Cutting Mechanics

Strain Forces Power

Built Up Edge

Machinability of Materials

Aluminum Easy

tool BUE (can be avoided)

high thermal expansion

Steel	Varies	
hardend		difficult
Leaded	Alloys	Easy
Low	Carbon	BUE
Cast		abrasive

Cast Iron

machinable

small chips

abrasive

free carbides

Copper difficult "gummy"

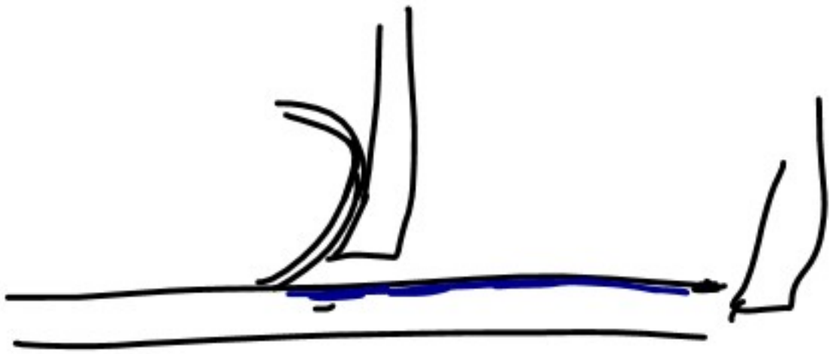
BUE

Alloy better

Super Alloys

primarily nickel based

Work Hardening



Titanium

Low thermal conductivity

BUE

Composits

Abrasive

Graphite

Abrasive

Plastics

Machinable

May need to cool

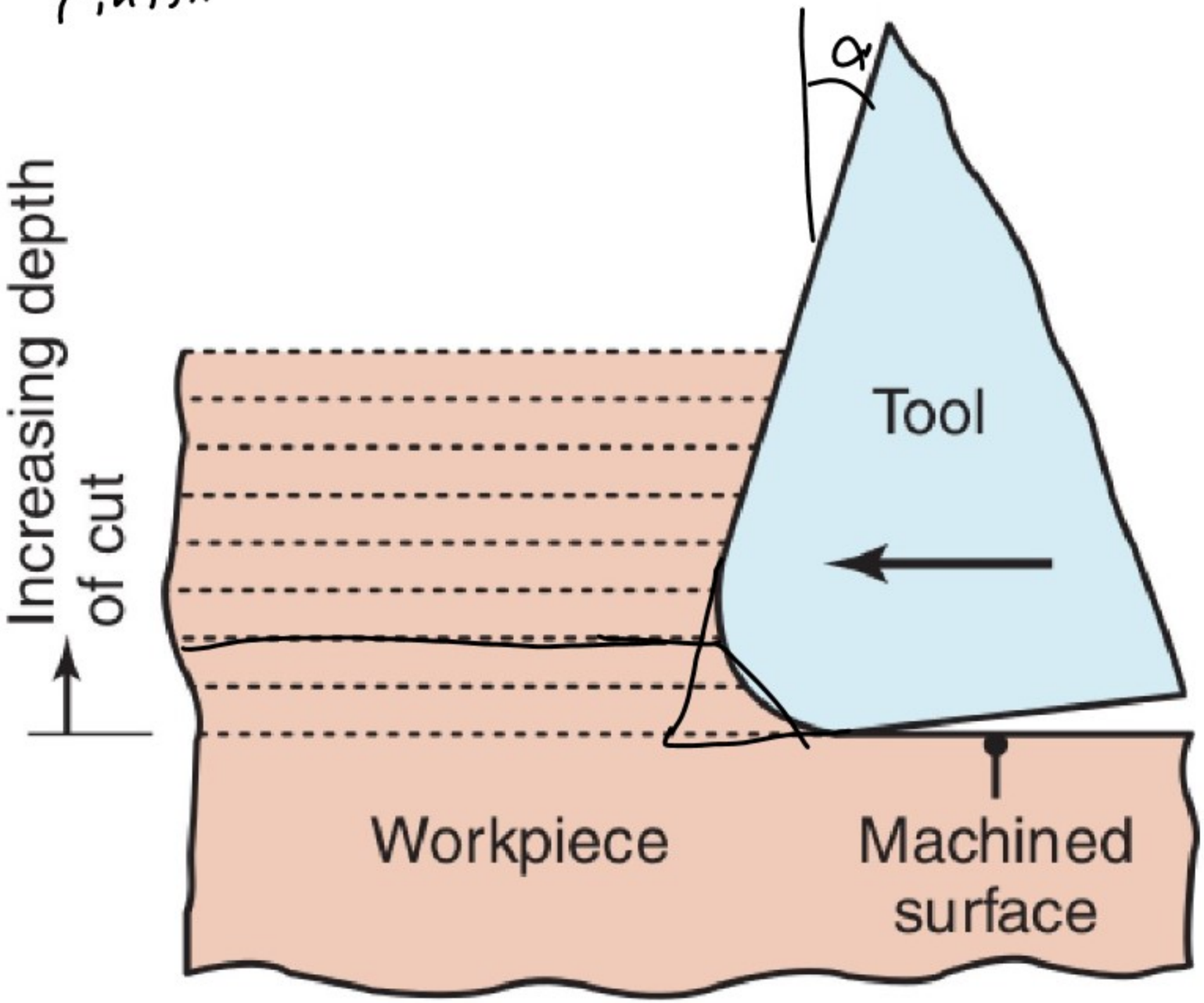
Wood

