Permanent filling materials

Amalgam

Metal-like restorative material composed of silver-tin-copper alloy and mercury.

Composition

- Mercury
- Metal alloy (Silver, tin, copper, zinc)

Mercury

- Clean, destilled
- Heavy metal, liquid (room temperature)

Particles of the alloy

- ✓ Irregulary shaped (filings - lathe cut)
- ✓ Microspheres
- ✓ Combination of the two
- ✓ Spheroids

Particles shape

High – Copper Amalgam

Microsphers of the same composition (unicompositional)

Mixture of irregular and spherical particles of different or the same composition (admixed)

Production of irregular particles

Ingot cooled slowly

Ingot heated at 400°C (6 – 8 hours)
(homogeneous distribution of Ag_3Sn)

Ingot cut on the lathe, particles passed trough a fine sieve and ball milled to form the proper particle size.

Aging of particles (60 - 100°C, 6 – 8 hours)

Particle size: 60 – 120 μm in length
10 – 70 μm in width
10 – 35 μm in thickness

Production of spheroid particles

Molten alloy is spraying into water under high pressue

Production of spherical particles

Molten alloy is spraying under high pressue of inert gas through a fine crack in a crucible into a large chamber

Diameter of the sphers: 2 – 43μm

Importance of components

- **Silver:** slow reaction with mercury, accelerates setting process, increaes mechanical properties, increases corrosion resistance.
- **Tin:** fast reaction with mercury, retardates setting time, decreases mechanical propeties, decreases corrosion resistance

  Copper: difficult slow reaction with mercury, increases hardness and corrosion resistance.
- **Zinc:** antioxidant agent, reason for internal electrochemical corrosion.
- **Noble metals:** increase corrosion resistance and price

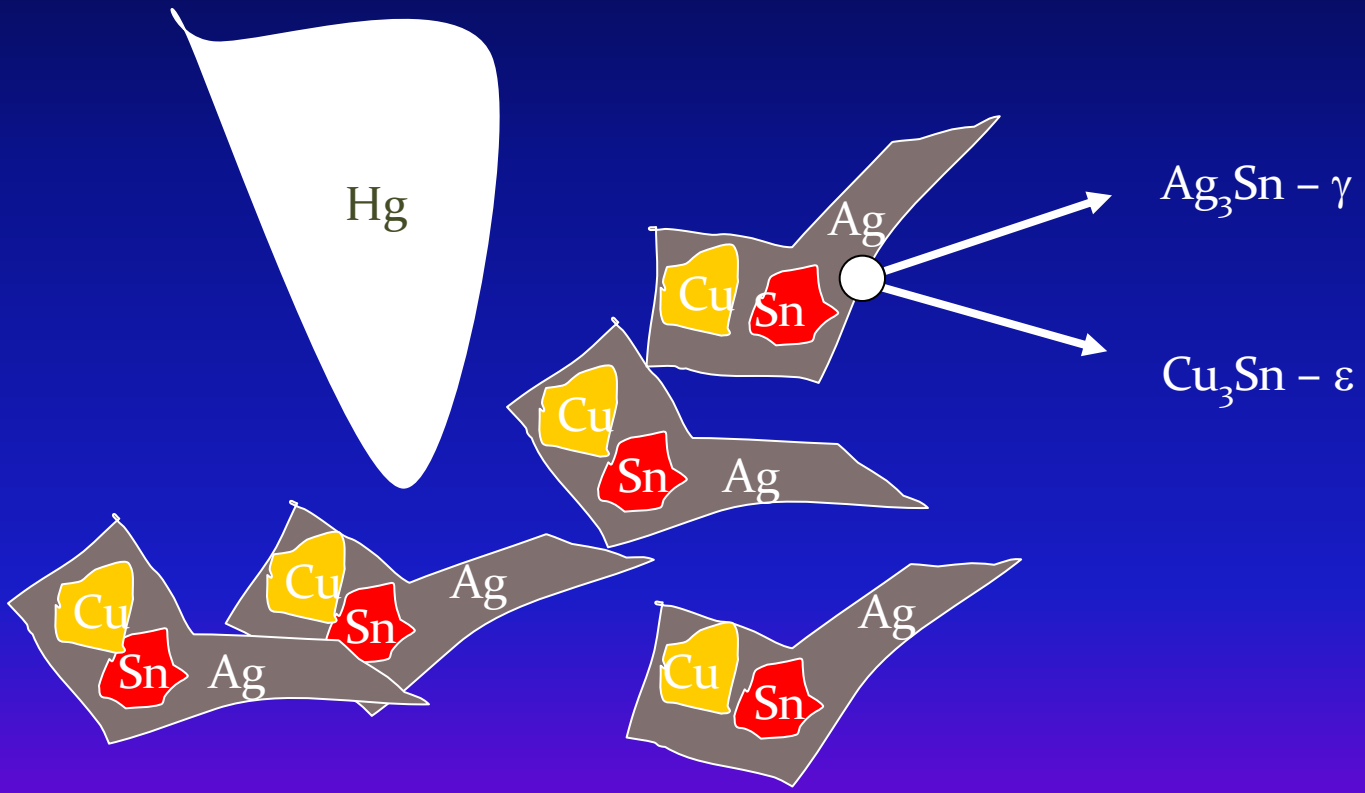
Conventional amalgam alloy– low copper amalgam

- Silver 70%
- Tin 24-26%
- Copper up to 6%
- Zinc 0 - 2%
- Noble metals (gold, platimun) – in some alloys

Setting of conventional amalgam

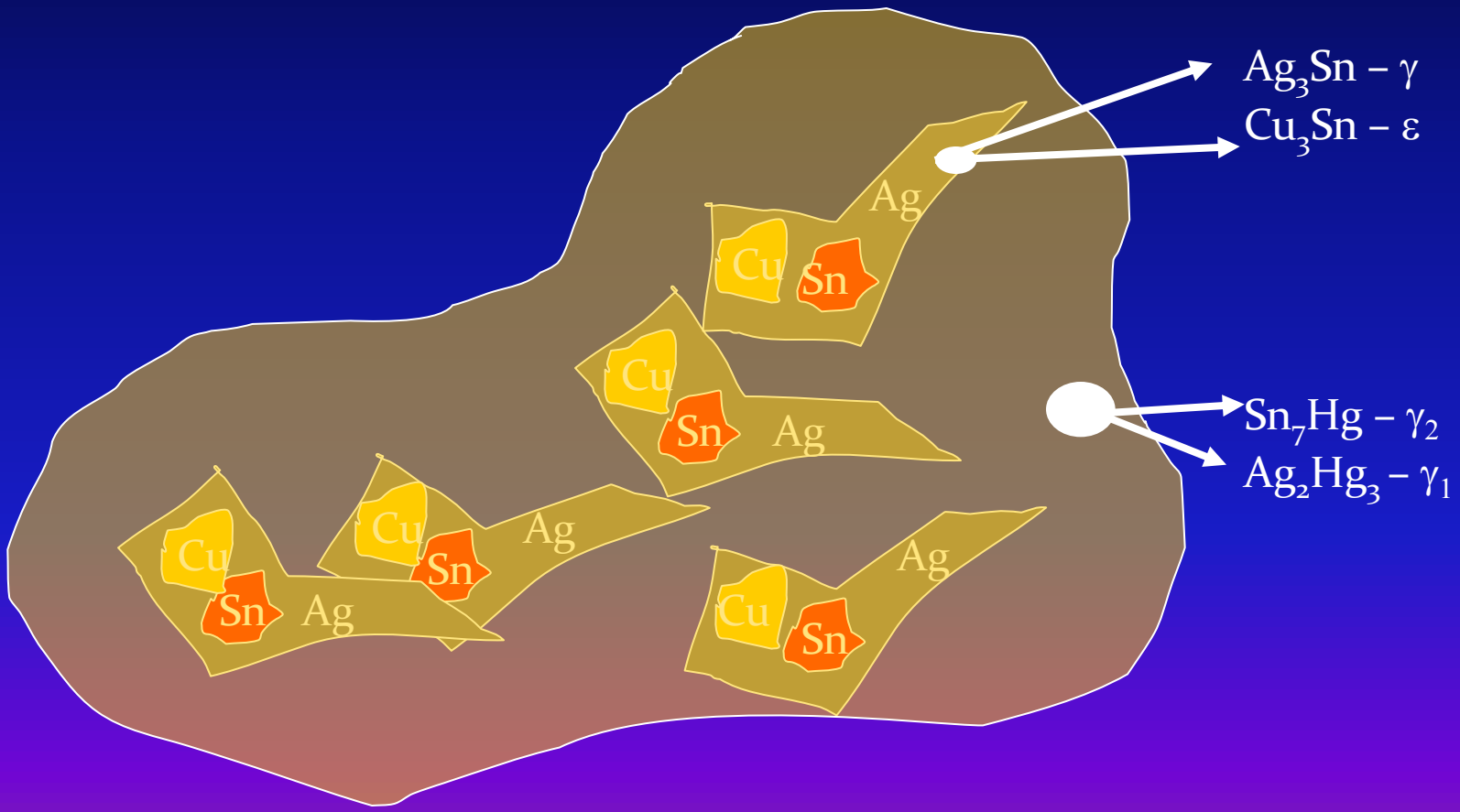
Alloy contents silver, tin and copper.
There are intermetalic compounds – phases
Gamma phase Ag-Sn
Epsilon phase Cu-Sn
Mercury dissolves particles of amalgam, arise new compounds - phases
Ag-Hg: gamma 1 phase
Sn-Hg: gamma 2 phase
The new phases crystallize
Part of gamma phase does not dissolve
Therefore the amalgam contains after setting gamma 1,gamma 2 and gamma phase.

