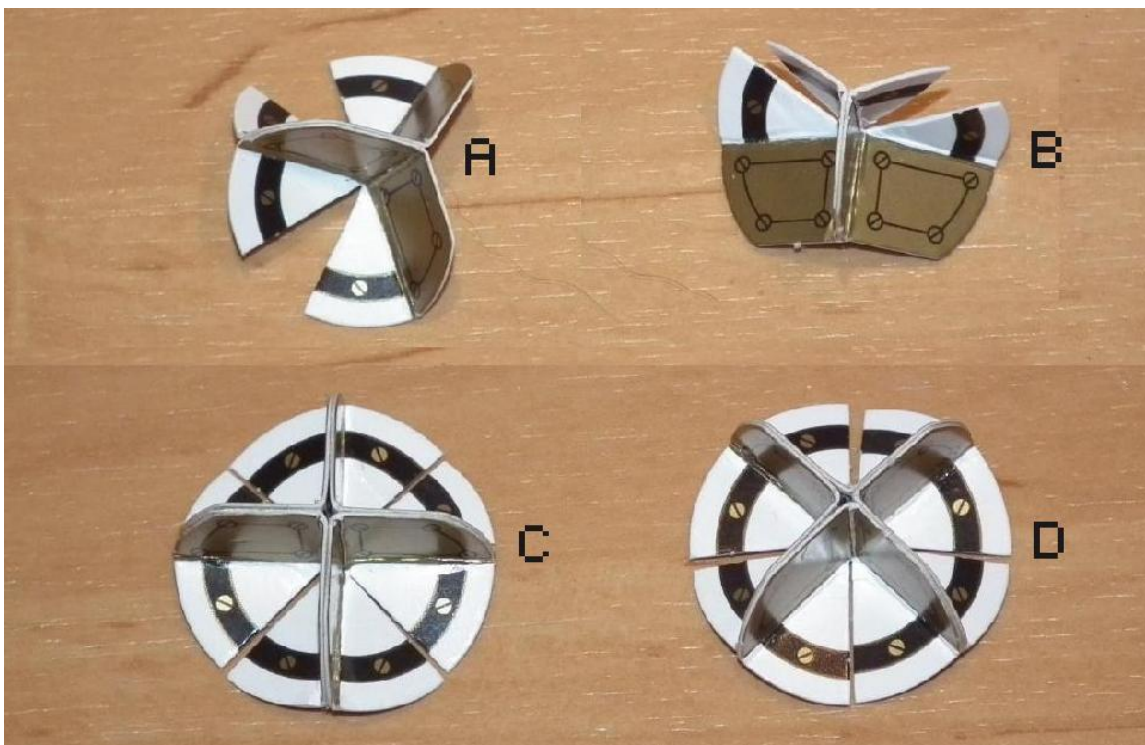


The finished flywheel after colouring the edges with gold and white paint.

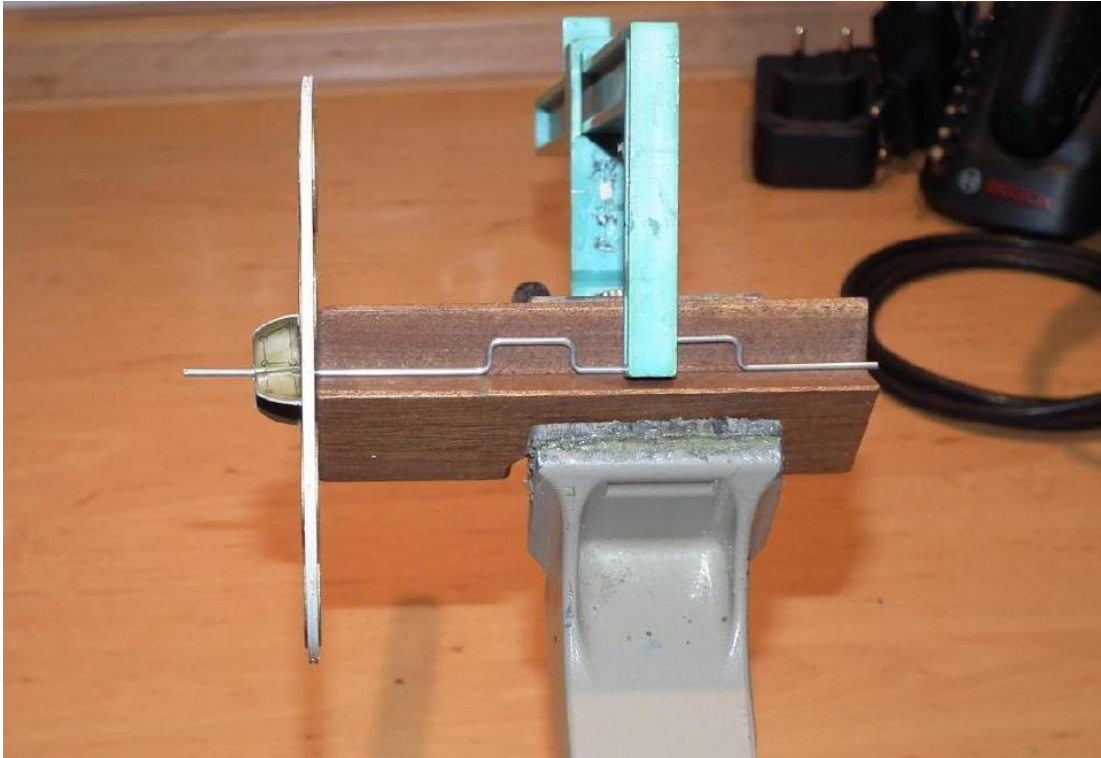
## Stage N - The flywheel hub and crankshaft assembly



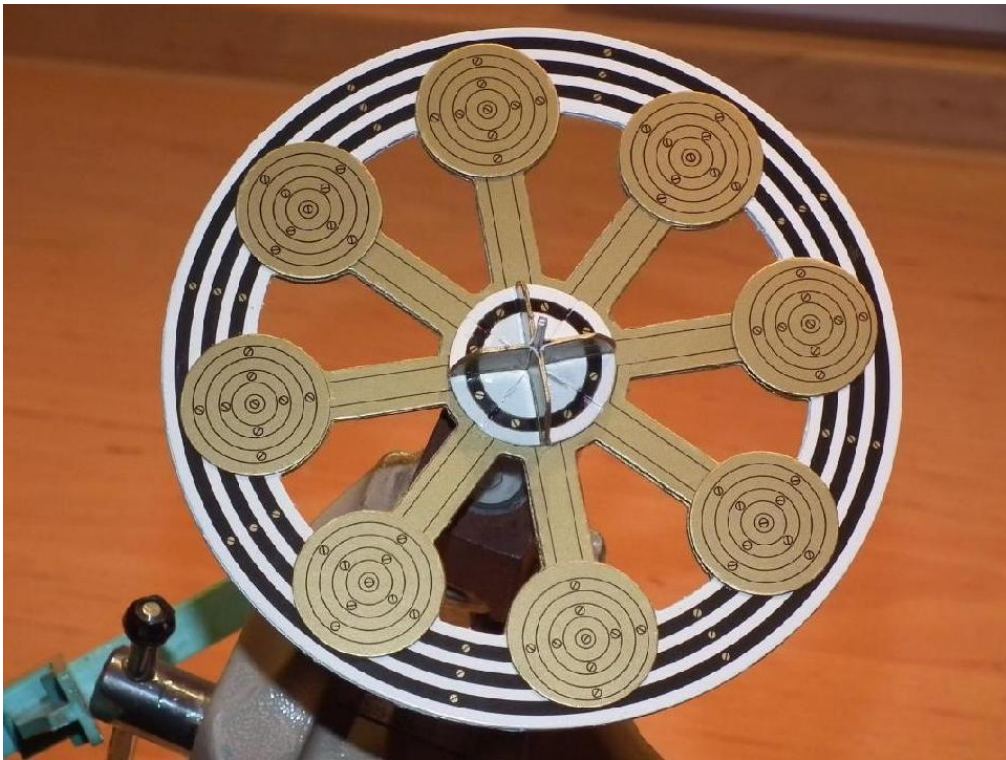
Steps 67 to 71 describe the production of the flywheel hubs. In the picture above, step 72 has already been completed and the six spacers and the seven axle locks have been cut off. The crankshaft assembly is then done according to steps 73-76.



First, two parts of a flywheel hub consisting of four parts are folded and glued together (A). The remaining two parts are processed in the same way (B) and, after drying, glued to the first two parts to form the complete hub (C). The second hub (D) is made in the same way. Steps 67 and 68 and 70.



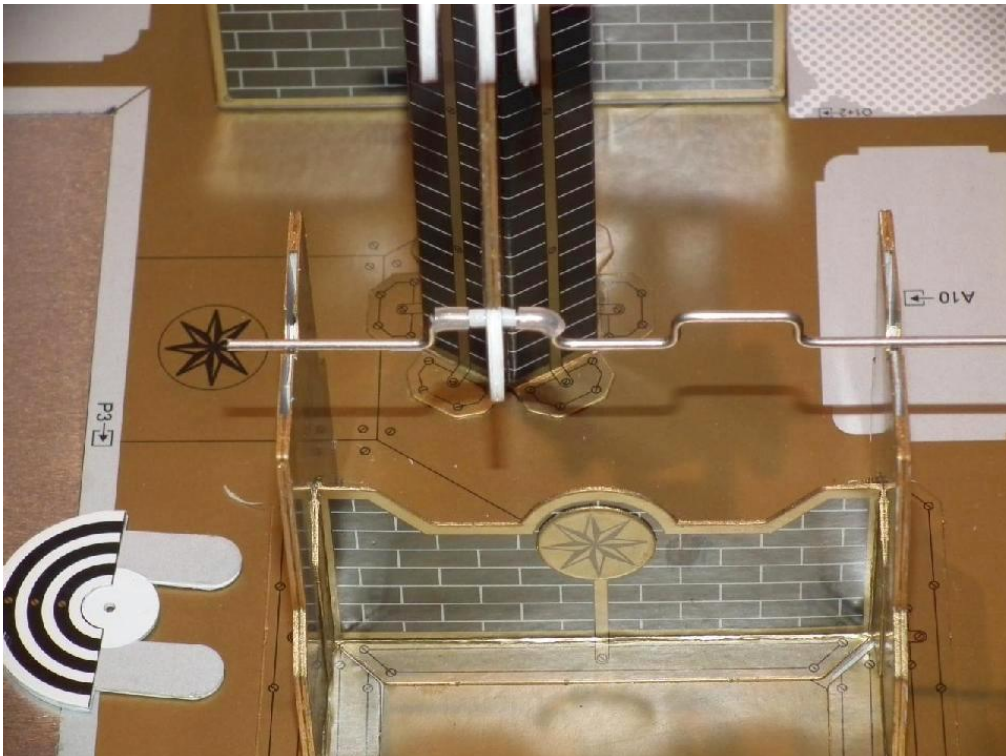
Step 69 explains how to mount a hub on the flywheel. It is important that the flywheel is perpendicular to the crankshaft. In order to bring the hub axle into alignment, it is advisable to fix the flywheel while the hub glue is drying. The picture shows a device in which the crankshaft is fixed in a square timber, which also forces the flywheel into a right angle to the axis of the crankshaft.



