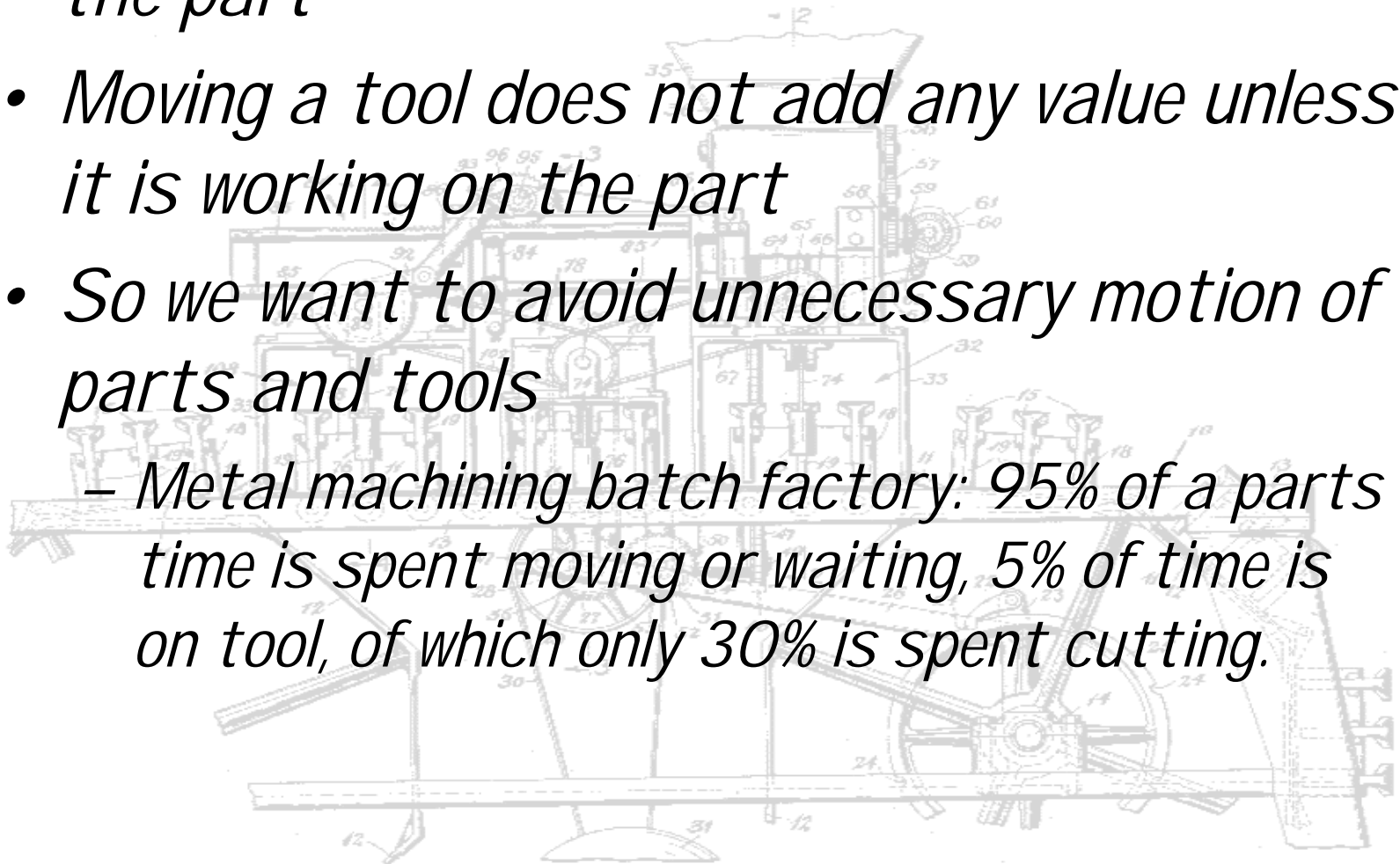


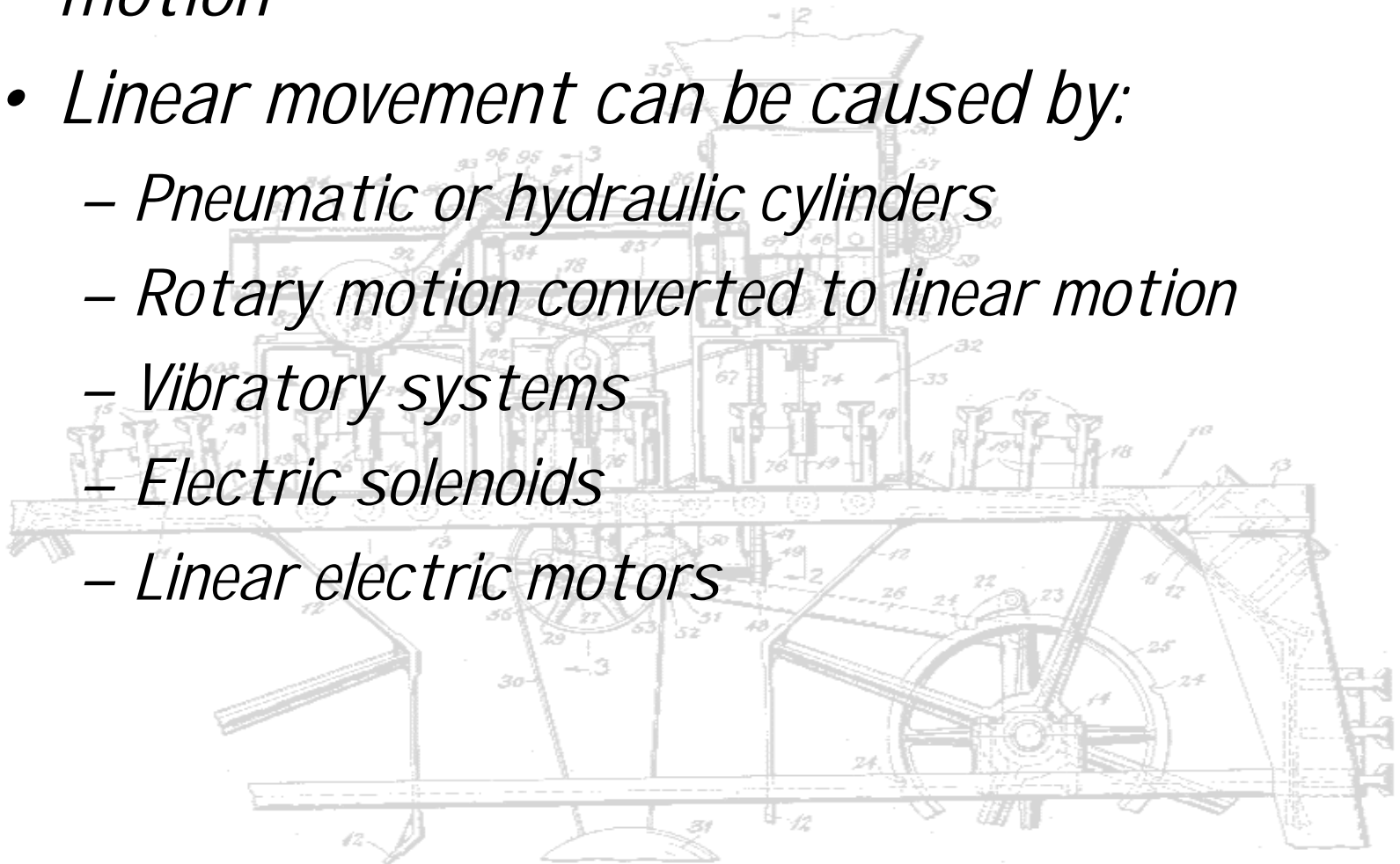
GENERATING MOTION

- *Moving a part does not add any value to the part*
- *Moving a tool does not add any value unless it is working on the part*