Amalgamation



Procesy amalgamace

Konvenční amalgám



External electrochemic corrosion

- Gamma 2 phase is not stable, Tin releases easily and disappears, mercury can dissolve gamma phase. The mechanical resistance to occlusal loading decreases

The process of degradation of gamma 2 phase is external electrochemic corrosion.

Internal electrochemic corrosion

- Zinc decomposes water: hydrogen and oxygen cause expansion of the filling,

Flow and creep

Flow is deformation of amalgam that is not completely set.

Creep is deformation of amalgam that is completely set. The filling is beaten during occlusal loading – smal thin spits break – margins of filling become rough.

High copper amalgam (non gamma 2)

- Content of copper increased up to 12%-30%

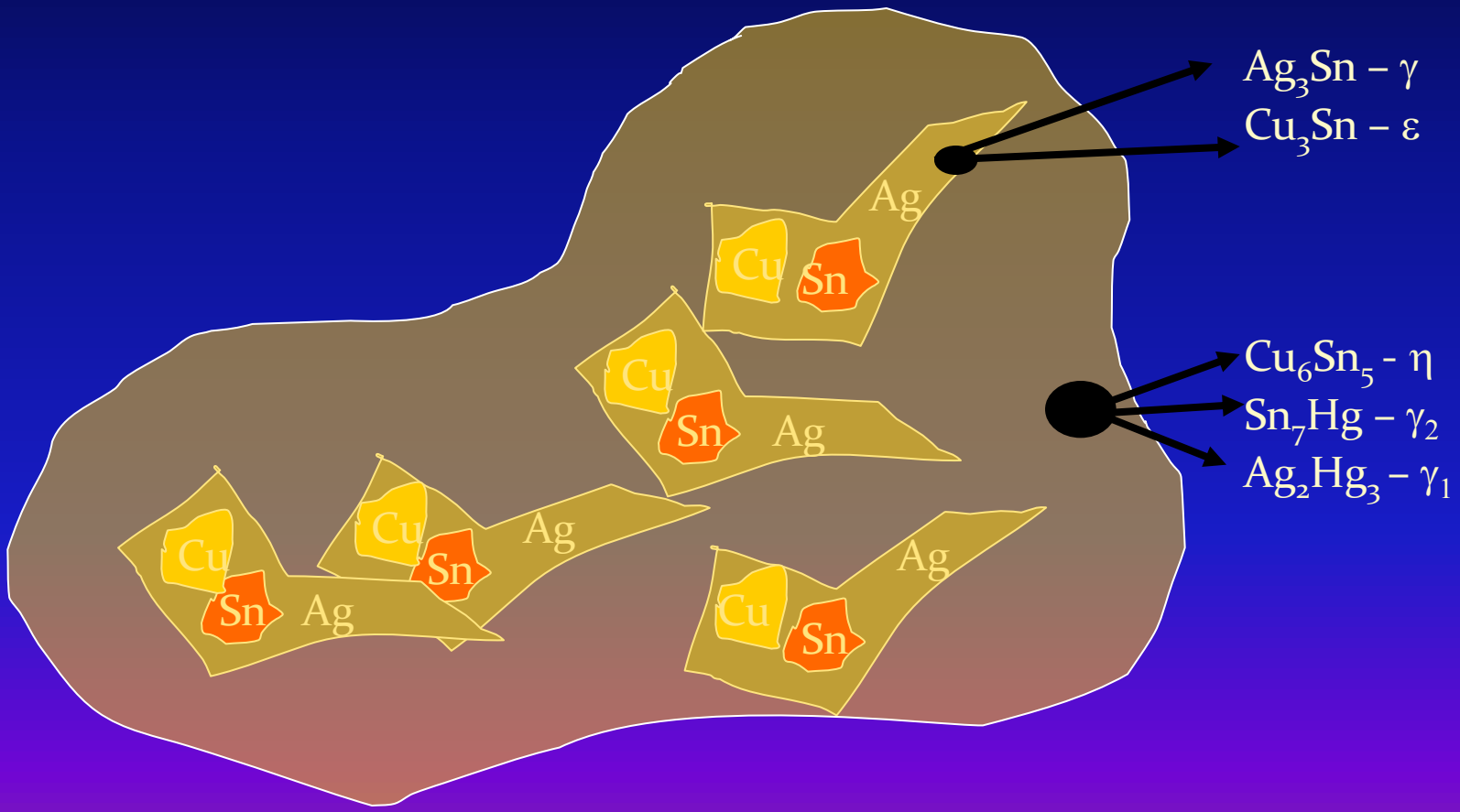
- Less tin and also silver

Better mechanical resistance, lower tendency to corrosion, lower flow and lower creep.