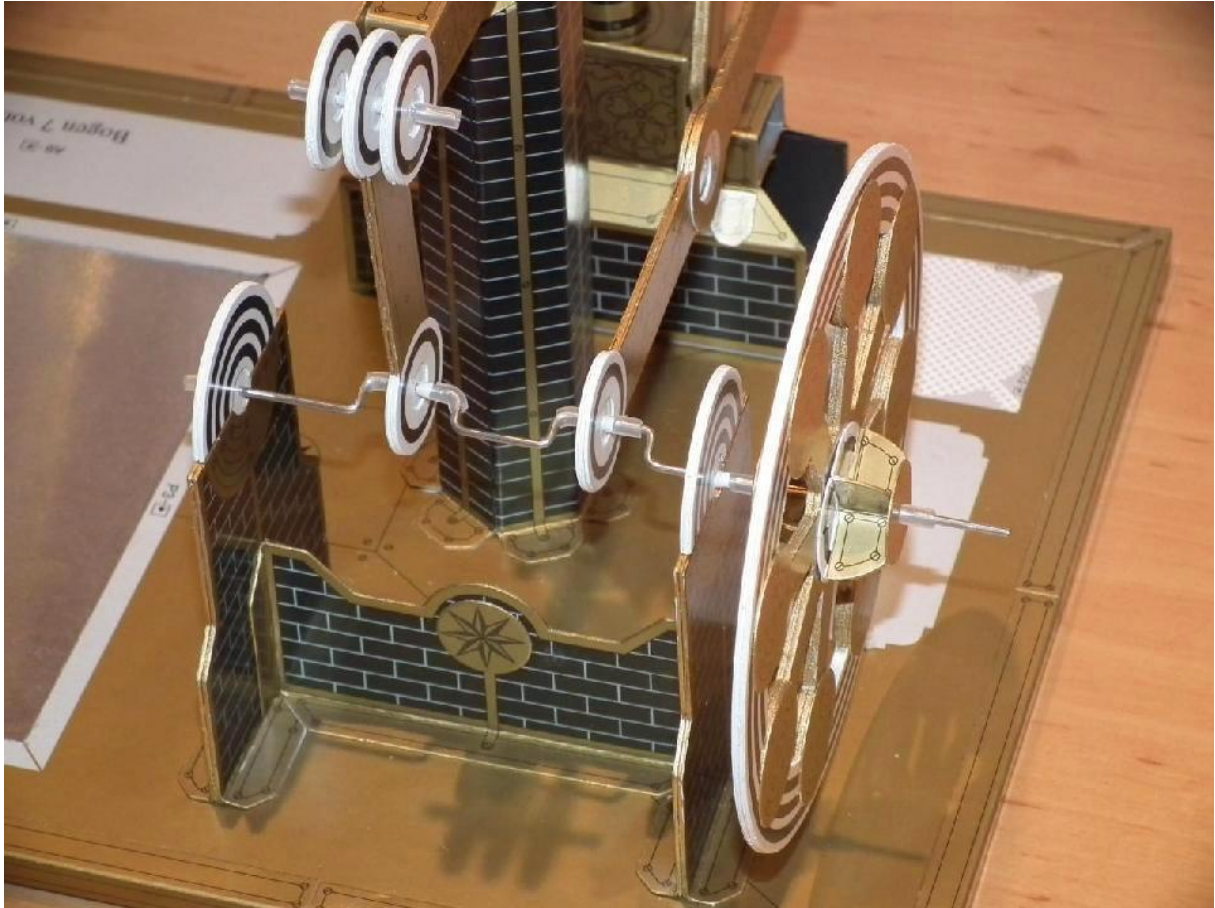
The state after step 70 - the second hub is also mounted.



After completing step 71, the hub covers are glued on. Now it is time to mount the crankshaft - which is actually easier than the length of the text in the instructions would suggest.

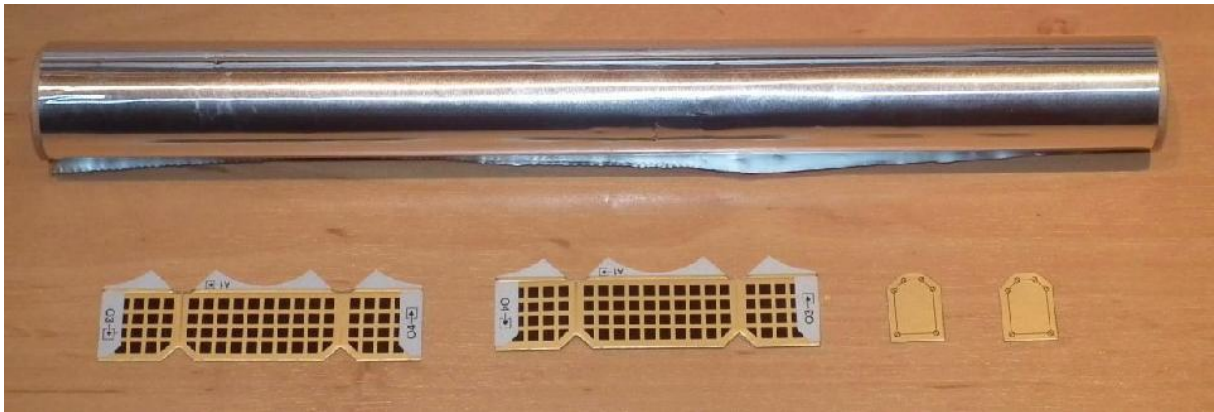


Following steps 74 to 76, the crankshaft is assembled, starting with the connecting rod. The bearing washers of the connecting rod and valve stem are each held on both sides by a spacer and a lock, while the crankshaft bearings only have a spacer and a lock on the outside. After the flywheel has been fitted, a locking device is pushed onto the long end of the shaft to hold the flywheel in place.

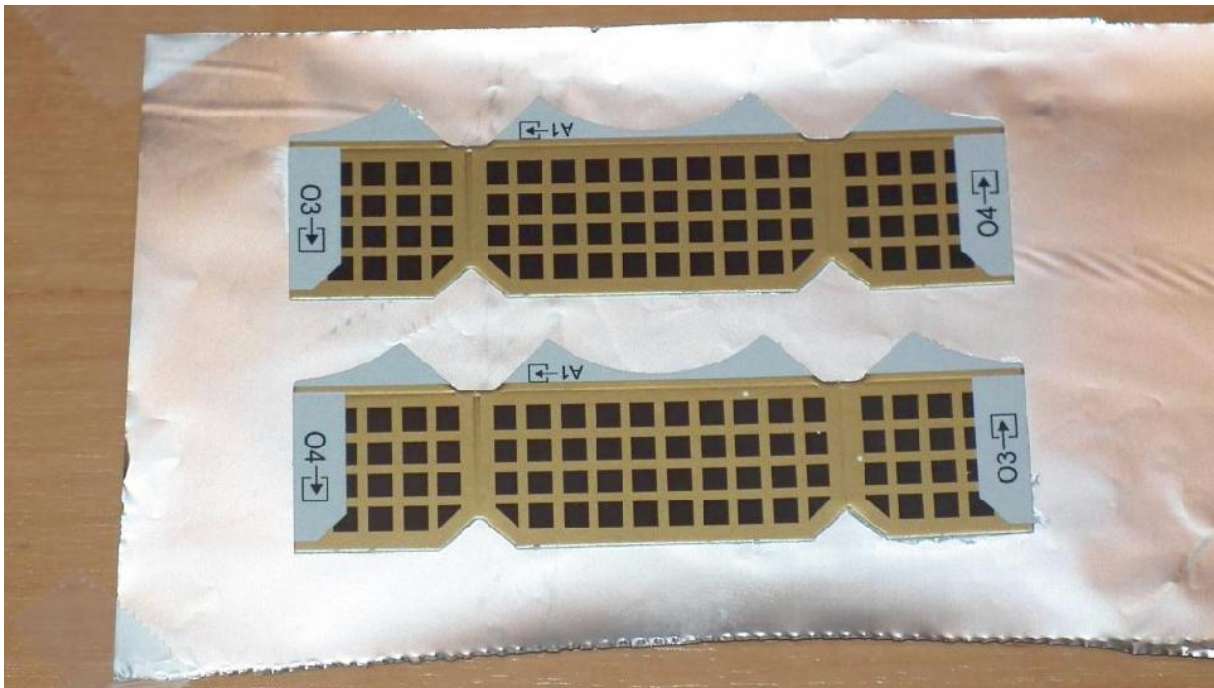


General view of the assembly with the crankshaft after completing step 76.

