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**Experience from  
the ASDEX and ASDEX Upgrade ICRF systems  
with emphasis on the antenna**

**or**

**(alternative title)**

**what we think we understand  
and what we still don't**

**Jean-Marie Noterdaeme  
for the ICRF group**

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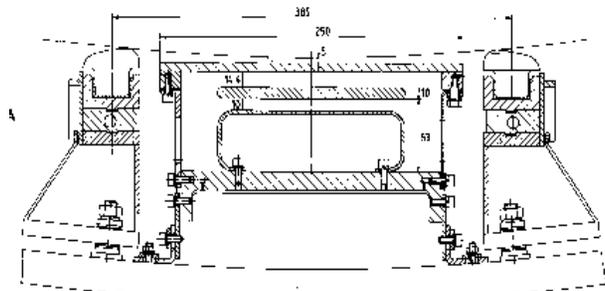
# ASDEX

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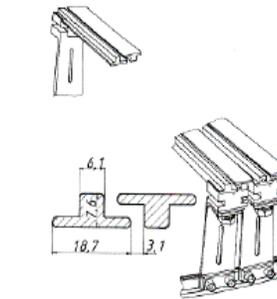


- **2 antennas, 2 generators (2 x 1.5 -> 2 MW)**
  - toroidally 1 strap, low power density
- **mostly problems with plasma**
  - second harmonic -> impurities
  - H minority -> getting H % low enough
  - better after carbonisation
- **technical problems**
  - transmission line through divertor -> needs to be vacuum tight
  - separate limiters -> arcing, despite grounded
  - H-mode transition -> matching gone -> generator turn off
- **tested :**
  - optically closed FS, optically open FS, cooled FS
  - coatings : TiN, TiC on Cu

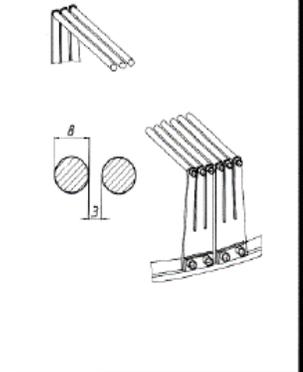
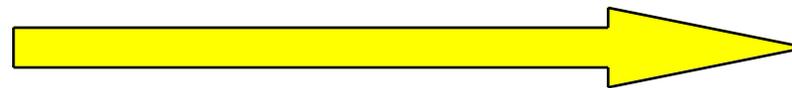
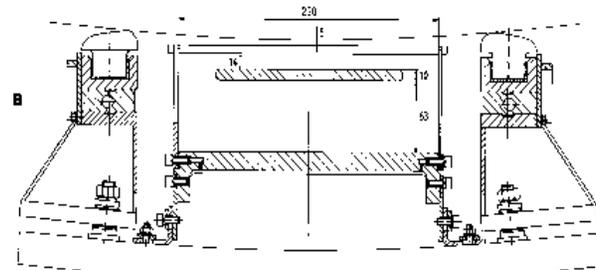
# ASDEX Faraday screens



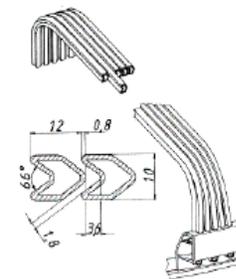
Optically closed



Optically open



Cooled,  
optically closed



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# ASDEX Upgrade

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- **4 antennas, 4 x 2 MW generators**
  - toroidally 2 straps, low power density
- **no problems with impurities in D(H)**
  - in very low single pass absorption scenario still difficult
- **matching**
  - H-mode o.k., but at first, massive problems with ELMs
  - solved with 3 dB couplers
- **limit now : depending on coupling/plasma**
  - power of generators (tubes old, getting refurbished)
  - or voltage limit (antenna)
- **technical problems**
  - arcing at insulators (capacitor plates and dc insulation to ground)
  - heat load on limiters due to fast particles NI