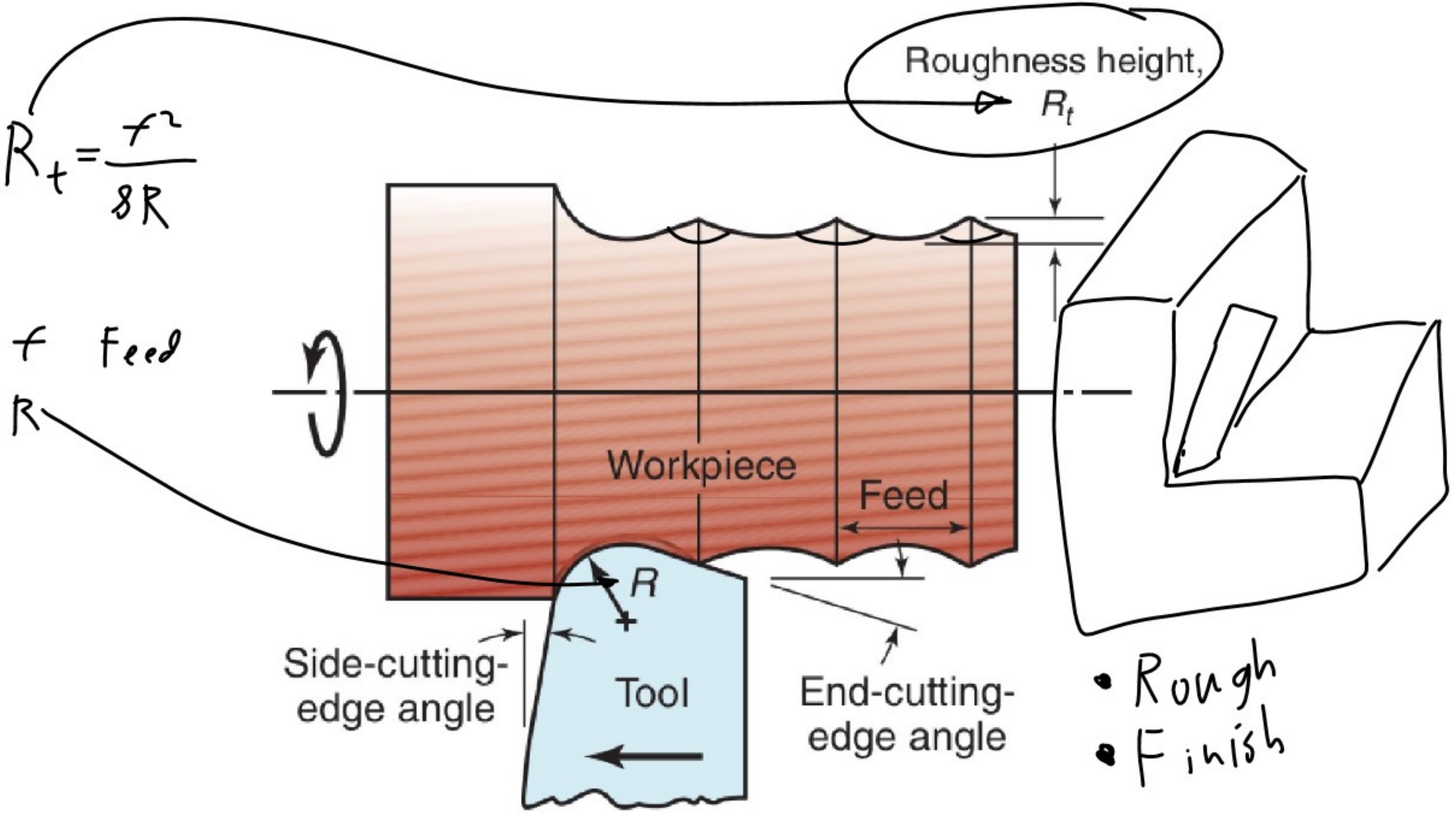
Machinable

Variable Material Properties

Art Form

Surface finish





$$R_t = \frac{f^2}{8R}$$

f Feed

R

- Rough
- Finish

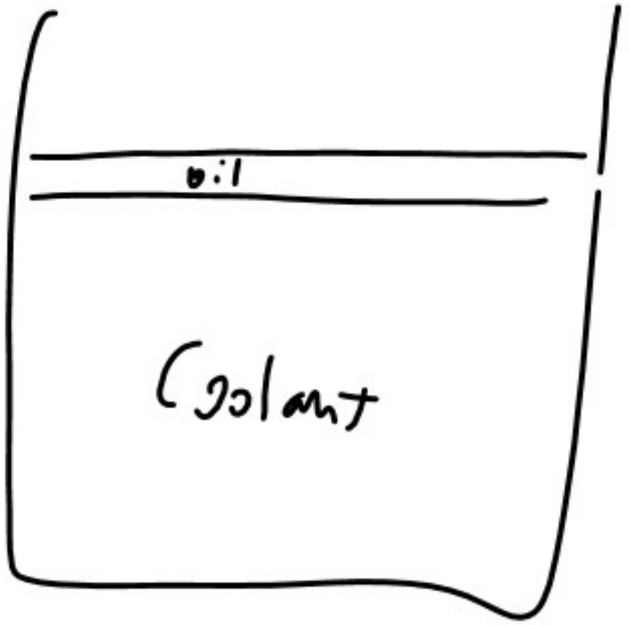
Tool Materials

Property	High-speed steels	Cast-cobalt alloys	Carbides		Ceramics	Cubic boron nitride	Single-crystal diamond*
			WC	TiC			
Hardness	83–86 HRA	82–84 HRA 46–62 HRC	90–95 HRA 1800–2400 HK	91–93 HRA 1800–3200 HK	91–95 HRA 2000–3000 HK	4000–5000 HK	7000–8000 HK
Compressive strength, MPa	4100–4500	1500–2300	4100–5850	3100–3850	2750–4500	6900	6900
Transverse rupture strength, MPa	2400–4800	1380–2050	1050–2600	1380–1900	345–950	700	1350
Impact strength, J	1.35–8	0.34–1.25	0.34–1.35	0.79–1.24	< 0.1	< 0.5	< 0.2
Modulus of elasticity, GPa	200	–	520–690	310–450	310–410	850	820–1050
Density, kg/m^3	8600	8000–8700	10,000–15,000	5500–5800	4000–4500	3500	3500
Volume of hard phase, %	7–15	10–20	70–90	–	100	95	95
Melting or decomposition temperature, °C	1300	–	1400	1400	2000	1300	700
Thermal conductivity, W/m K	30–50	–	42–125	17	29	13	500–2000
Coefficient of thermal expansion, $\times 10^{-6}/°C$	12	–	4–6.5	7.5–9	6–8.5	4.8	1.5–4.8

*The values for polycrystalline diamond are generally lower, except for impact strength, which is higher.