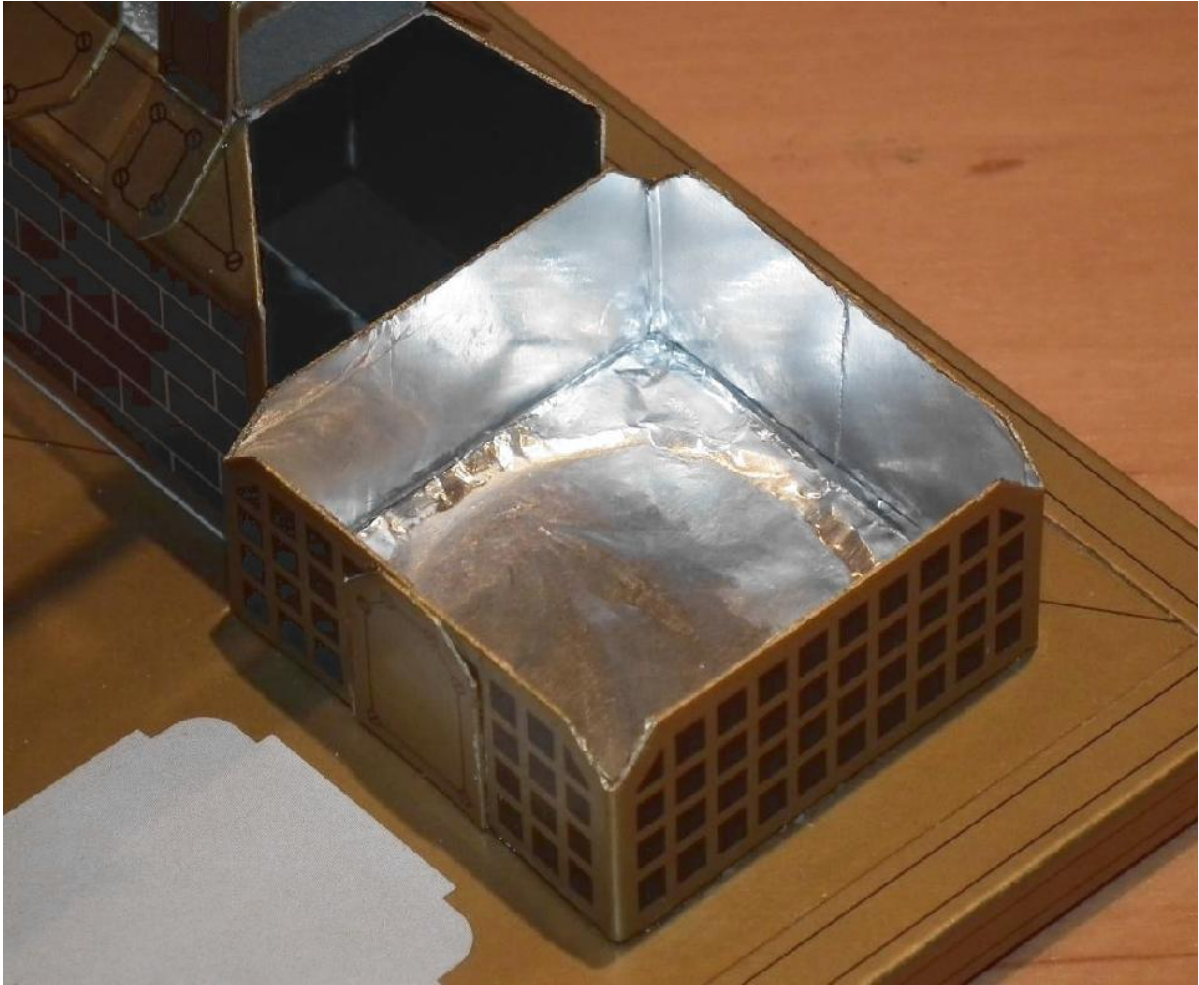
## Stage O - The Chimney Socket



The making of the chimney socket seems comparatively undemanding - if it weren't for the aluminium foil, the use of which is explained in steps 77 to 80 for the construction of the chimney socket.

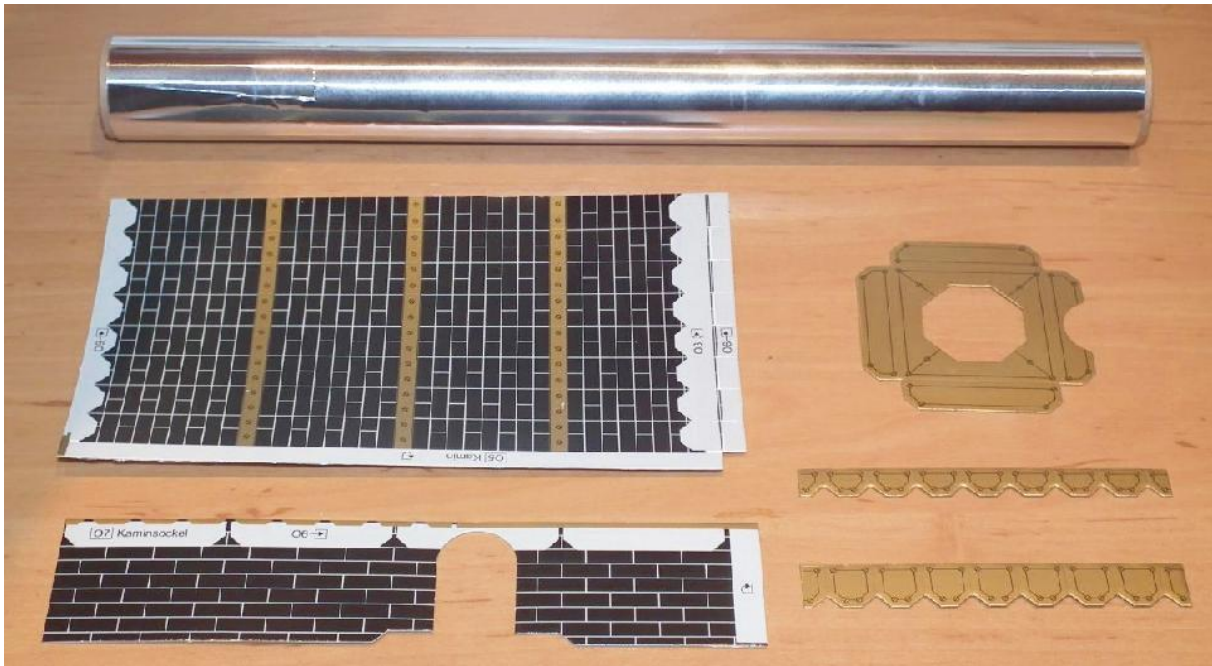


According to step 77, the backs of the chimney bases are covered with aluminium foil. For stress-free handling of the foil and a good result, fix the foil to the work surface with a little adhesive film and then stick on the cardboard parts - allow to dry well and then cut out the stuck-on parts.

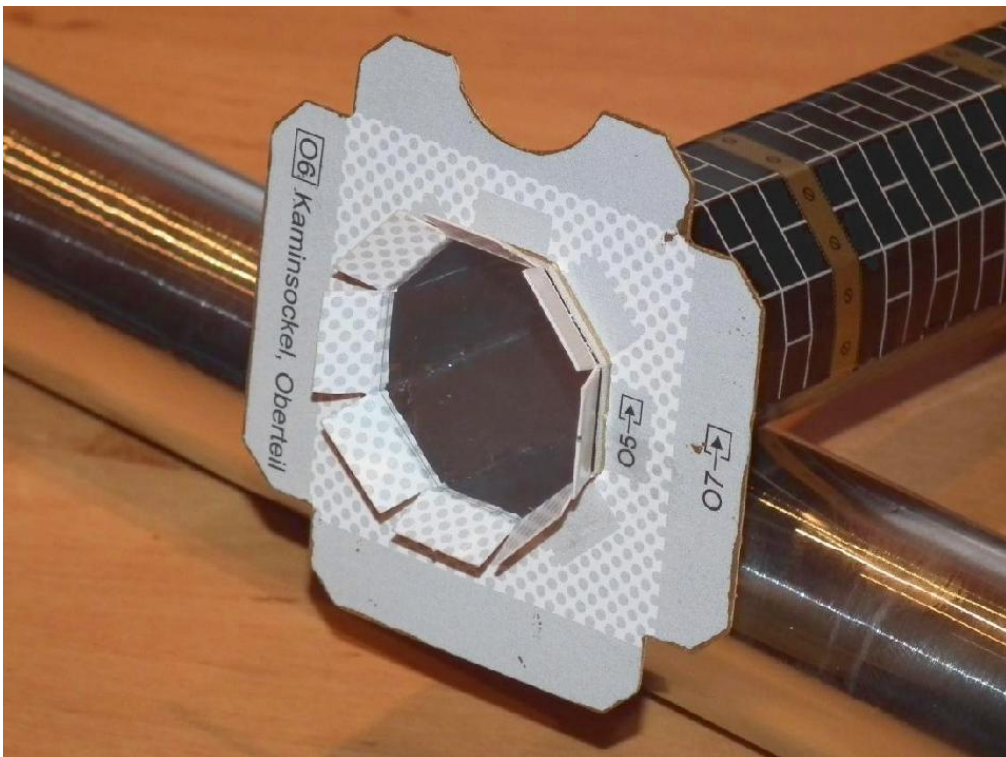


Steps 78 to 80: The two base socket parts are joined by means of two connecting pieces to form a square part, which is glued onto the base plate. Finally, the bottom of the base socket is covered with aluminium foil.