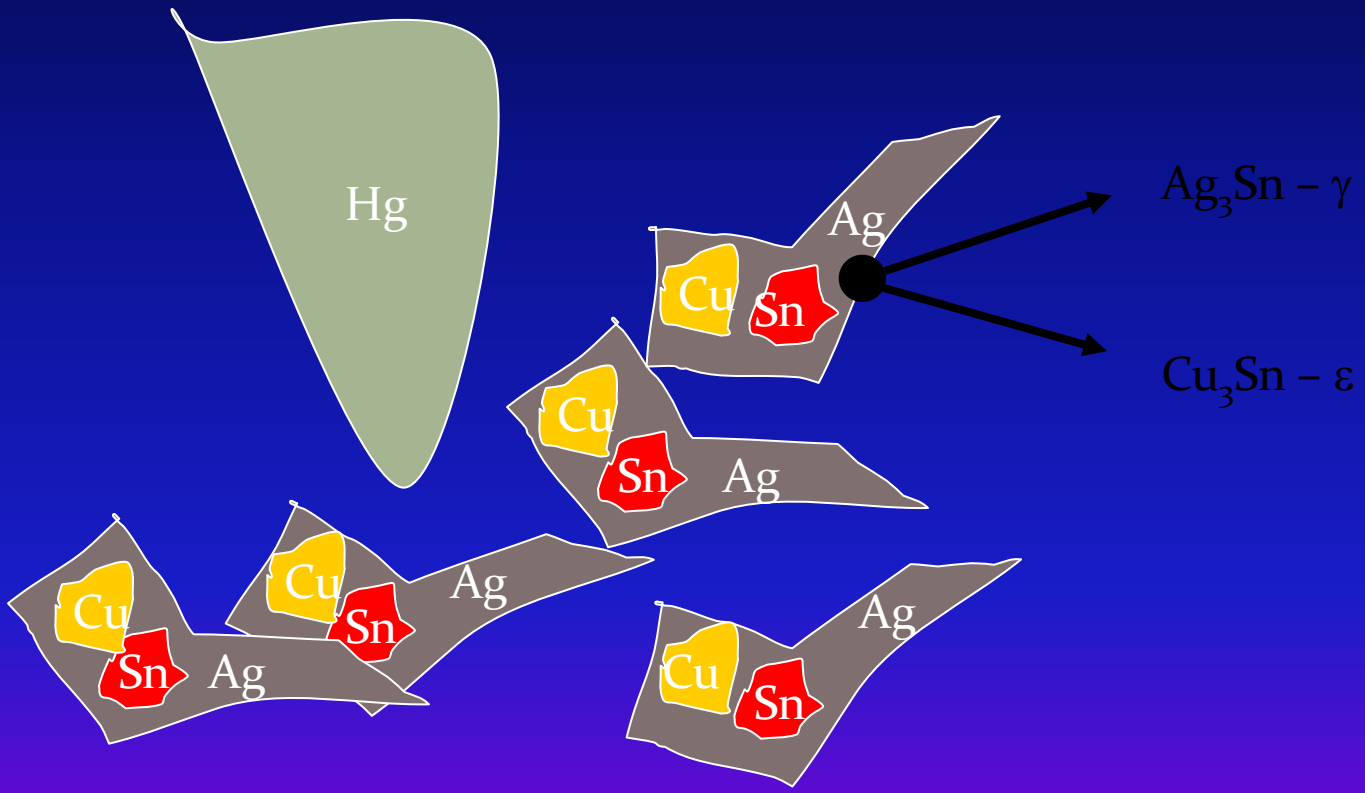
Setting of non gamma 2 amalgam

- Mercury dissolves particles of amalgam:
- Gamma 1 phase a gamma 2 phase
- Due high reactivity of cooper and tin eta phase arises, gamma 2 phase dissapears or does not appear (if contenc of copper is around 20% and more)

Setting of high copper amalgam



Amalgamation processes



Amalgam - properties

Amalgam

- **Wear and pressure resistance (2mm thickness ast least)**
- **Easy handling**
- **Thermal and electrical conductivity**
- **Corrosion**
- **Bad aesthetics**
- **Flow**
- **Creep**