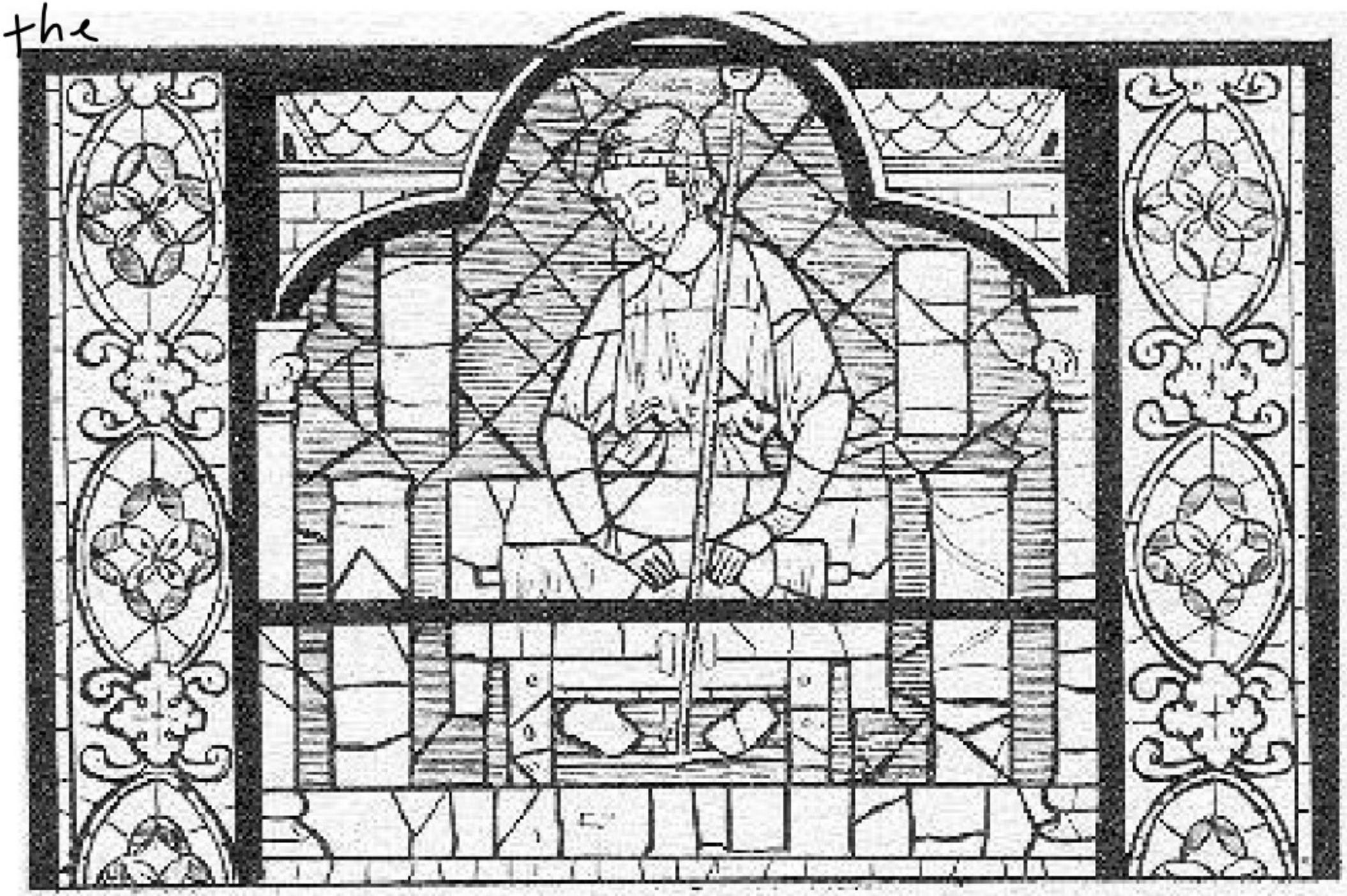
Cutting Fluid

- Coolant, Lubricant } increase tool life
- Flush away chips
- Reducing cutting forces
- Reducing Power