## Stage P - The Chimney

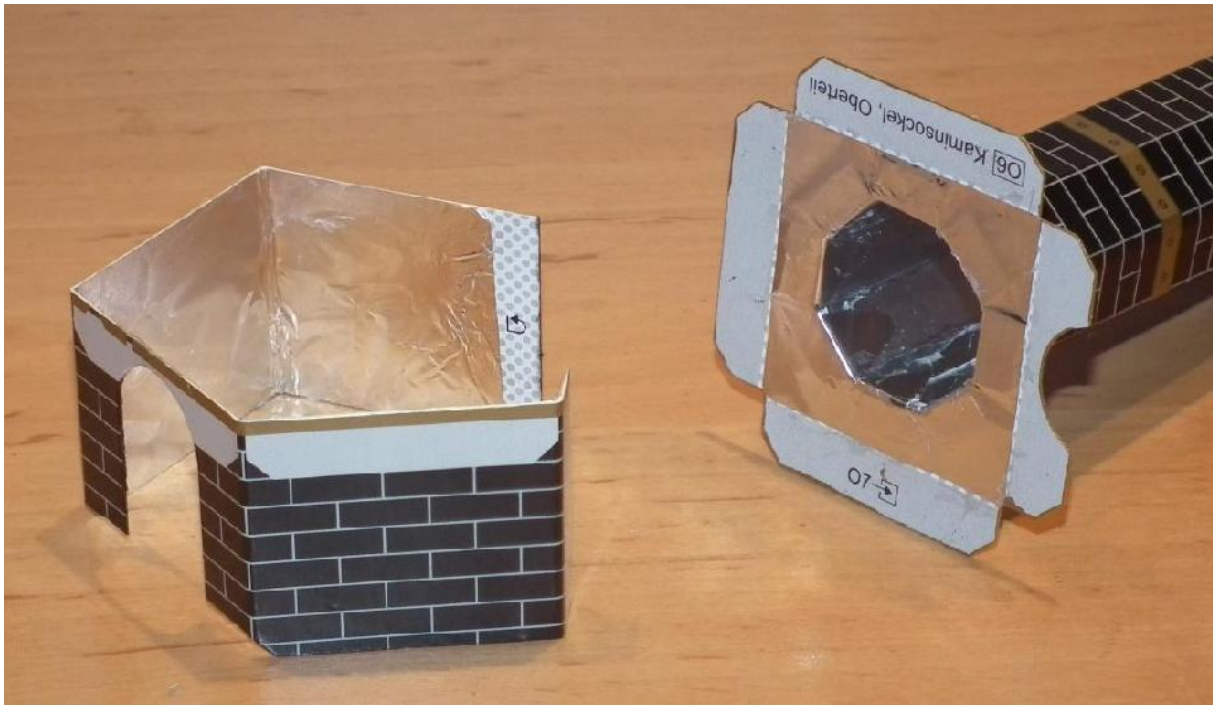


Stage P describes the construction of the chimney in steps 81 to 88. Start with the chimney pipe, the back of which (except for the side and bottom flaps) is first covered with aluminium foil and, after it has dried, folded into an octagonal tube and glued along the long flap.



Step 82 - The top of the chimney base has been removed from arch 6 and is next glued to the foot tabs of the chimney.

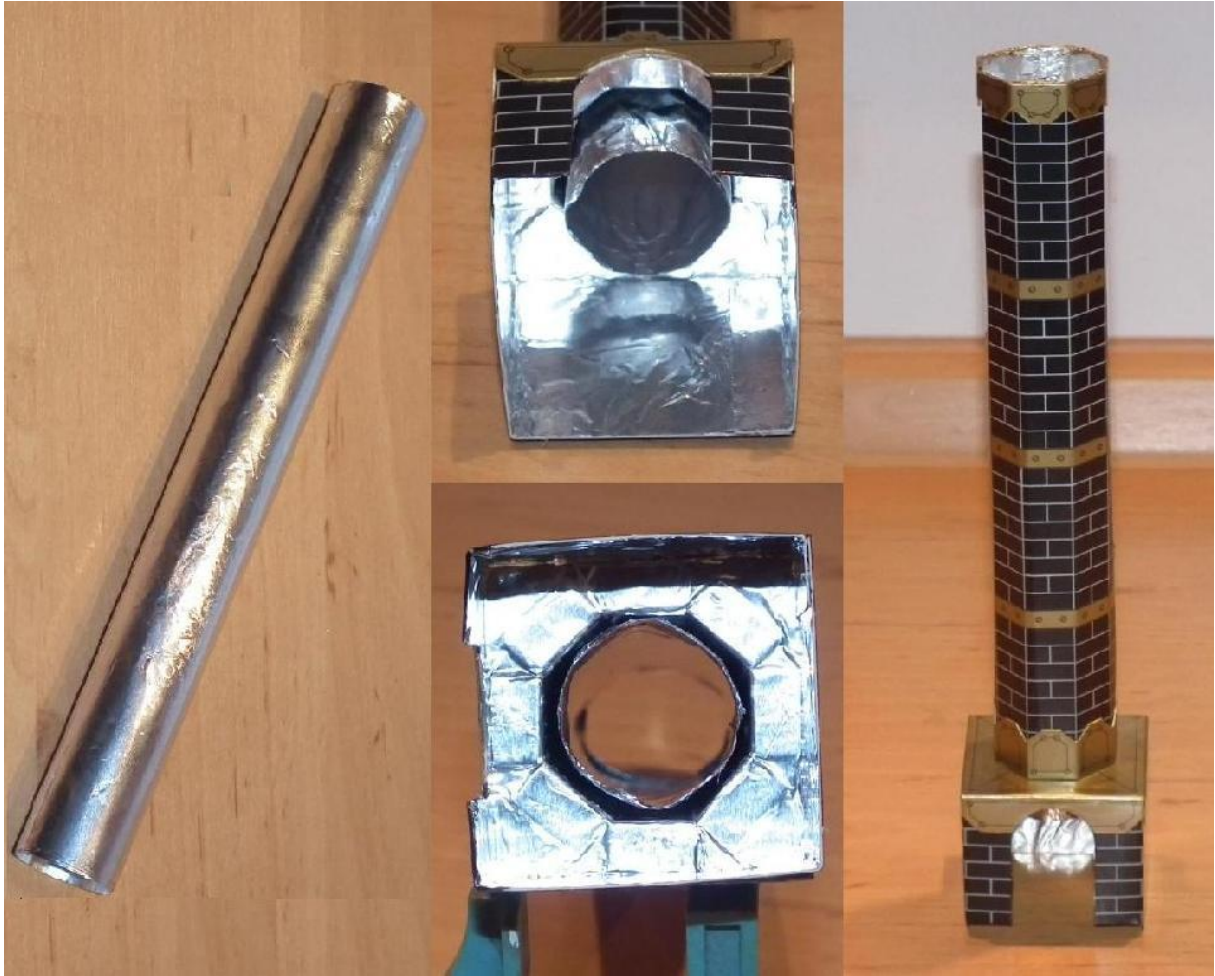




The result of step 83 can be seen on the right of the picture, after the underside of the chimney top has been covered with aluminium foil. On the left of the picture, the state of the base can be seen during step 84, for the completion of which only the gluing of the base into a square is missing.

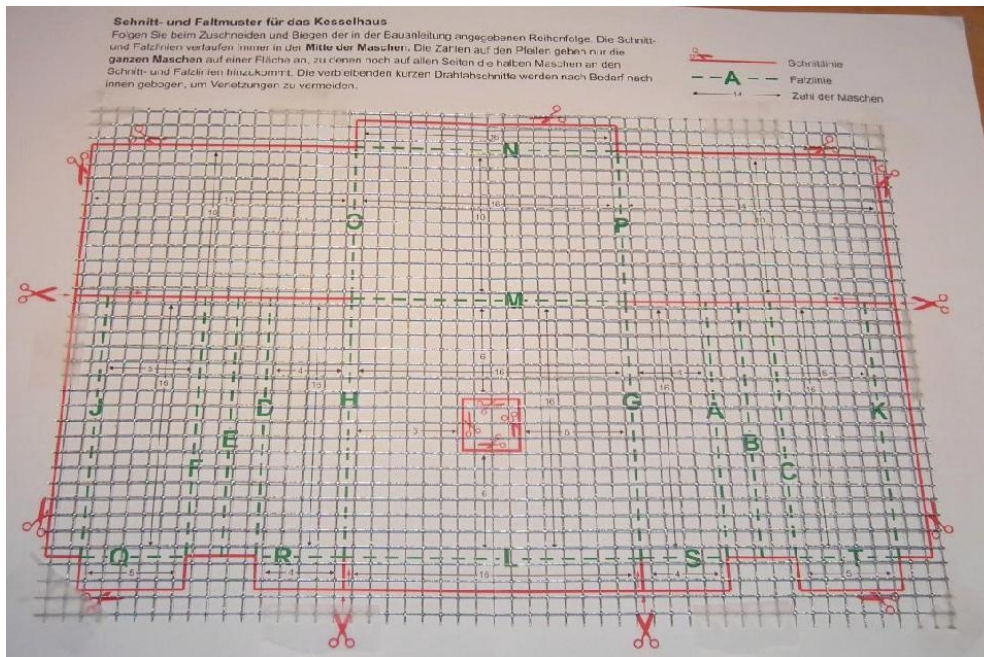


After the gluing of the base has dried into a square, the top part of the fireplace is glued to the base (step 85). Next, the two sleeves are attached to the top and bottom of the mantel (step 86). While these glues are drying, step 87 is started, the creation of an 18cm long tube of aluminium foil, which is built into the chimney - here e.g. a broomstick (o.a. with approx. 24mm diameter) is quite helpful.



After the tube of aluminium foil has been wrapped, cut and glued as described in step 87, it is pulled into the chimney as described in step 88.