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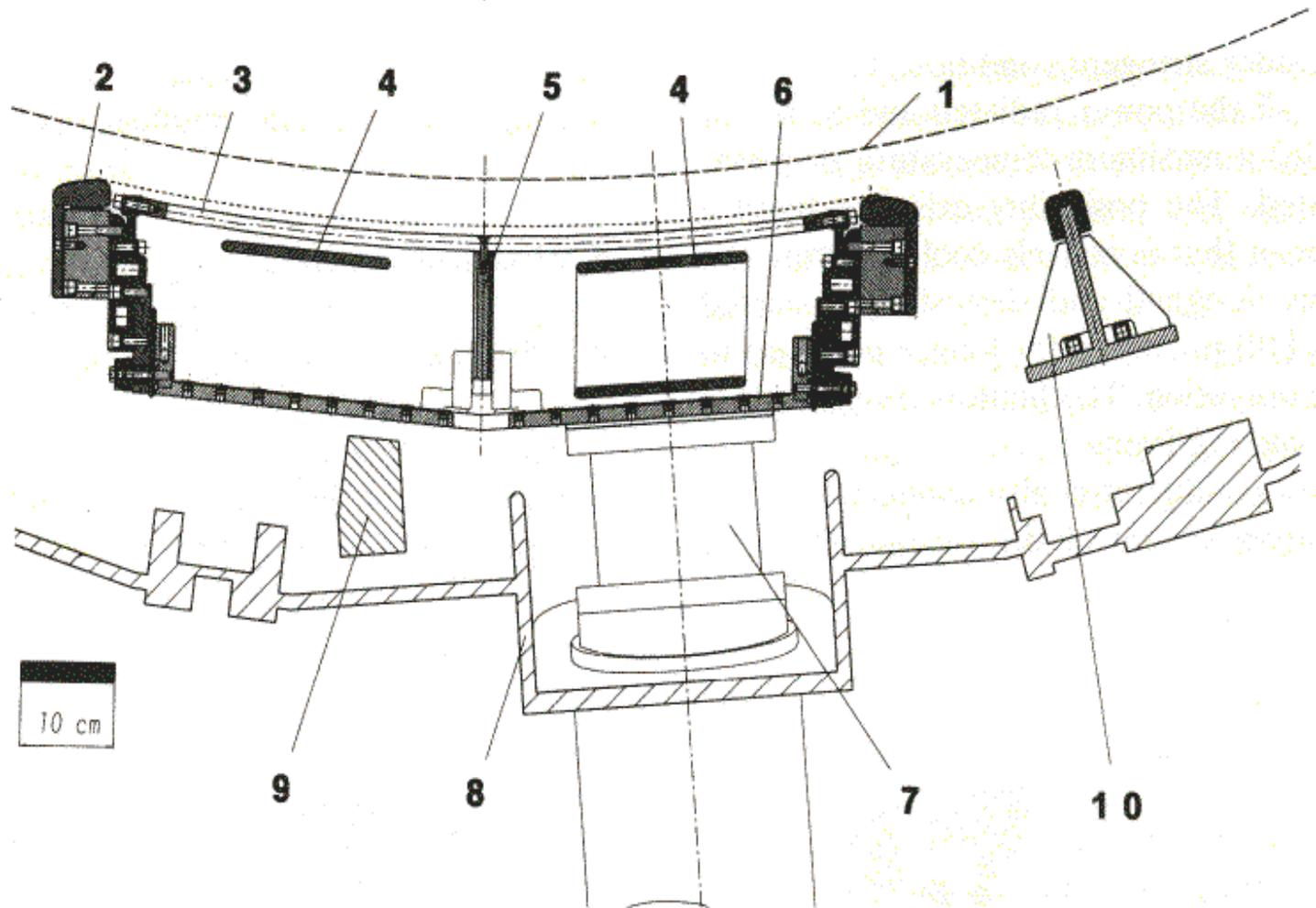
## changes since 1992

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- **removal of capacitor plates**
- **removal of insulation top and bottom**
- **3-dB couplers**
- **test antenna w.o. FS (add central limiter)**
- **increase width limiters**
- **adaptation to larger triangularity**
  - further away
  - larger depth
- **insulation removed in water feed**