Lathe

1200



Pole Lathe

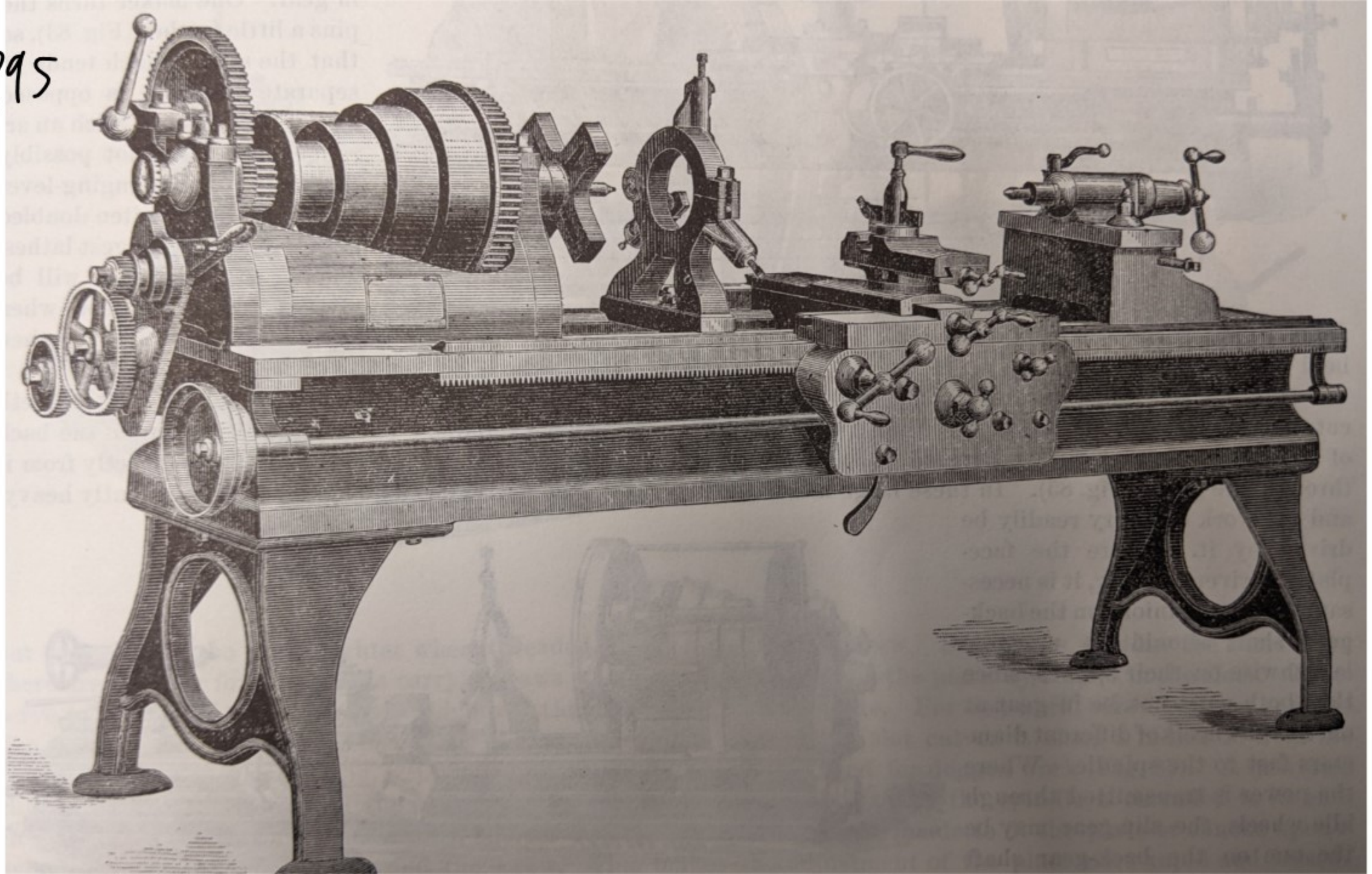
1568

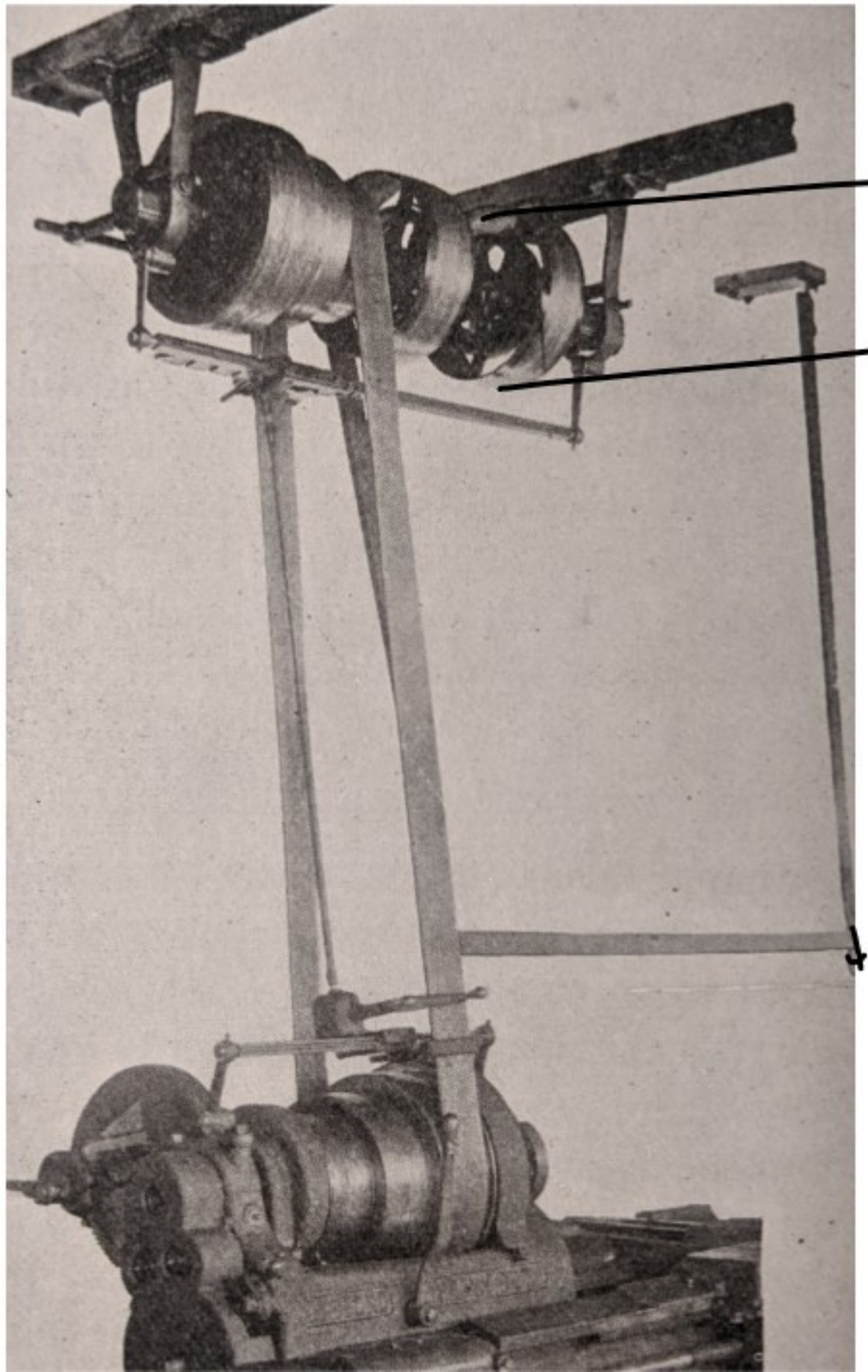
Continuous Rotation

Horse Power

Water Wheels

1895

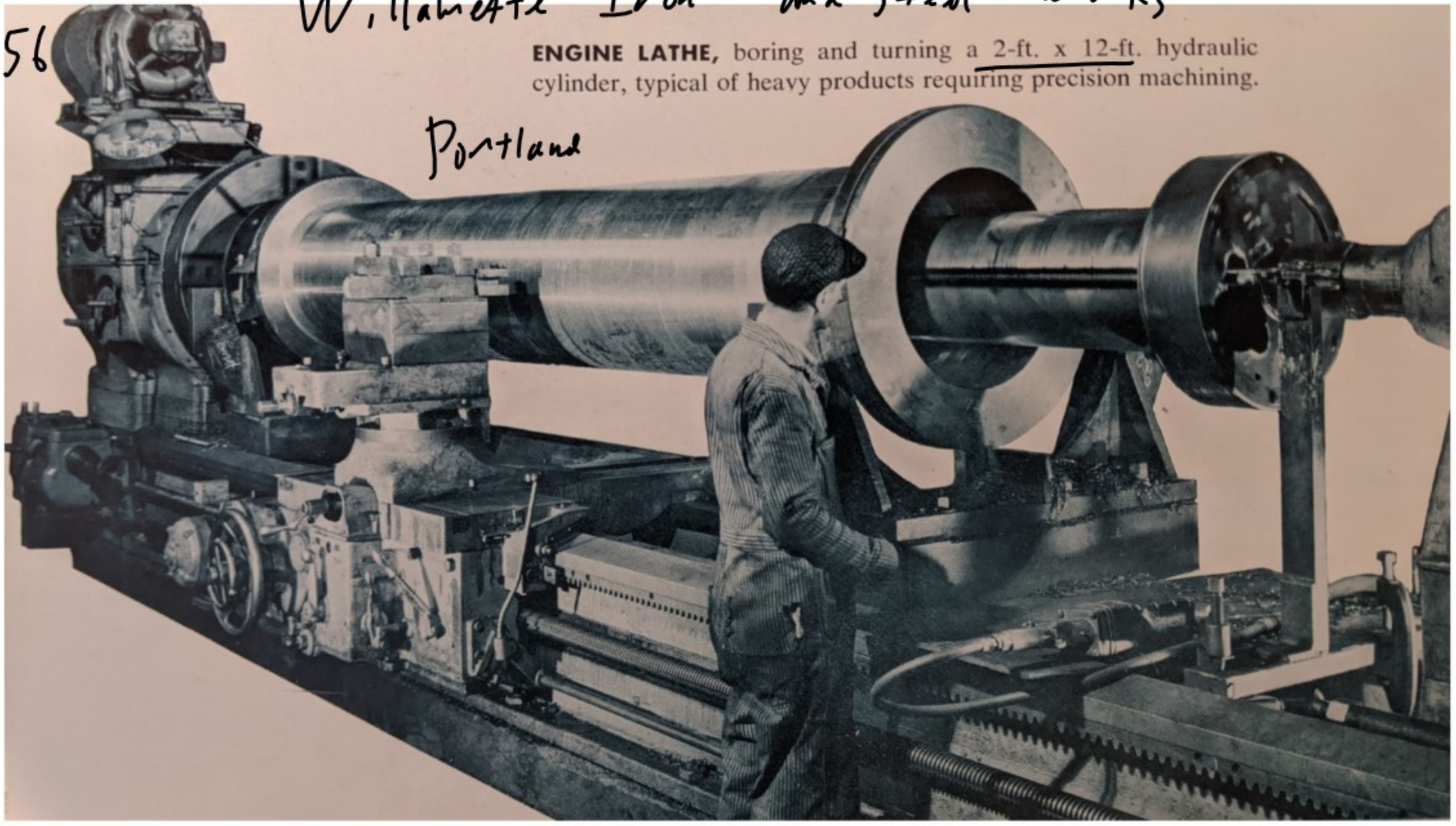




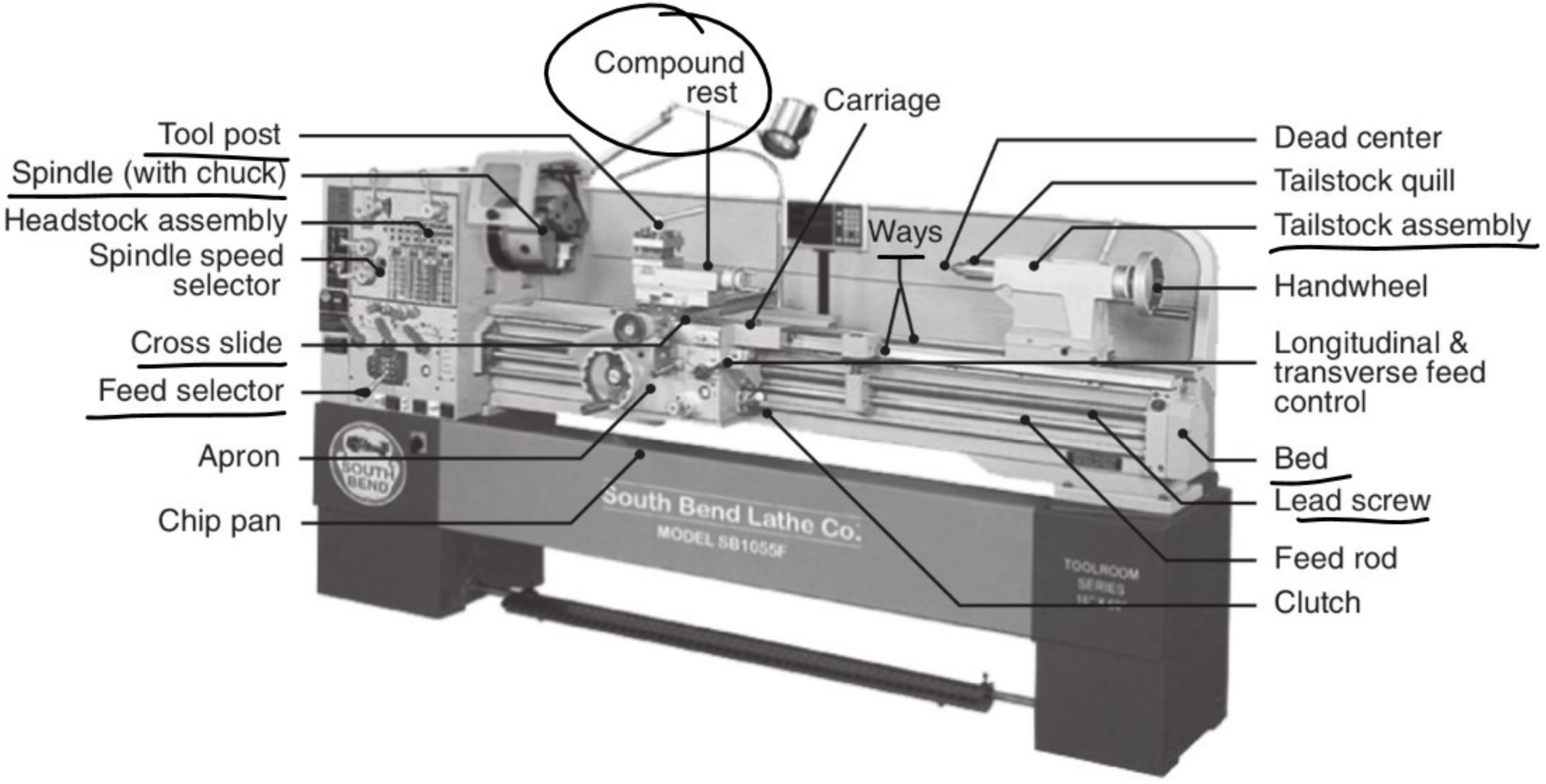
1956

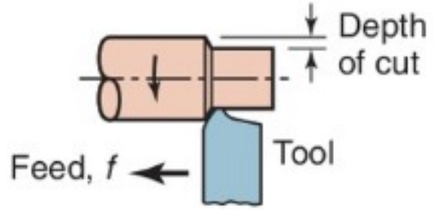
Willamette Iron and Steel Works

Portland

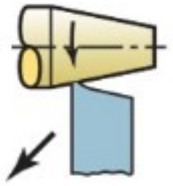