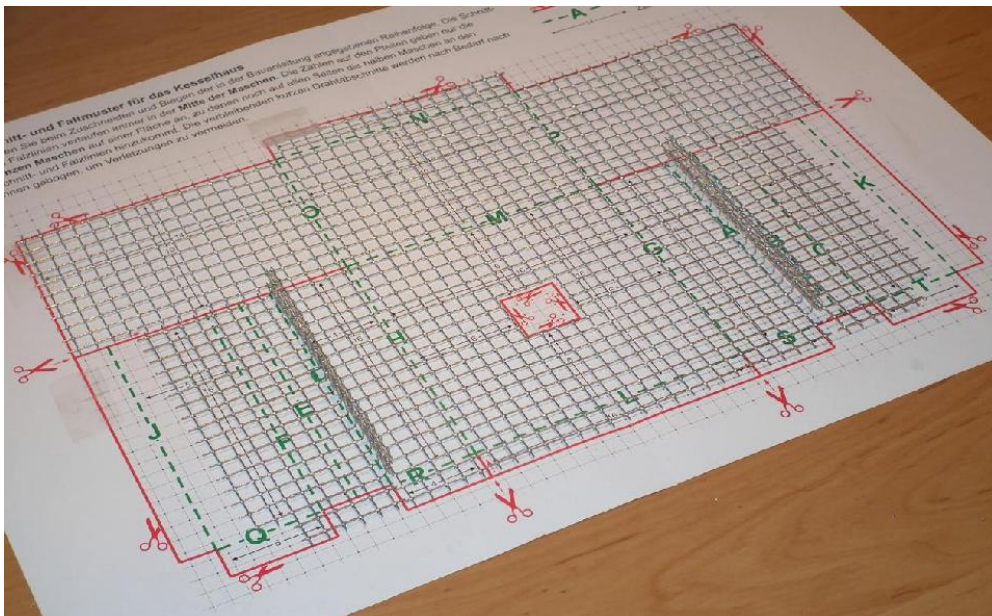
## Stage Q - The Boiler House



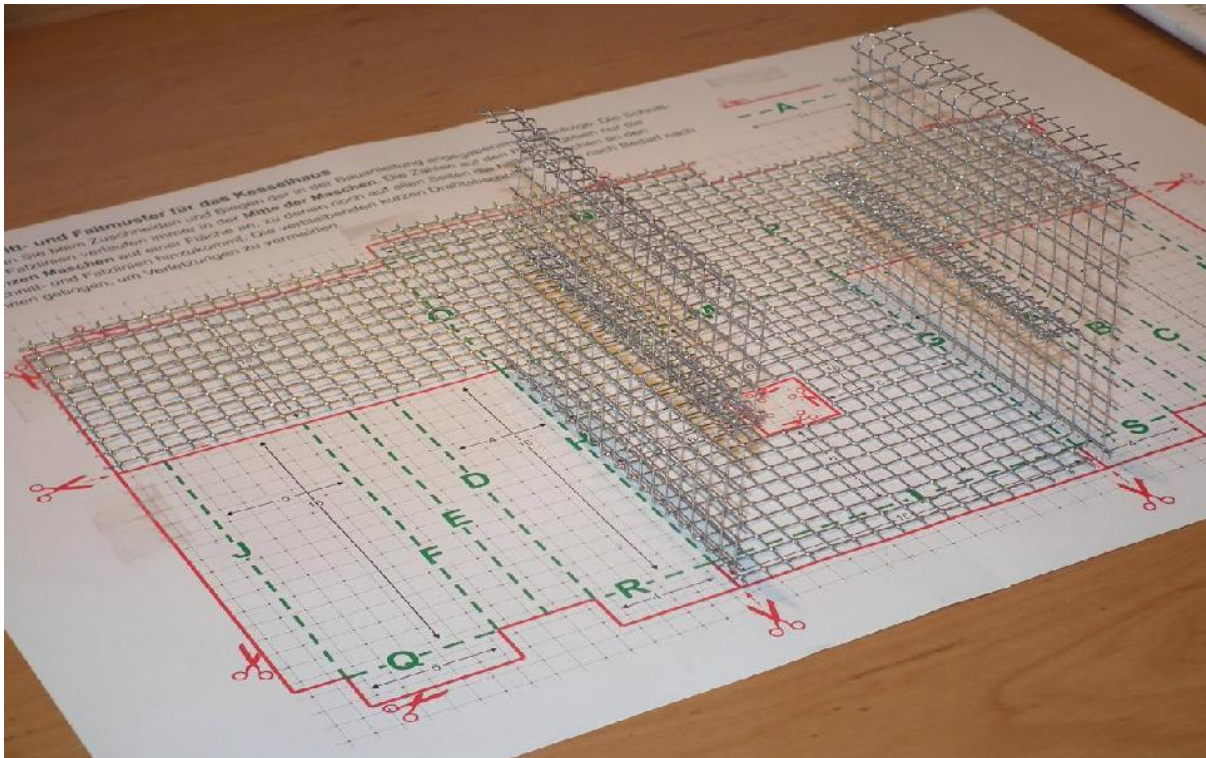
The pattern sheet may seem a bit confusing or complicated at first glance, but after completing the first steps to build the boiler house, it becomes clear that it is actually quite simple.

First, attach the pattern sheet to the work surface with a little adhesive tape. Following steps 89 and 90, unfold the wire mesh and attach it to the pattern sheet with a few strips of tape - as shown in the picture above.

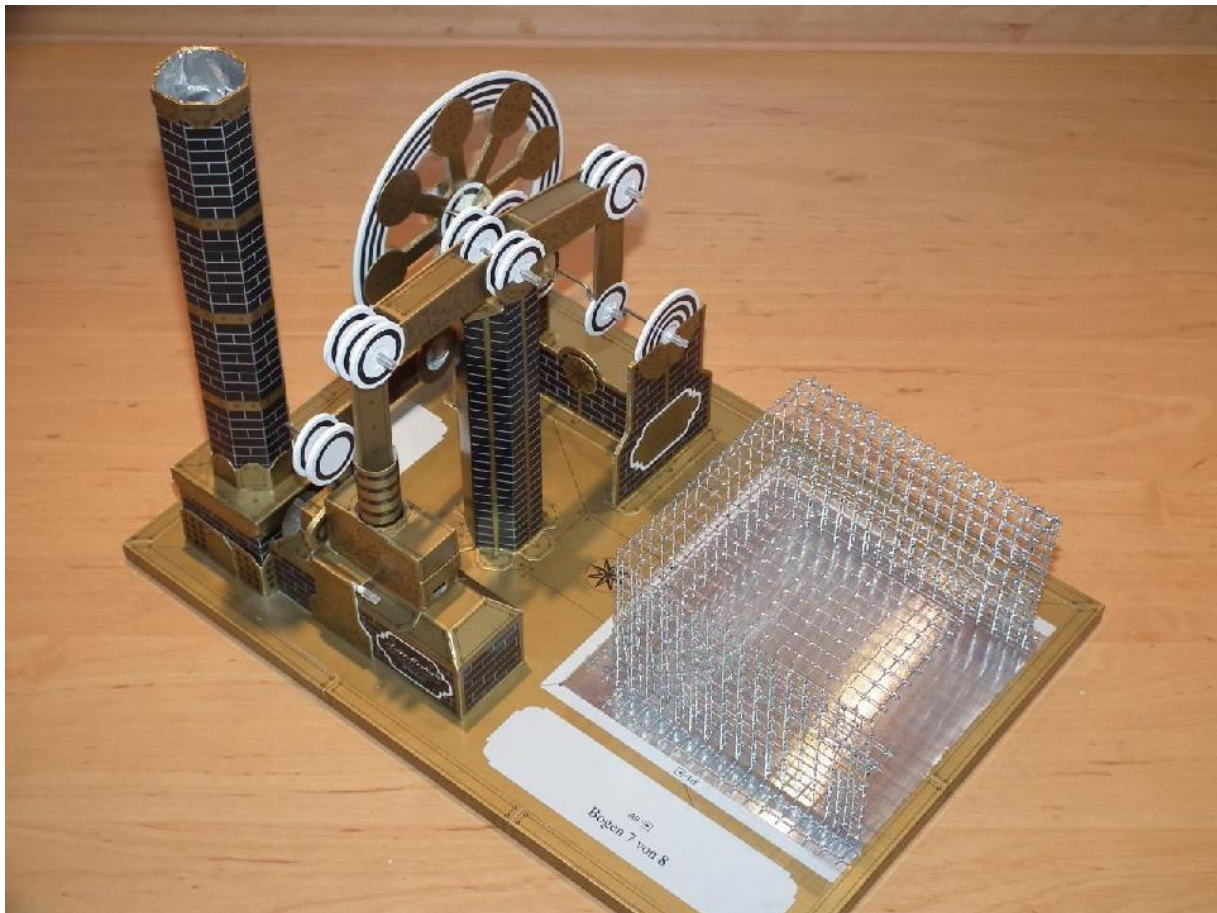
If the meshes of the wire grid and the pattern sheet are not absolutely congruent, align the grid with the centre of the pattern sheet.



According to step 91, the wire mesh was first given its shape by cutting out and cutting in along the red marking lines. Following steps 92 to 94, the first folds were made.



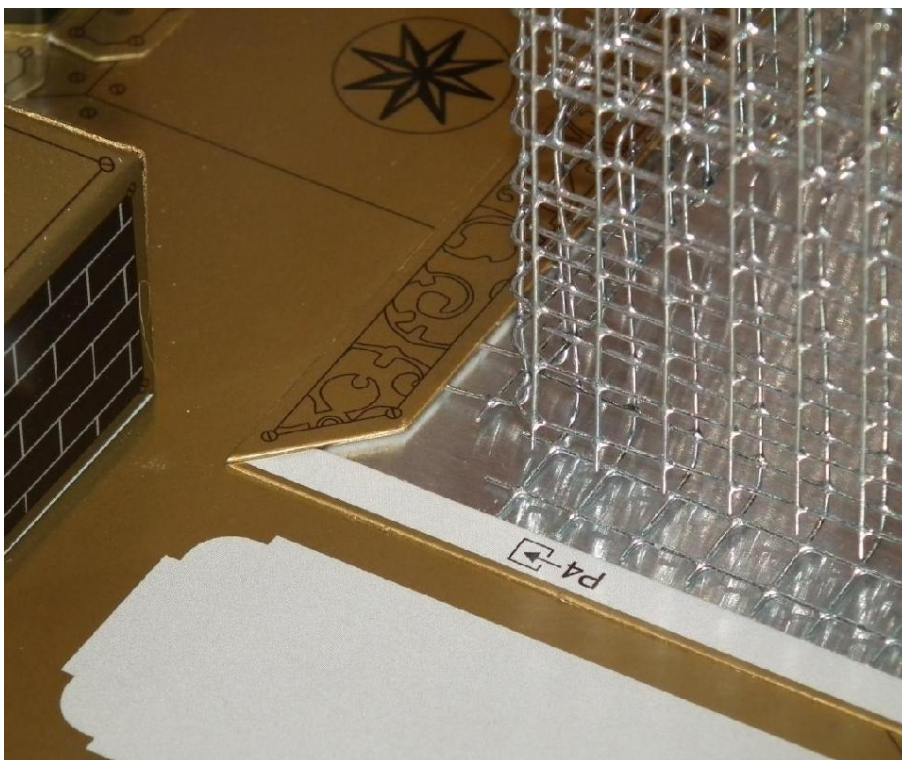
The boiler house is already taking recognisable shape after the completion of step 96.