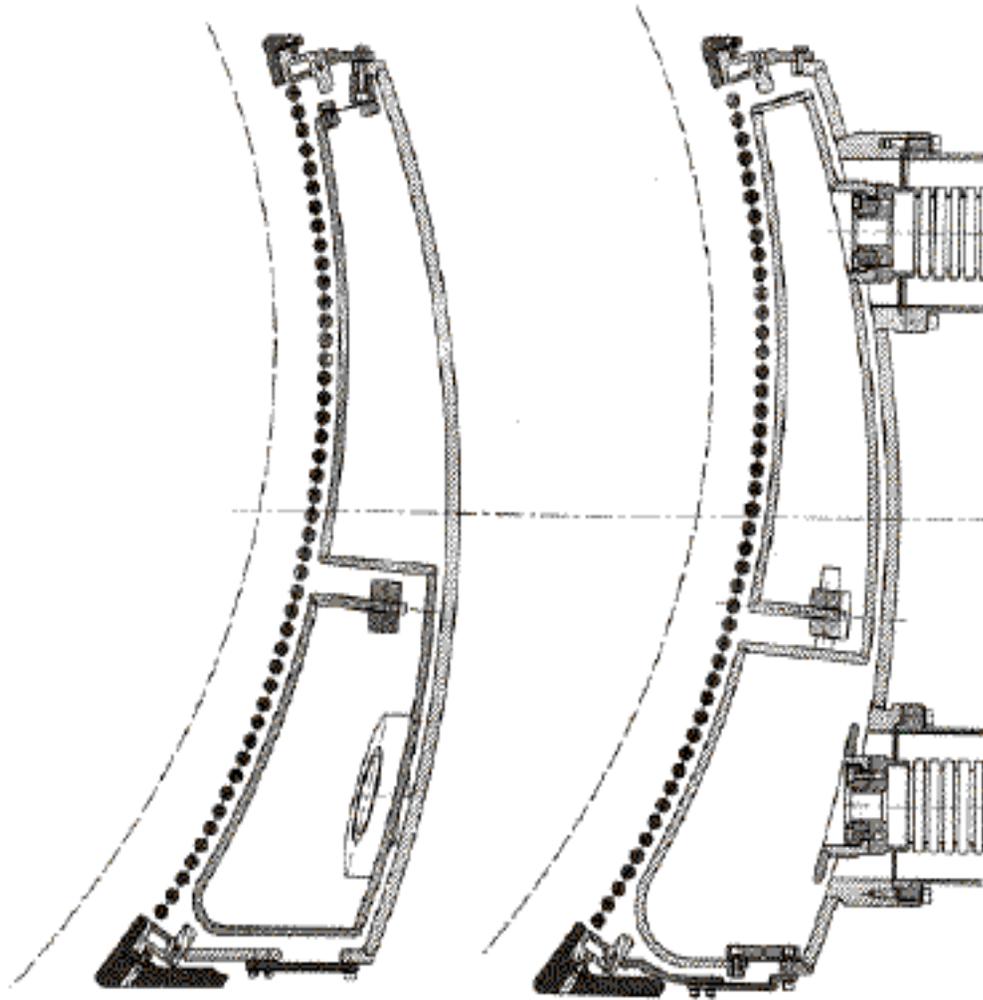
# Horizontal cut through the antenna



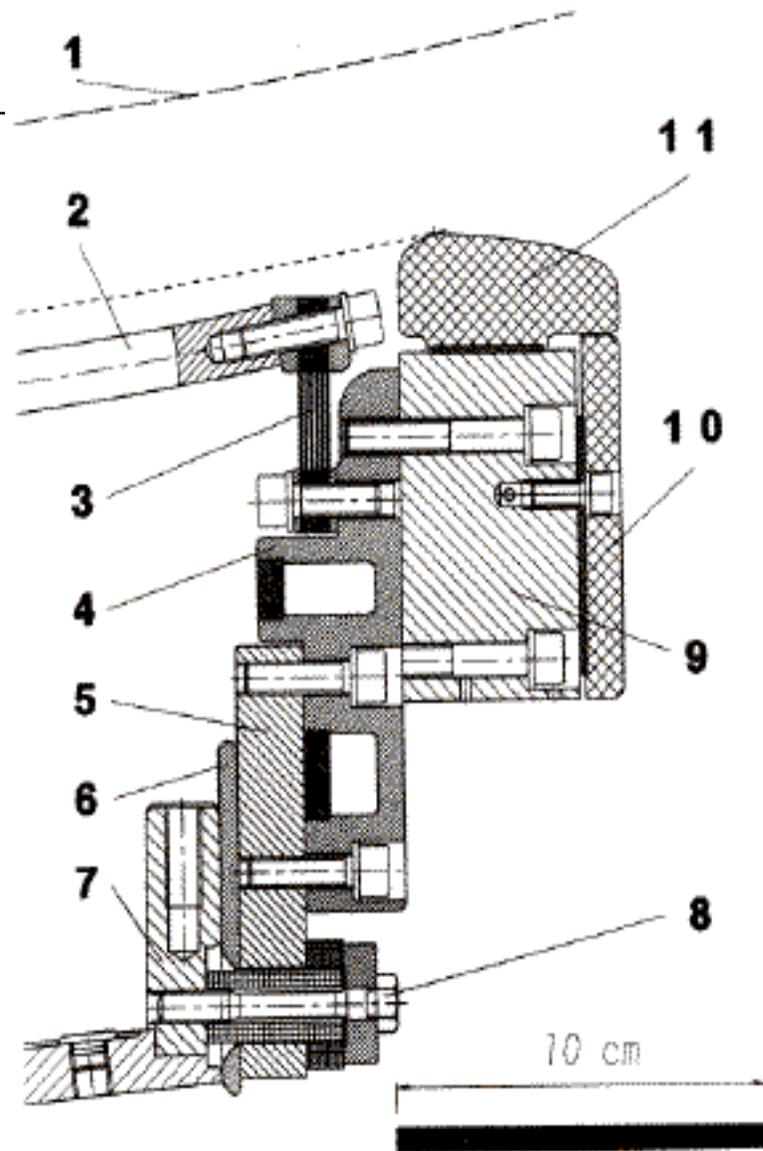
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