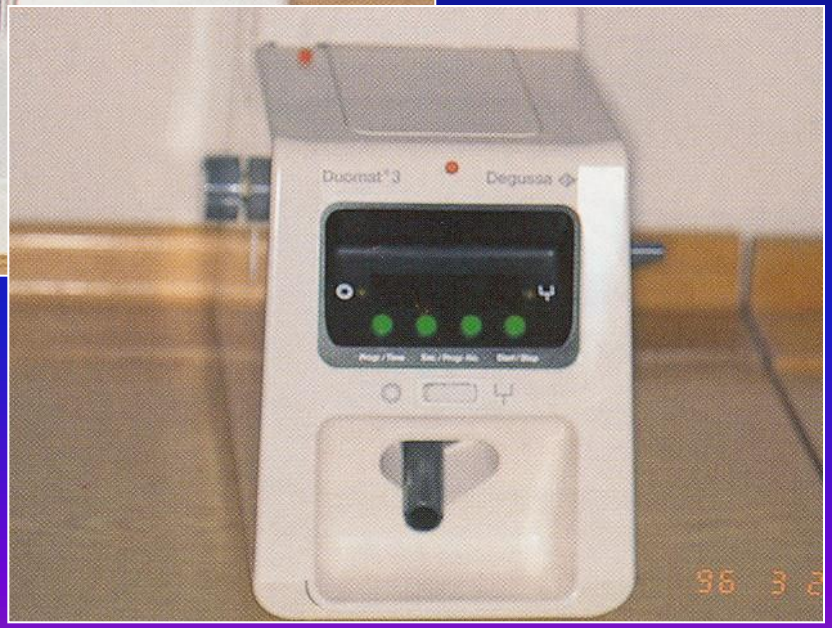
Mixing of amalgam

- **Hand mixing (obsolete)**
- **Power driven trituration**

Amalgamators

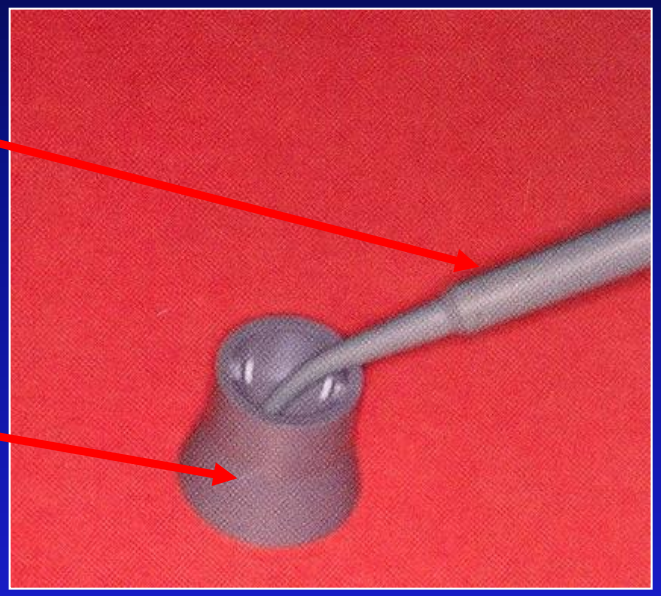

ADM


LARIOVIBRO
LARIO MEDICAL

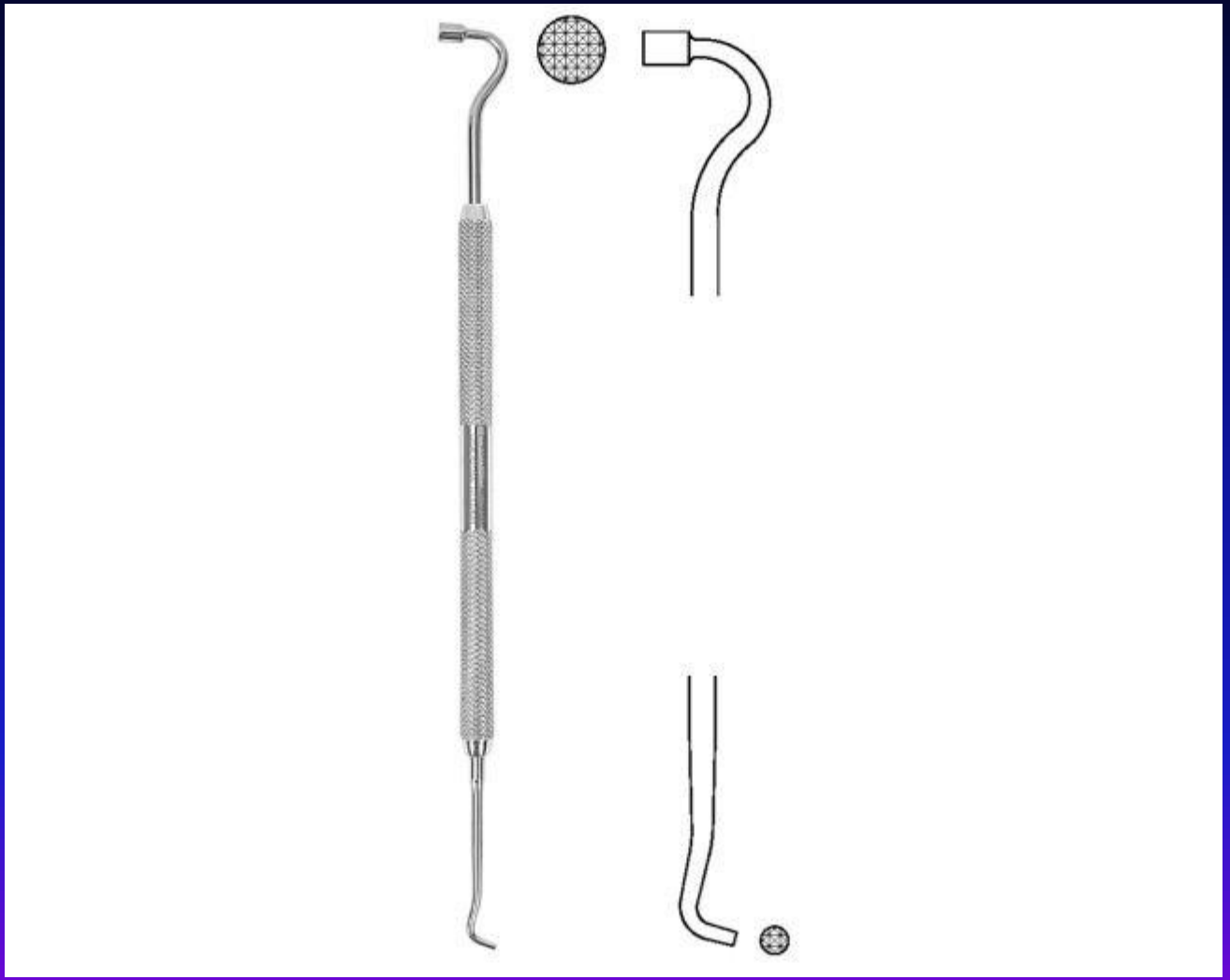

Ducomat°3
Degussa

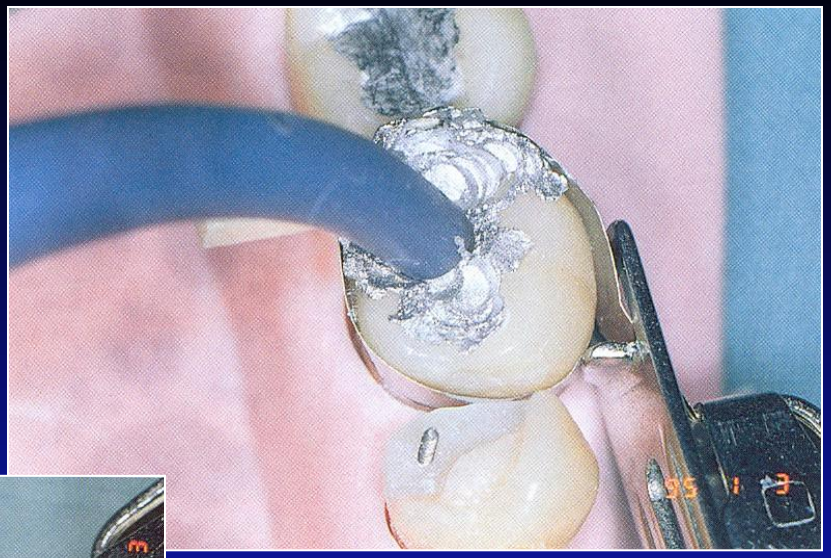
Amalgam gun

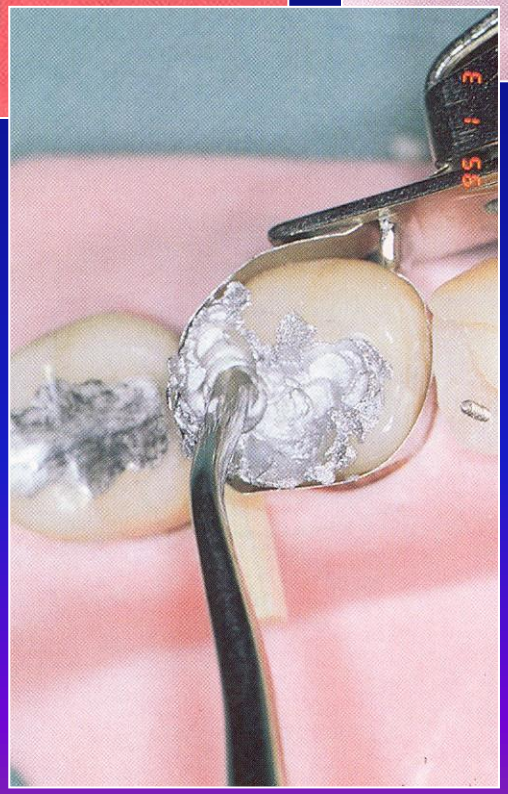
Crucible



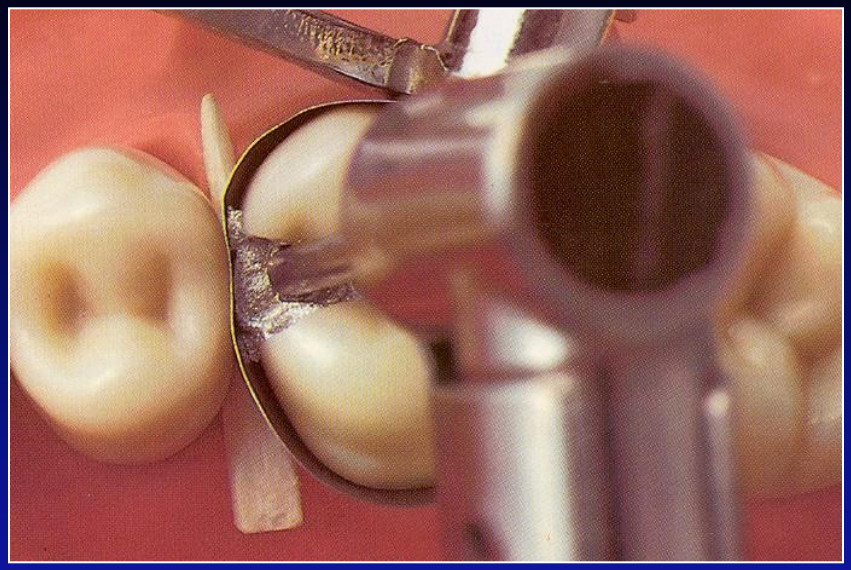