ENGINE LATHE, boring and turning a 2-ft. x 12-ft. hydraulic cylinder, typical of heavy products requiring precision machining.

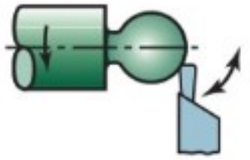

Compound rest
Carriage
Tool post
Spindle (with chuck)
Headstock assembly
Spindle speed selector
Cross slide
Feed selector
Apron
Chip pan
Ways
Dead center
Tailstock quill
Tailstock assembly
Handwheel
Longitudinal & transverse feed control
Bed
Lead screw
Feed rod
Clutch
South Bend Lathe Co.
MODEL SB1055F
SOUTH BEND
TOOLROOM SERIES



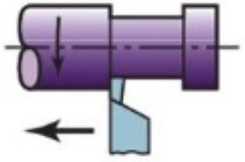
(a) Straight turning



(b) Taper turning

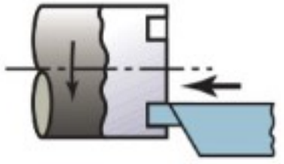


(c) Profiling

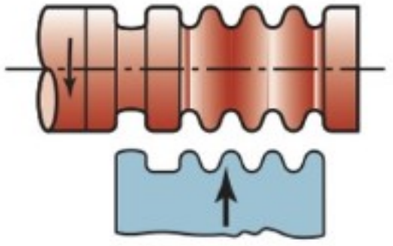


(d) Turning and external grooving

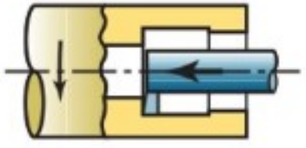