# Poloidal cut

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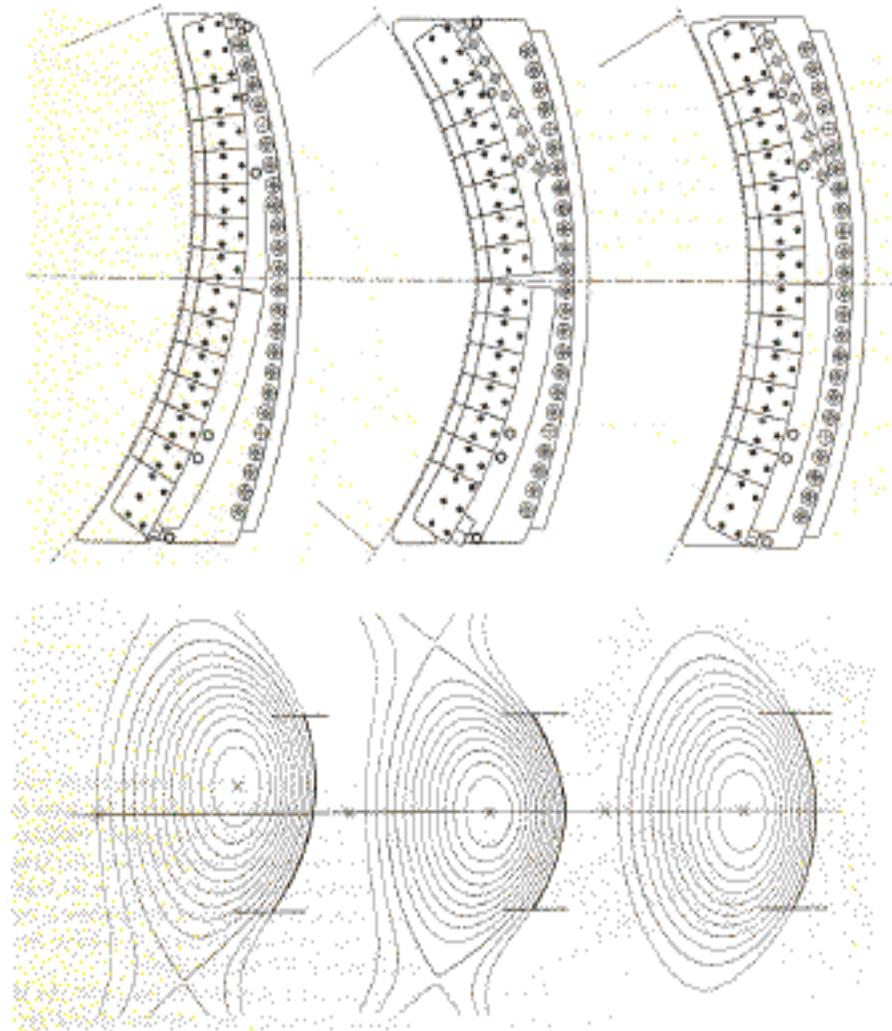
# Detail of the side