Amalgam carrier





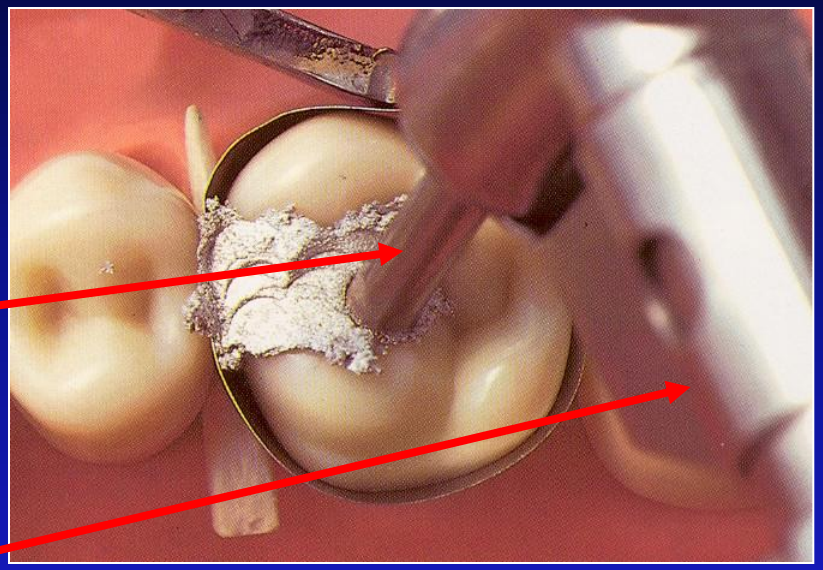


Portion by portion and condensation



Power driven condensor

Special handpiece



Instruments

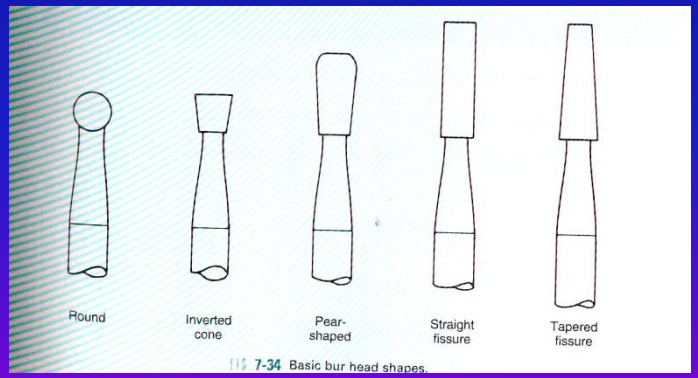
- **Preparation instruments**
- **Filling instruments**
- **Carvers**
- **Burnishers**

Instruments

- **Preparation instruments - power driven**

Burs

Diamonds

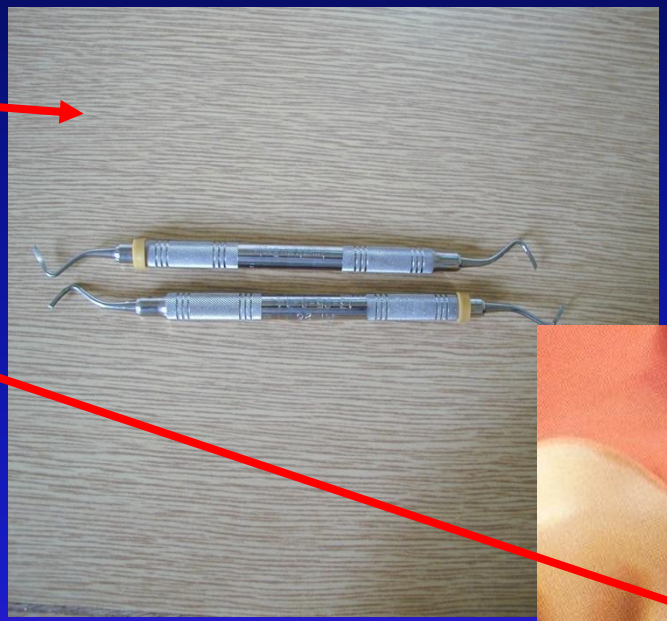


7-34 Basic bur head shapes.