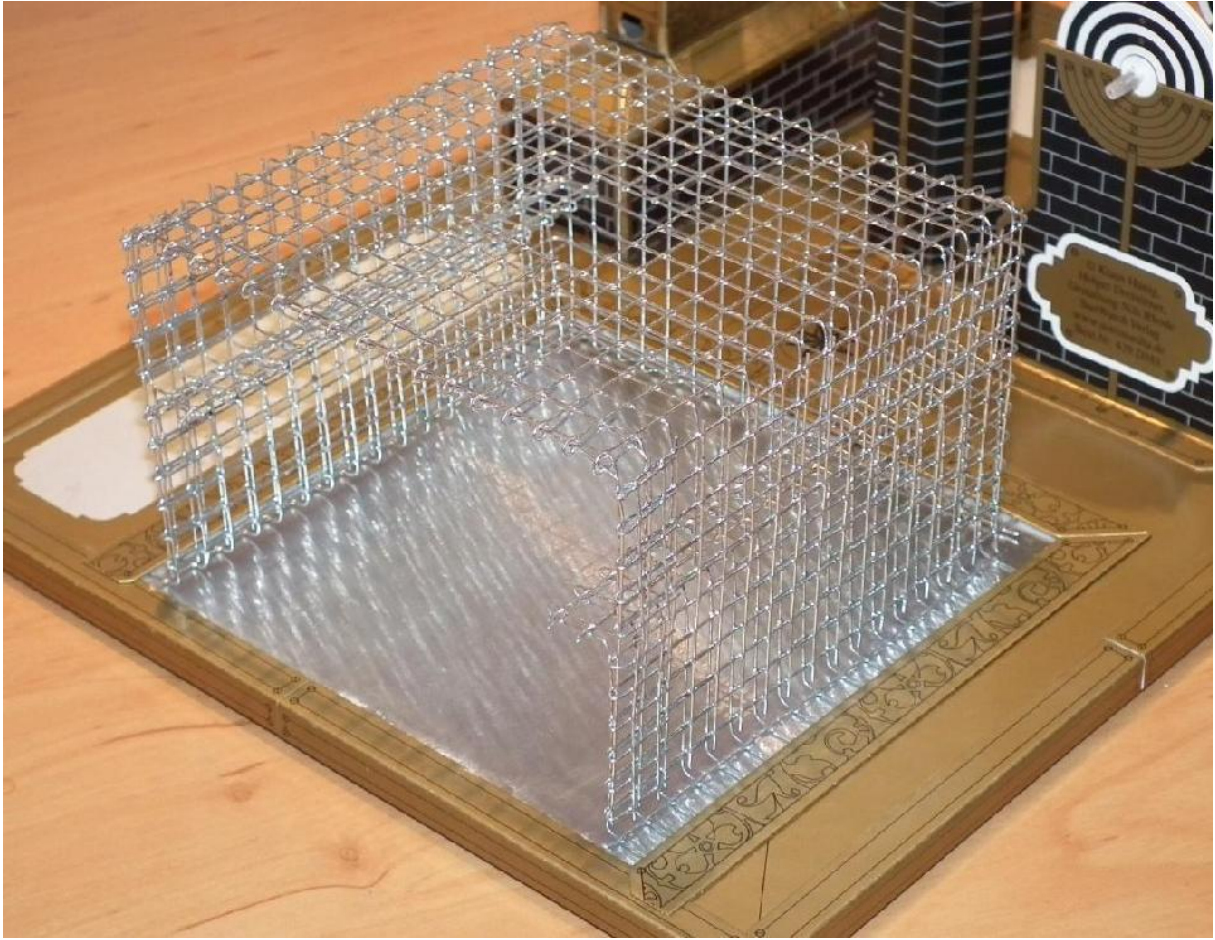
Step 99 follows to check the fit of the boiler house in the cut-out on the top of the base plate and the fit of the boiler in its compartment in the boiler house, so that any necessary corrections can be made before the boiler house is fitted.



The lower and upper boiler house surrounds are glued to the base plate according to the instructions in steps 100 to 104. The picture shows the condition after step 102 with the pocket between the aluminium sheet and the upper surround to accommodate the rear baseboard of the boiler house. If superglue is used for the edging strips, virtually no drying time is required and the last steps of this construction section are quickly completed.

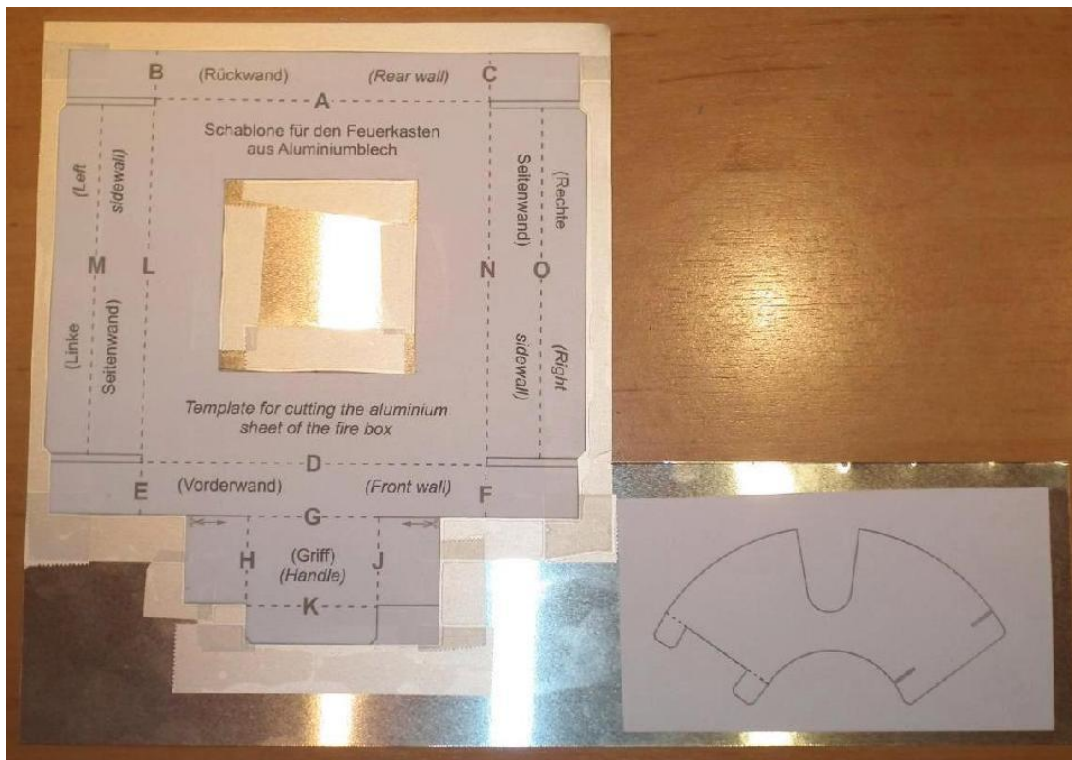


Step 103 - The boiler house is pushed into the pocket with the rear baseboard and checked again for correct seating of the side baseboards.

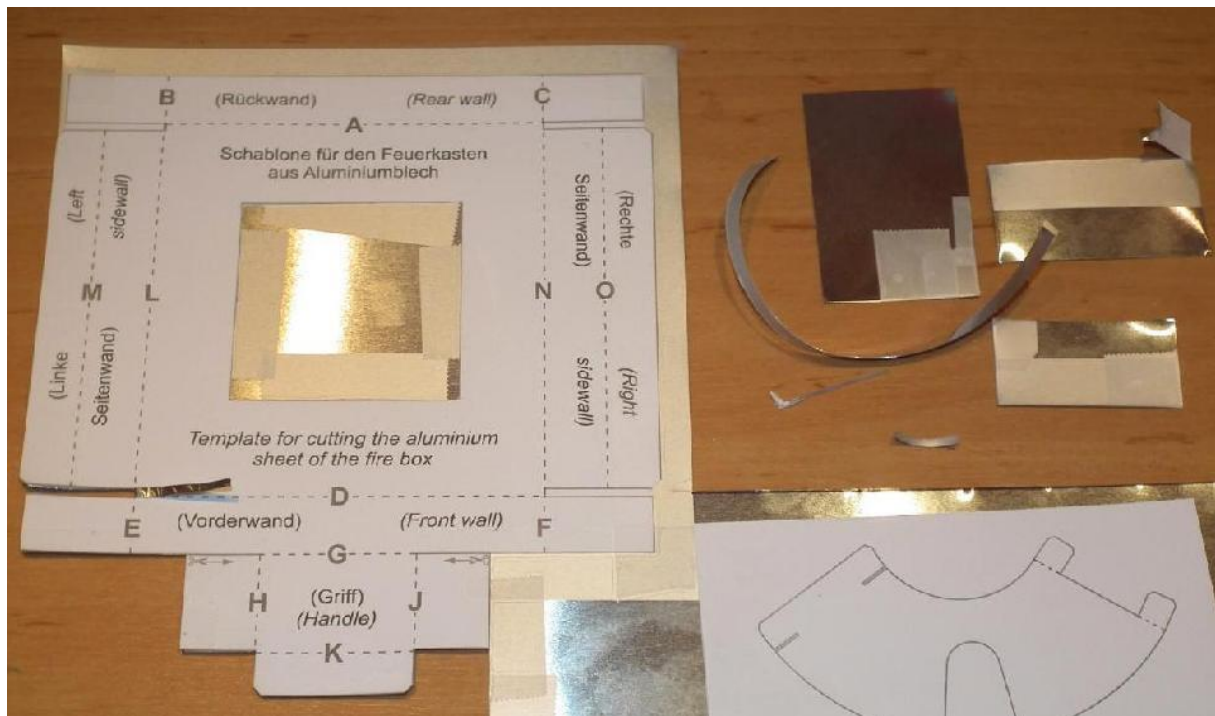


The state after step 104, the assembly of the two lateral upper edging strips.