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# Distance plate to adapt to different plasma configurations

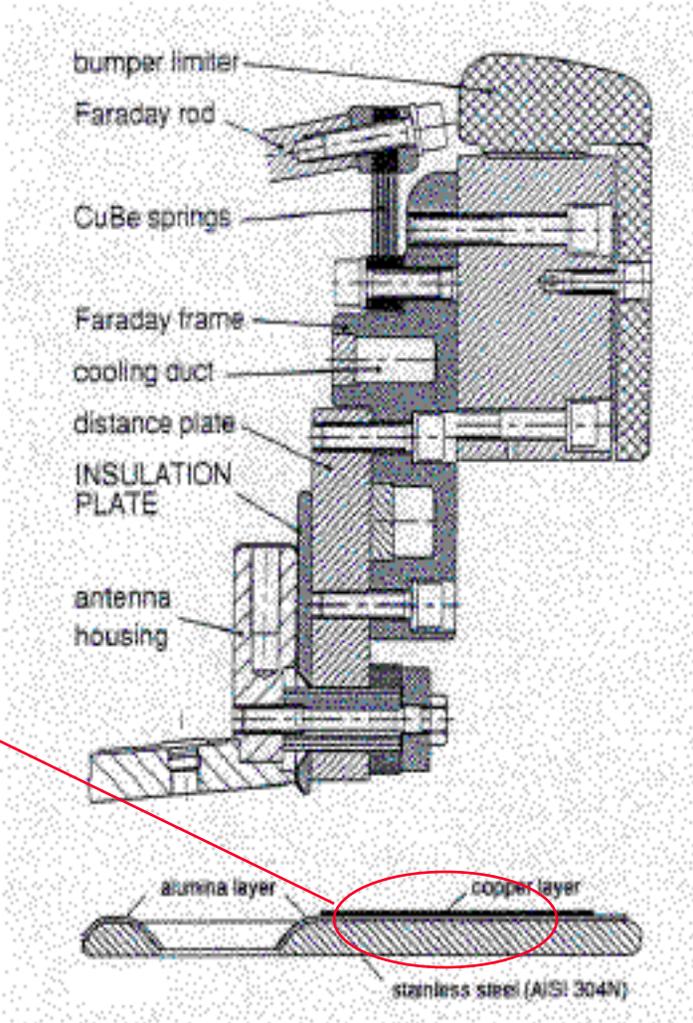
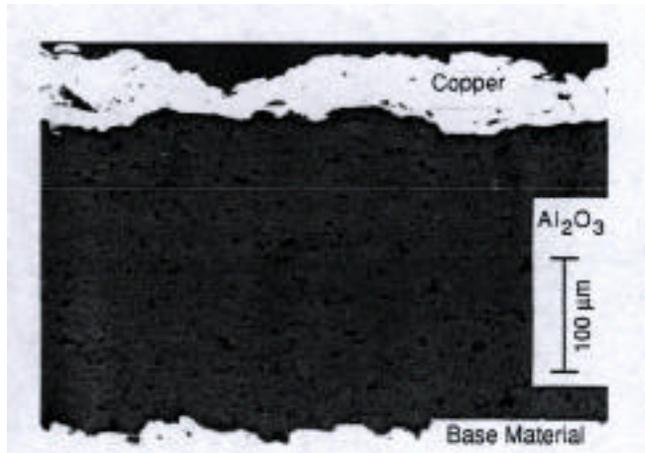
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# Insulation plate : $\text{Al}_2\text{O}_3$ on SS, Cu (plasma sprayed)