(e) Facing



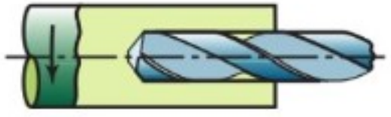
(f) Face grooving



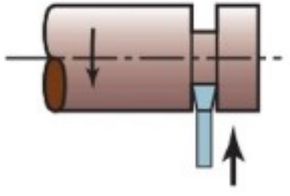
(g) Cutting with a form tool



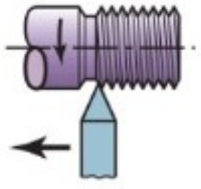
(h) Boring and internal grooving



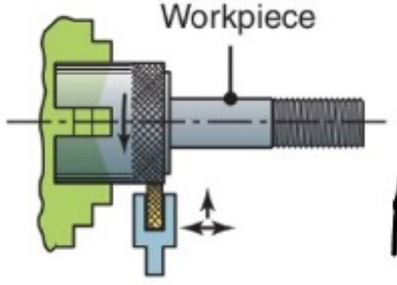
(i) Drilling



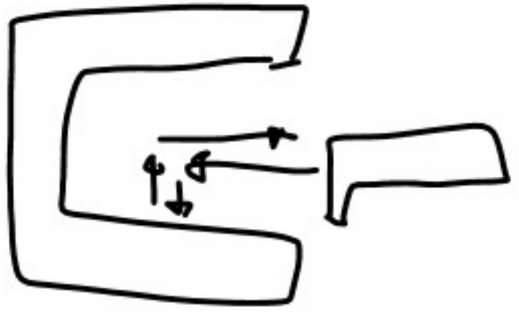
(j) Cutting off



(k) Threading



(l) Knurling



Knurling