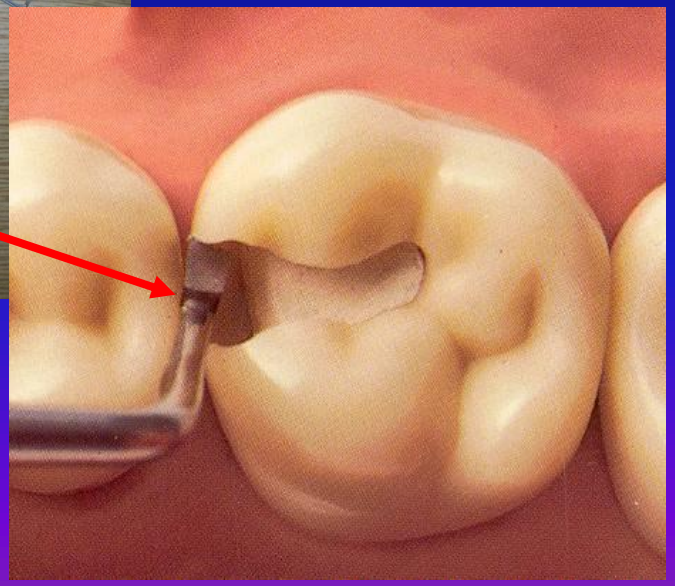
Instruments

- **Preparation instruments - hand**

Chisel



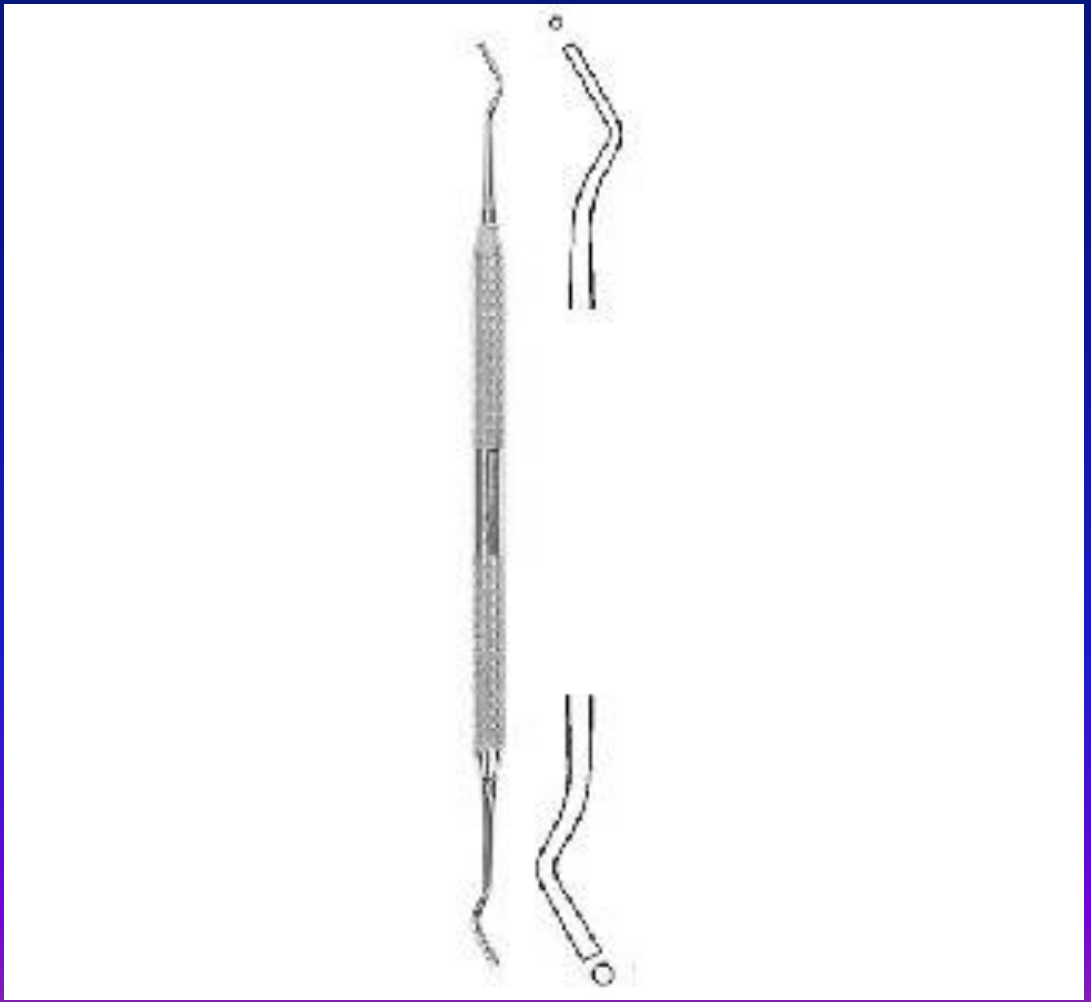
Excavator



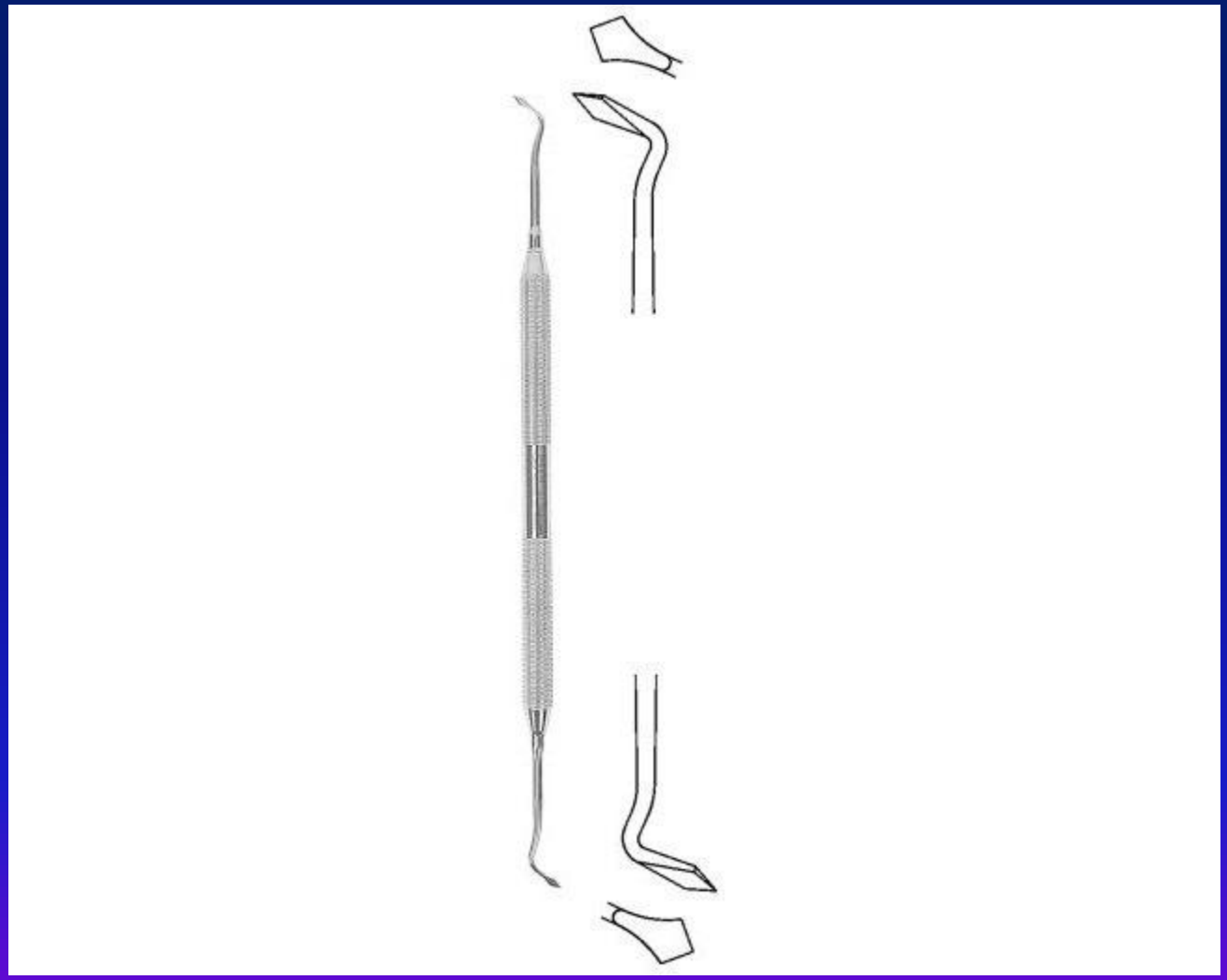
Instruments

- **Filling instruments condensors and spatulas**