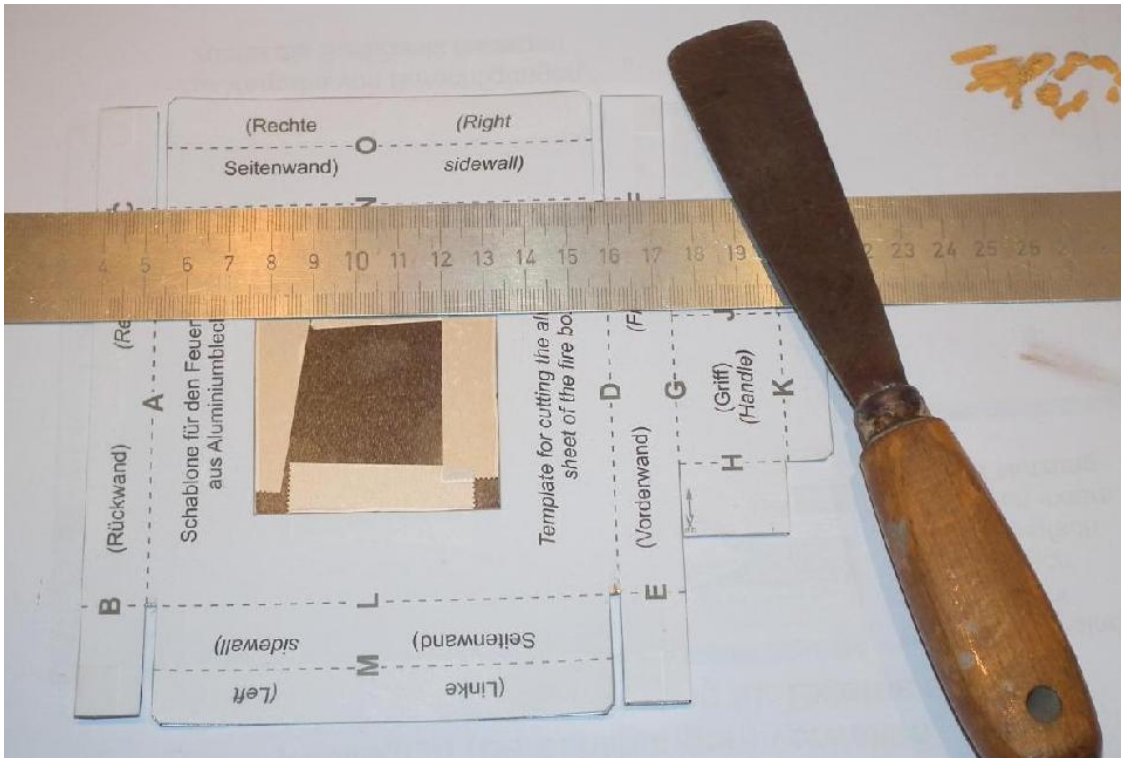
## Stage R - The Fire Box



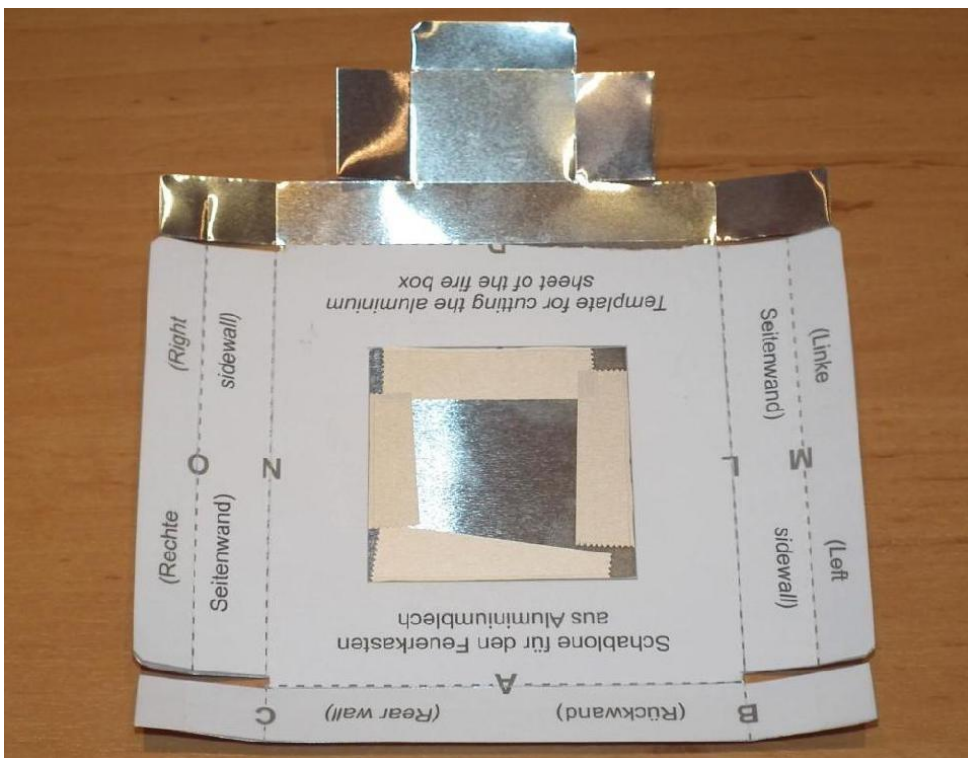
Steps 105 to 110 show how to make the firebox that will hold the five tea lights to heat the boiler. The procedure shown here for cutting the box (step 105) out of the sheet metal differs slightly from the instructions. A copy of the template was made and cut out exactly at the edges and also glued onto the sheet metal without adding any borders. Furthermore, step 107 was done before 106.



The method of using the template without adding borders has proven itself.

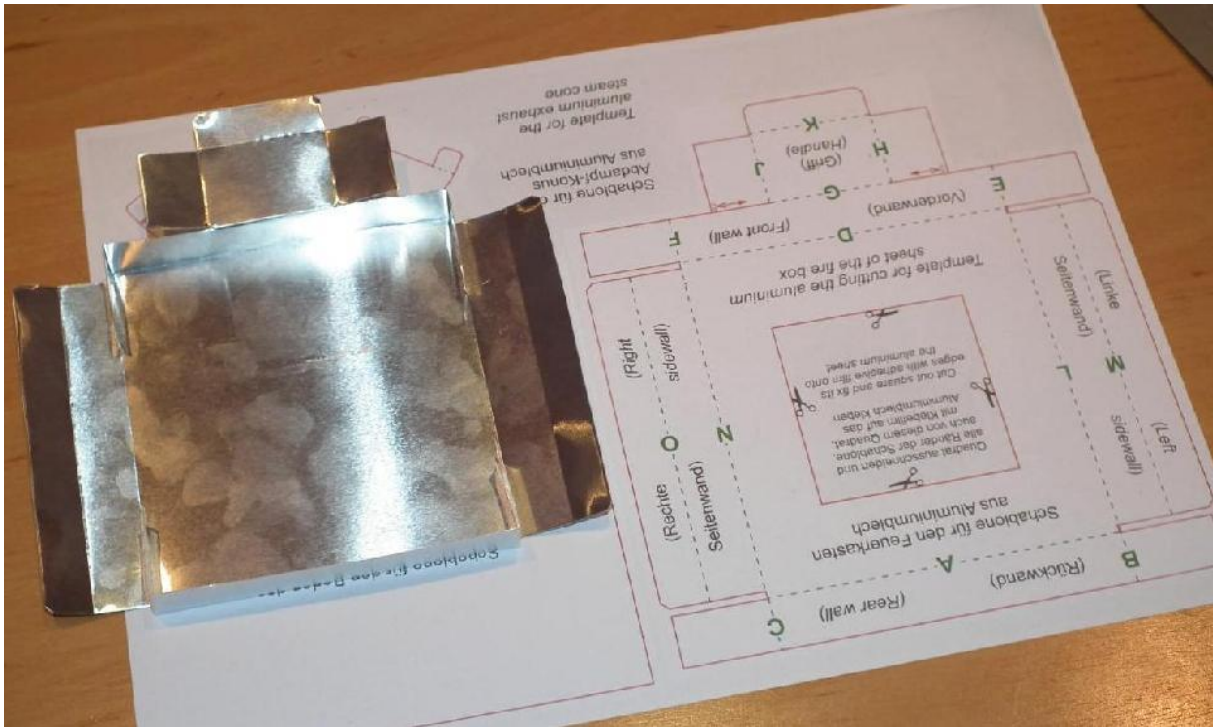


Step 106 - Creasing the sheet along the given lines is done on a stack of paper with an old spatula (round, thin corners) along a steel ruler.



When grooving with the spatula, the template suffers losses, but the sheet now knows what it has to do...





Steps 108 to 112 describe in detail the folding of the walls and the handle of the firebox. A (steel) ruler is helpful for exact execution.



The completion of the firebox was surprisingly quick. A little 2C glue in the angle between the handle and the front side wall should prevent the sheet metal from tearing during frequent use.