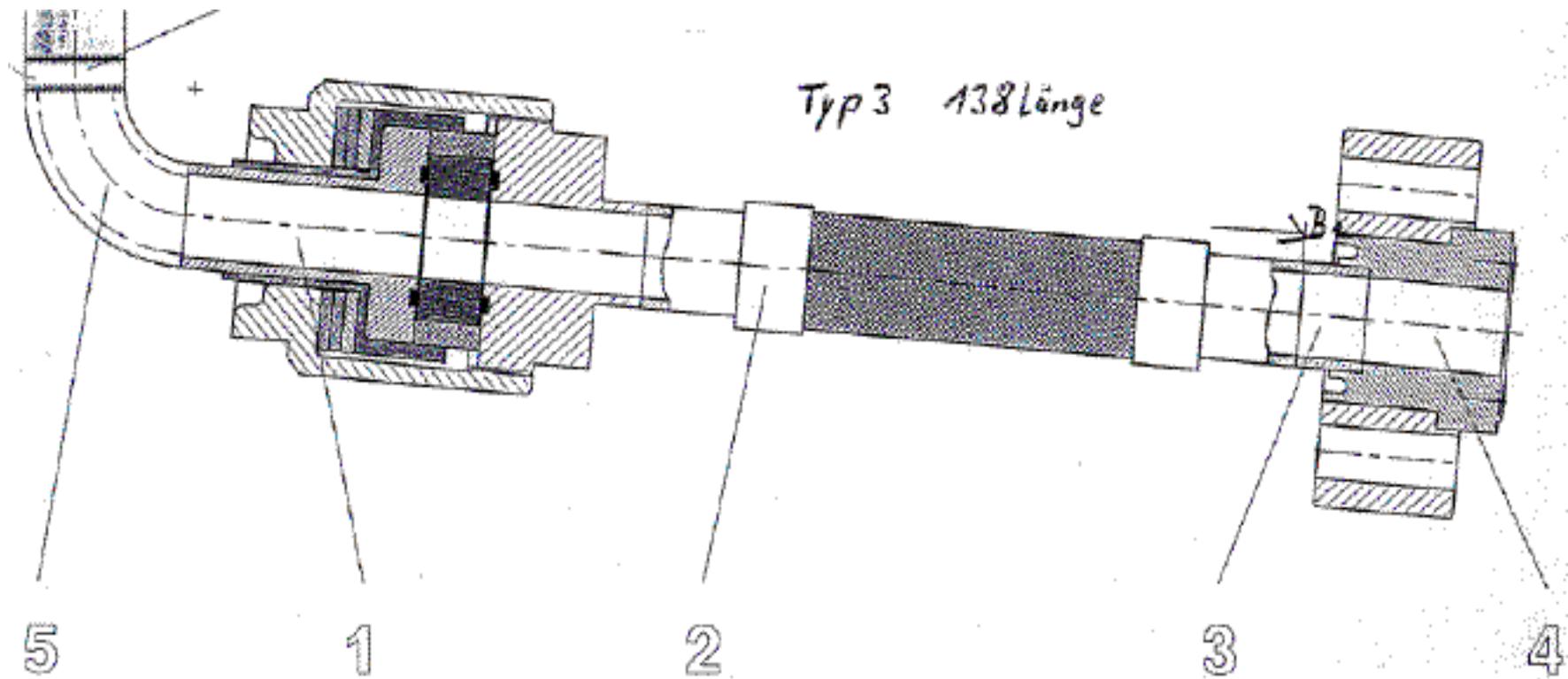
other options considered  
and rejected :

Mica  
anodic oxidation of Al



ref. Kutch et al., Fusion Techn. 92, 569

# Water connection



# Insulated water connection