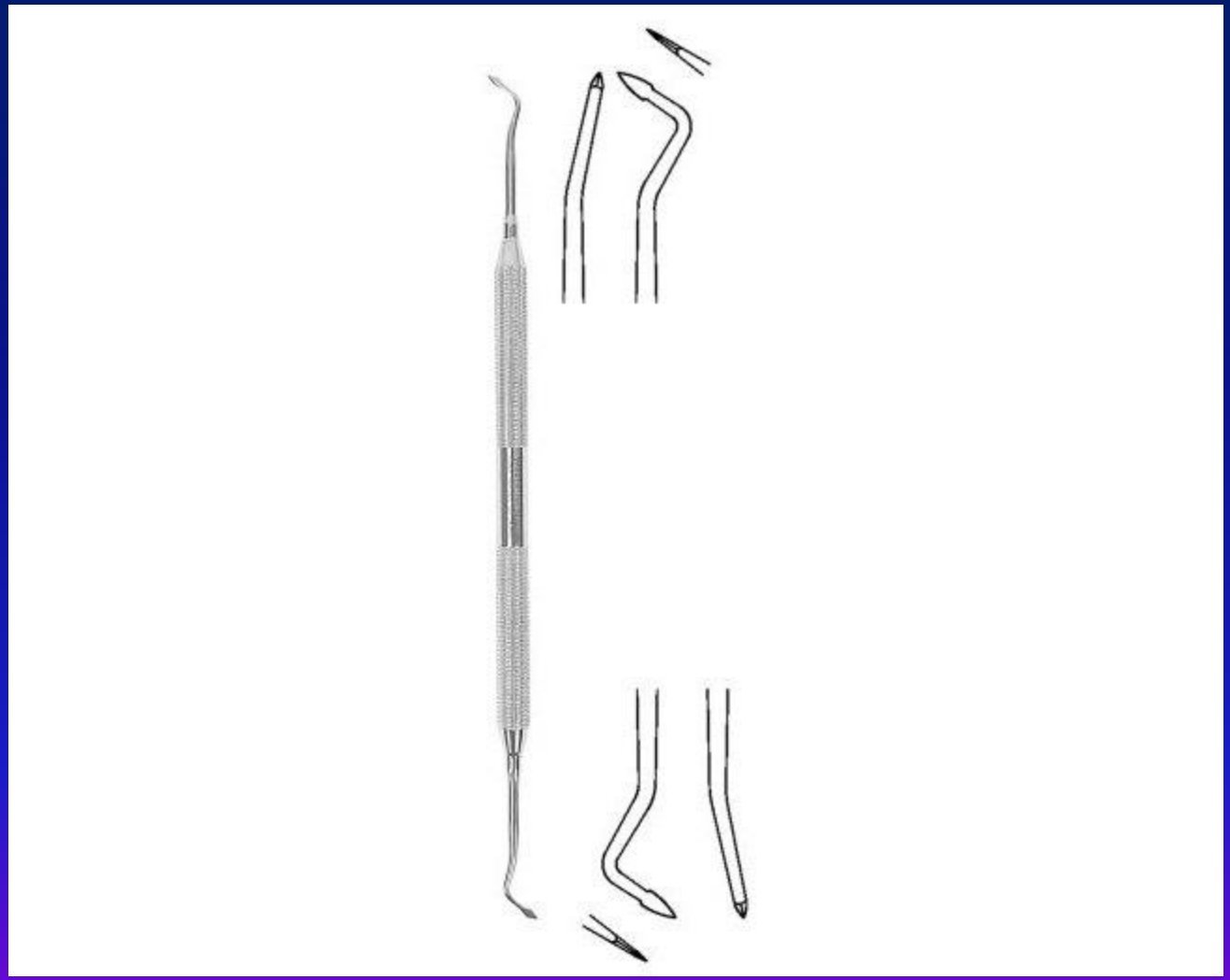
Condensor with straight front



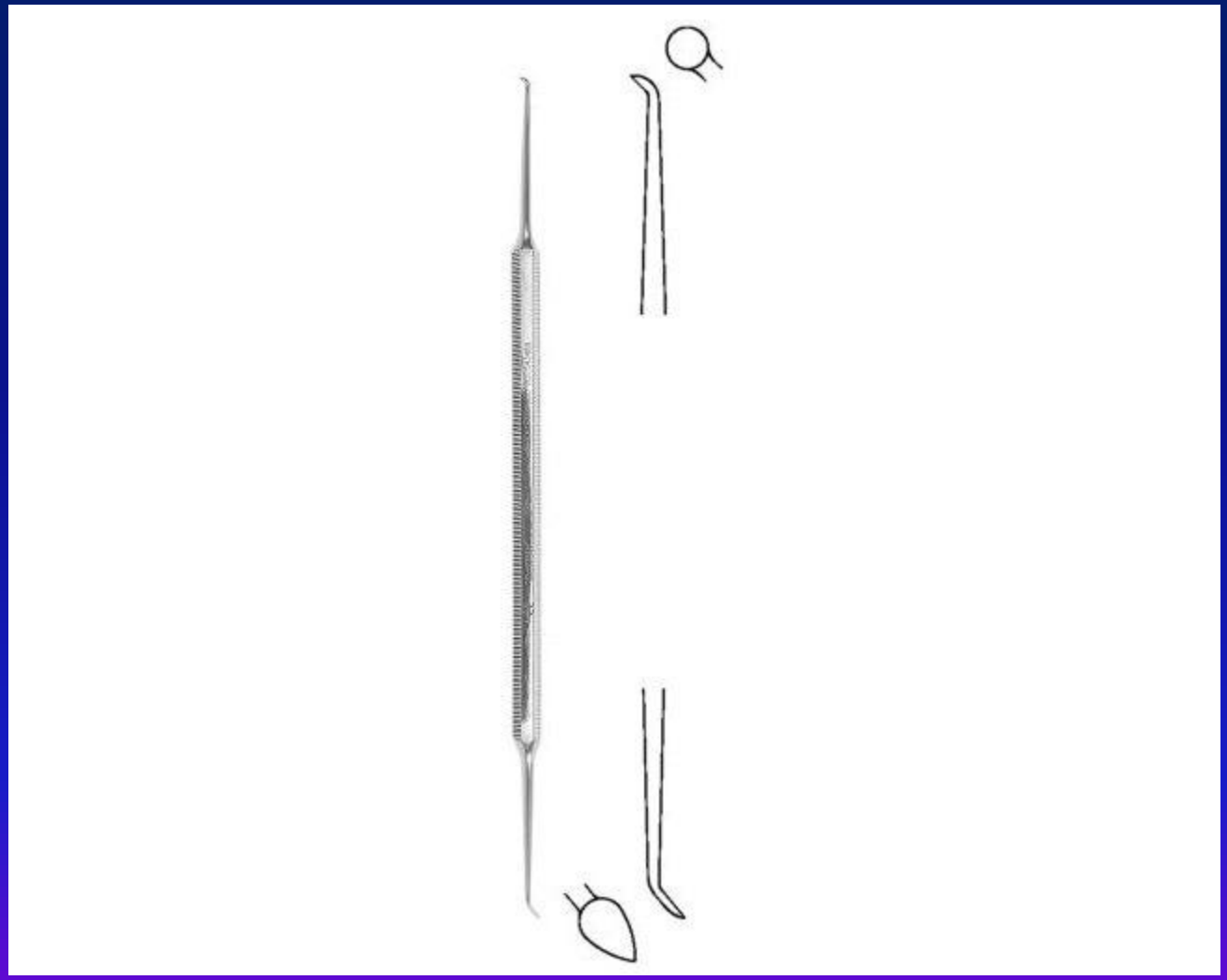
Carver -Frahm



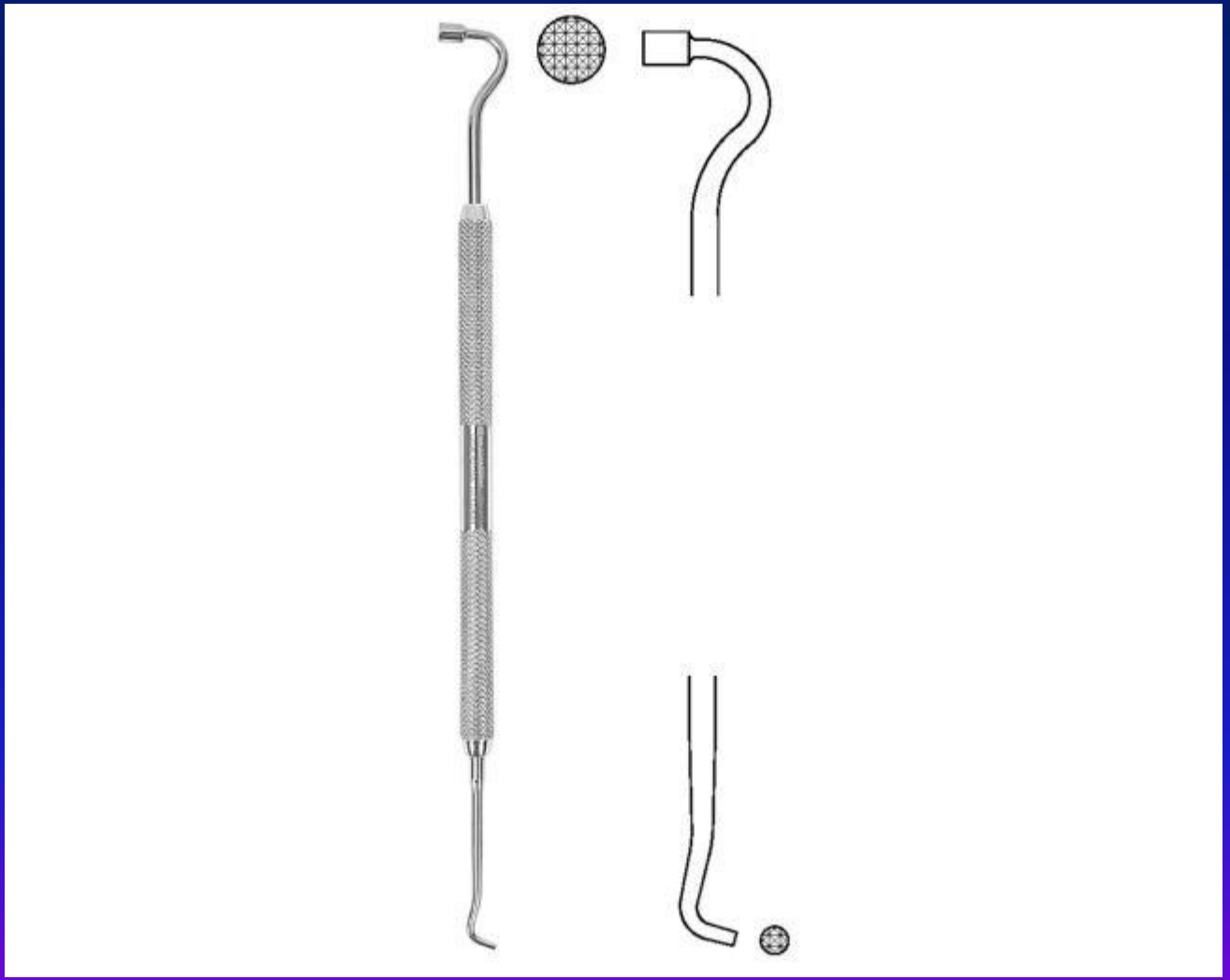
Carver - Sapin



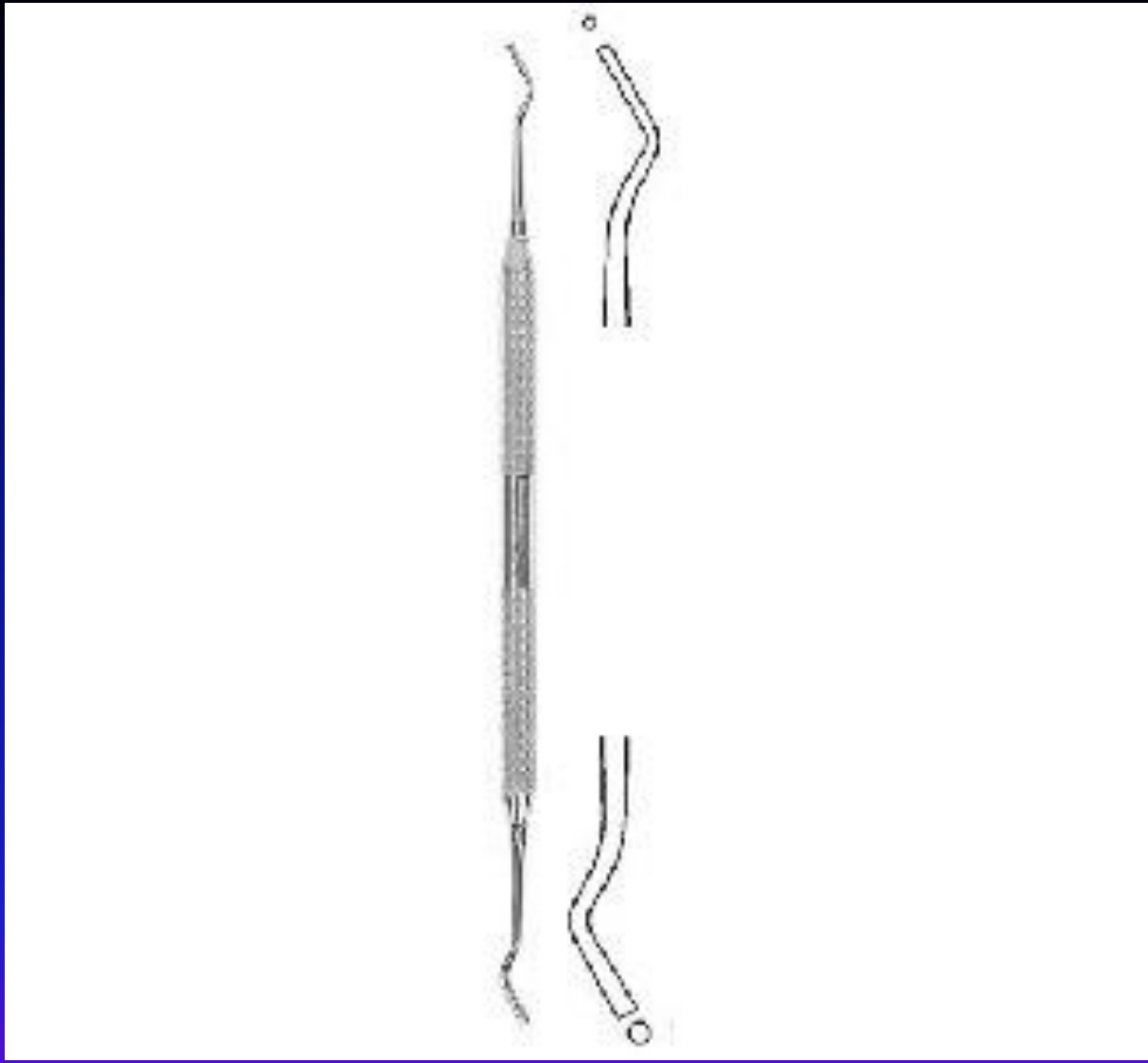
Carver
Discoid-cleoid