## Stage S - The Steam System



How two syringes, a silicone tube, four O-rings and a disposable glove are transformed into a steam system is explained in steps 113 to 116.

In the picture, you can see that step 113 has already been completed on the large syringe: There is a 2cm piece of silicone tubing on the nozzle. Alternatively, you can use a 3.2mm heat-shrinkable tube of the same length, which is pressed onto the nozzle (but NOT shrunk). Fastening is not necessary.

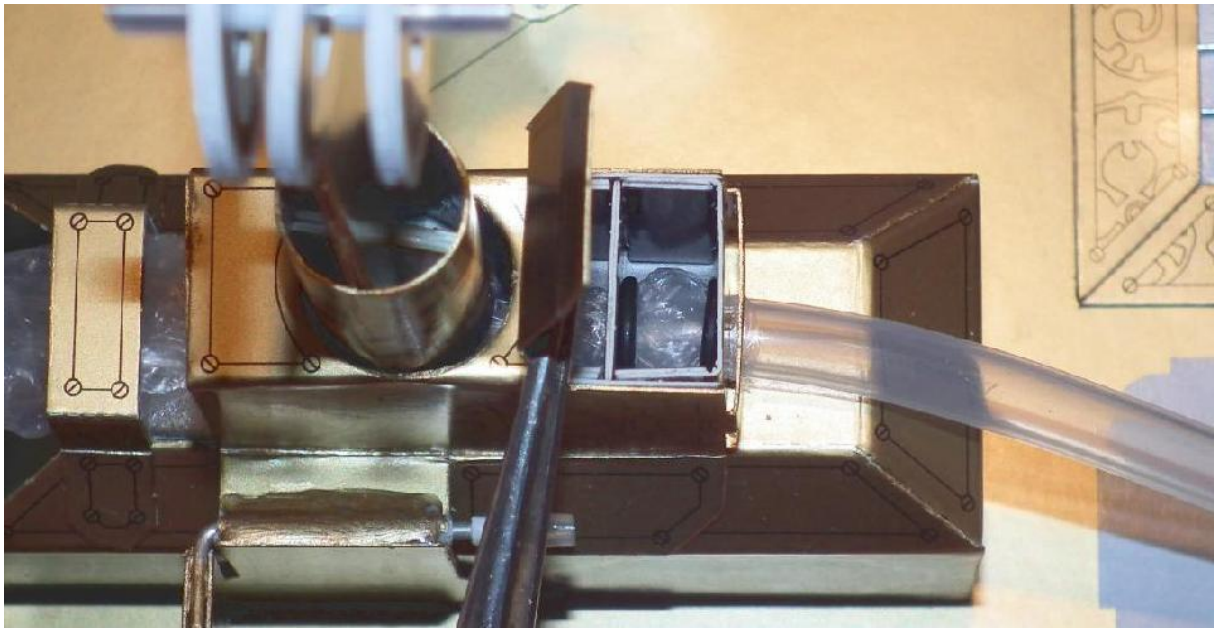


Step 114 - Cut off one finger of the glove and make a hole in the closed end to fit the hose. Pass the hose through this hole and secure it with the two small O-rings, which must be 1cm apart.



According to steps 115 and 116, the steam system is completed with the exhaust pipe - consisting of the small, modified syringe. The sealing on the exhaust side is done by means of the large O-rings.

**Stage T - The installation of the steam system and the exhaust cone**



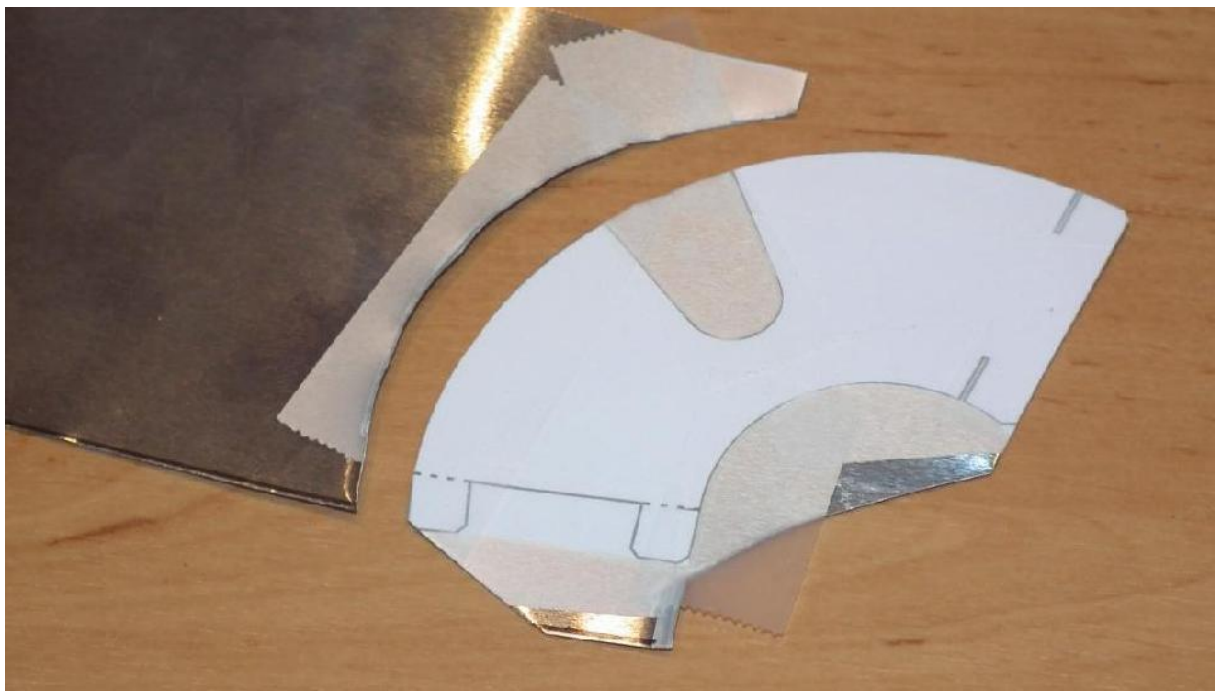
Install the steam system in the cylinder block as described in step 117, here the area to the right of the partition wall. The O-rings are in contact with the outer wall and the partition wall.



The exhaust pipe protrudes into the condensation water tank. When installing, make sure that the piston bellows does not twist.



The steam hose is passed through the magnet and should extend 1 to 2 mm beyond its edge. More prose on this in step 118 of the instructions.



In the middle of step 119 - After fixing the (copy of the) template for the evaporation cone on the sheet metal by means of a few strips of adhesive film, the necessary cuts are made.



Step 120 describes how to bend the sheet into a cone and how to proceed with the tabs for locking. The result can be seen in the picture above.



The exhaust pipe projects into the condensation water container in which the exhaust cone is located. The latter ensures that the exhaust steam enters the pipe of the chimney.

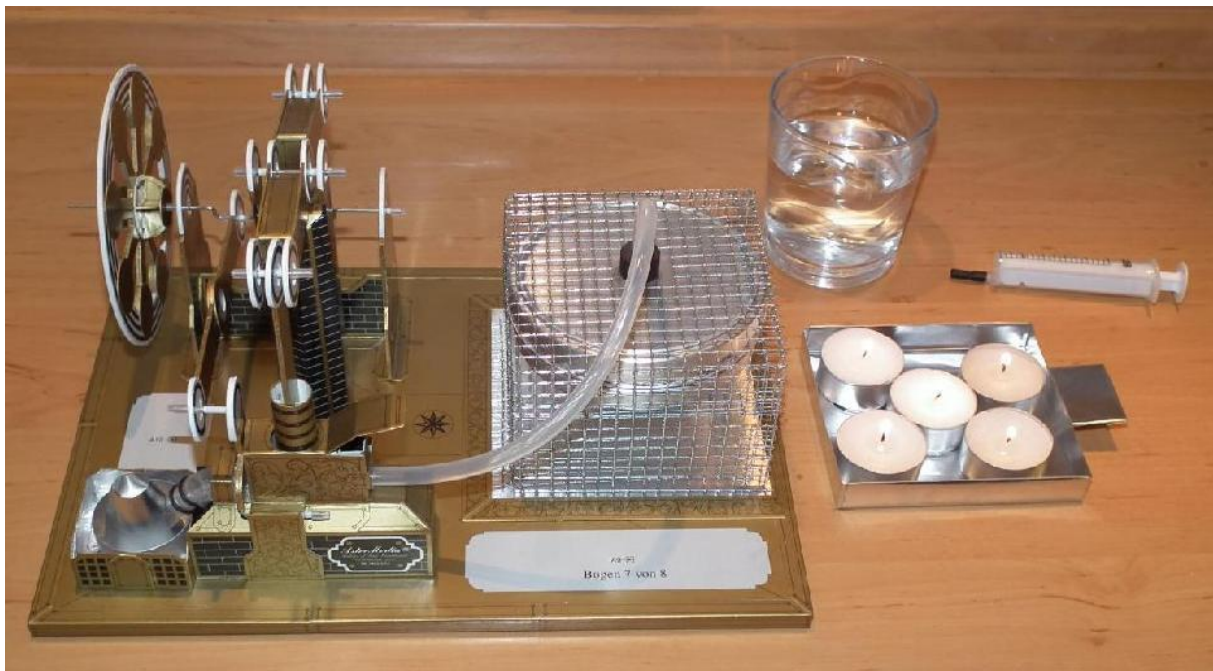
## Stage U - The piston rod and valve stem adjustment



Step 122 - Two spacers and a lock on the valve linkage. Contrary to the instructions, the spacer between the valve and the valve stem is 14mm long. The locking piece is correspondingly shorter.

Steps 121 and 123 do not allow any meaningful pictures - follow the text of the instructions !

## Stage V - The first launch



Condition after steps 124 and 125 - Kettle filled as specified, five tea lights and one chimney not yet inserted.



**It's steaming!**