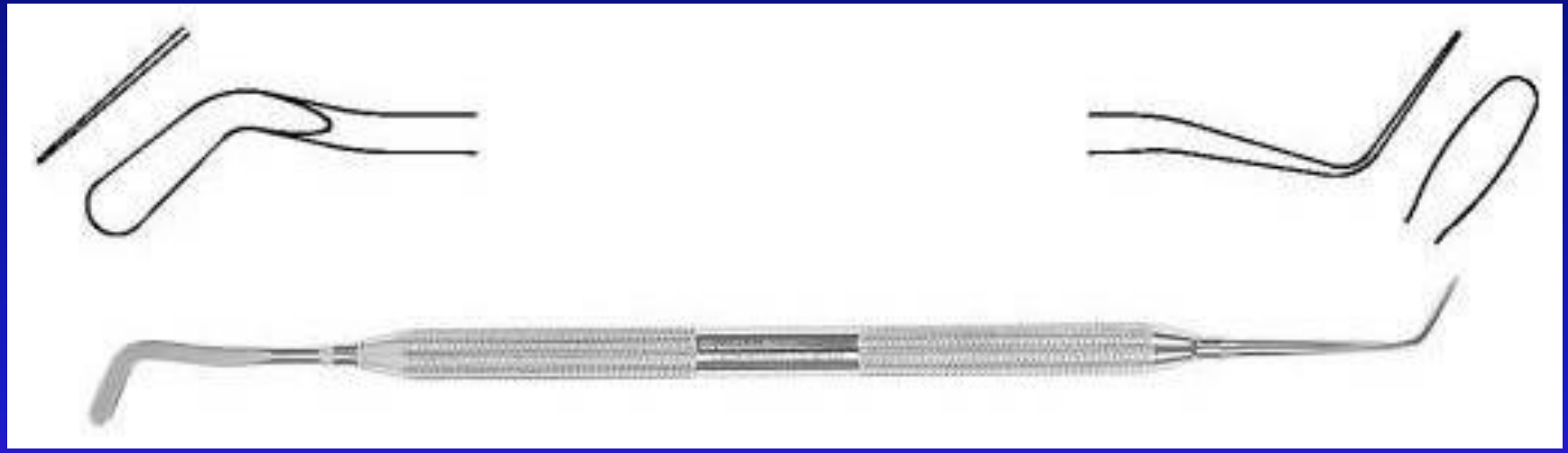
Nosič amalgámu



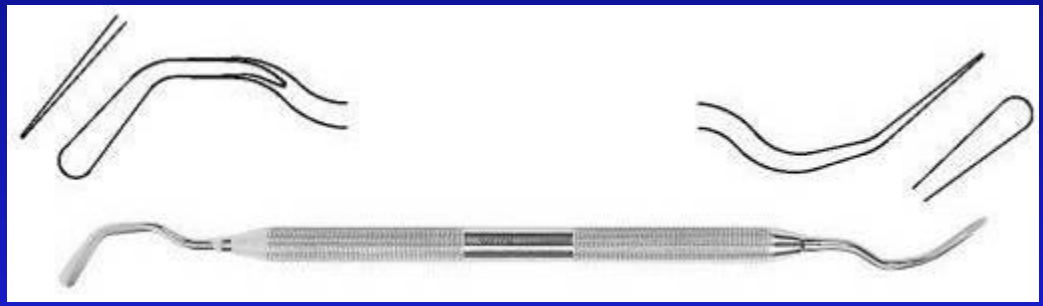
Condensor - stamen



Burnisher - spatula
Angular- trough edge trough face



Burnisher – spatula, angular three face



Ball condensor – used as a burnisher at most