- *So we want to avoid unnecessary motion of parts and tools*
 - *Metal machining batch factory: 95% of a parts time is spent moving or waiting, 5% of time is on tool, of which only 30% is spent cutting.*



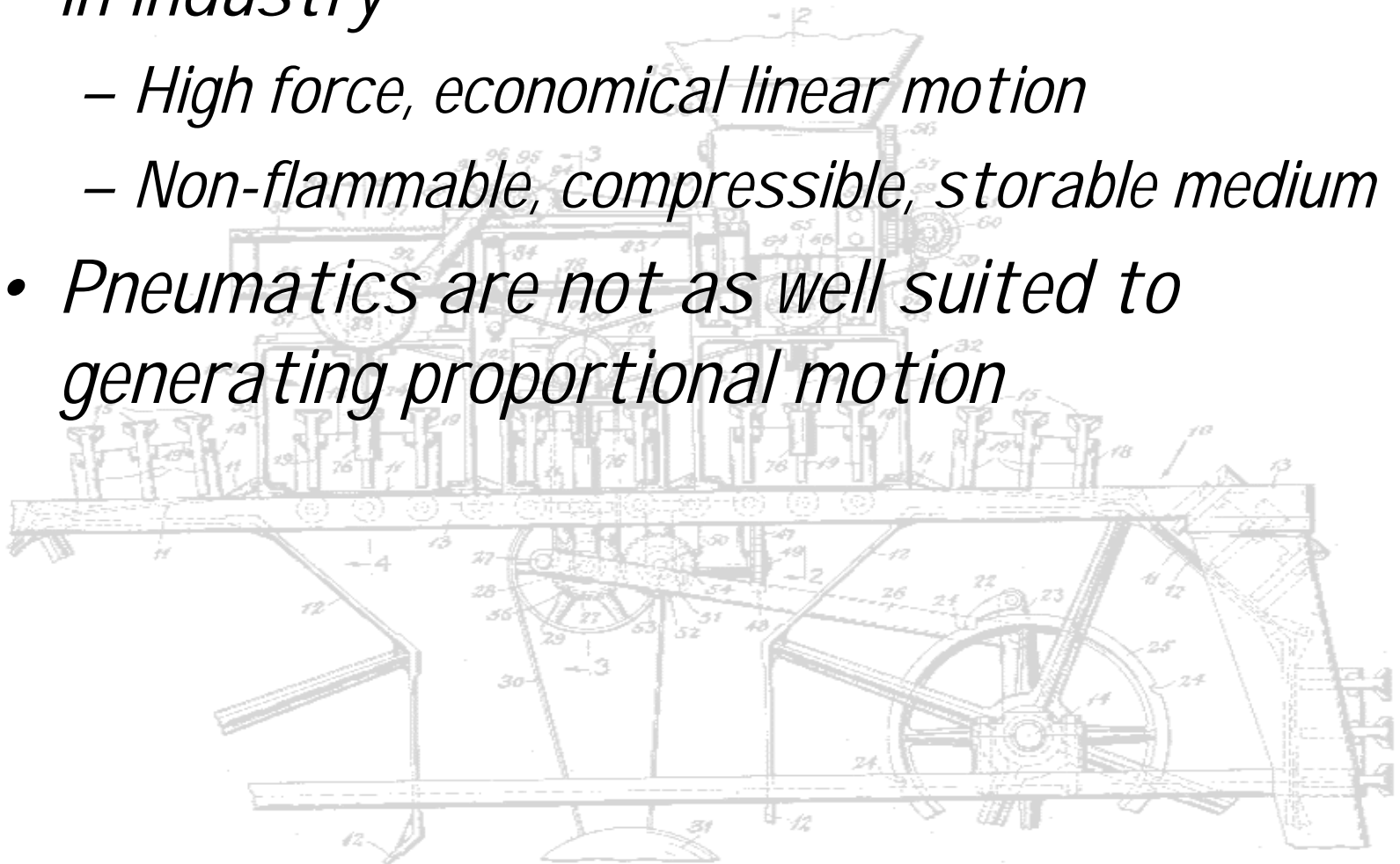
LINEAR MOTION

- *Linear translation is the most common motion*
- *Linear movement can be caused by:*
 - *Pneumatic or hydraulic cylinders*
 - *Rotary motion converted to linear motion*
 - *Vibratory systems*
 - *Electric solenoids*
 - *Linear electric motors*



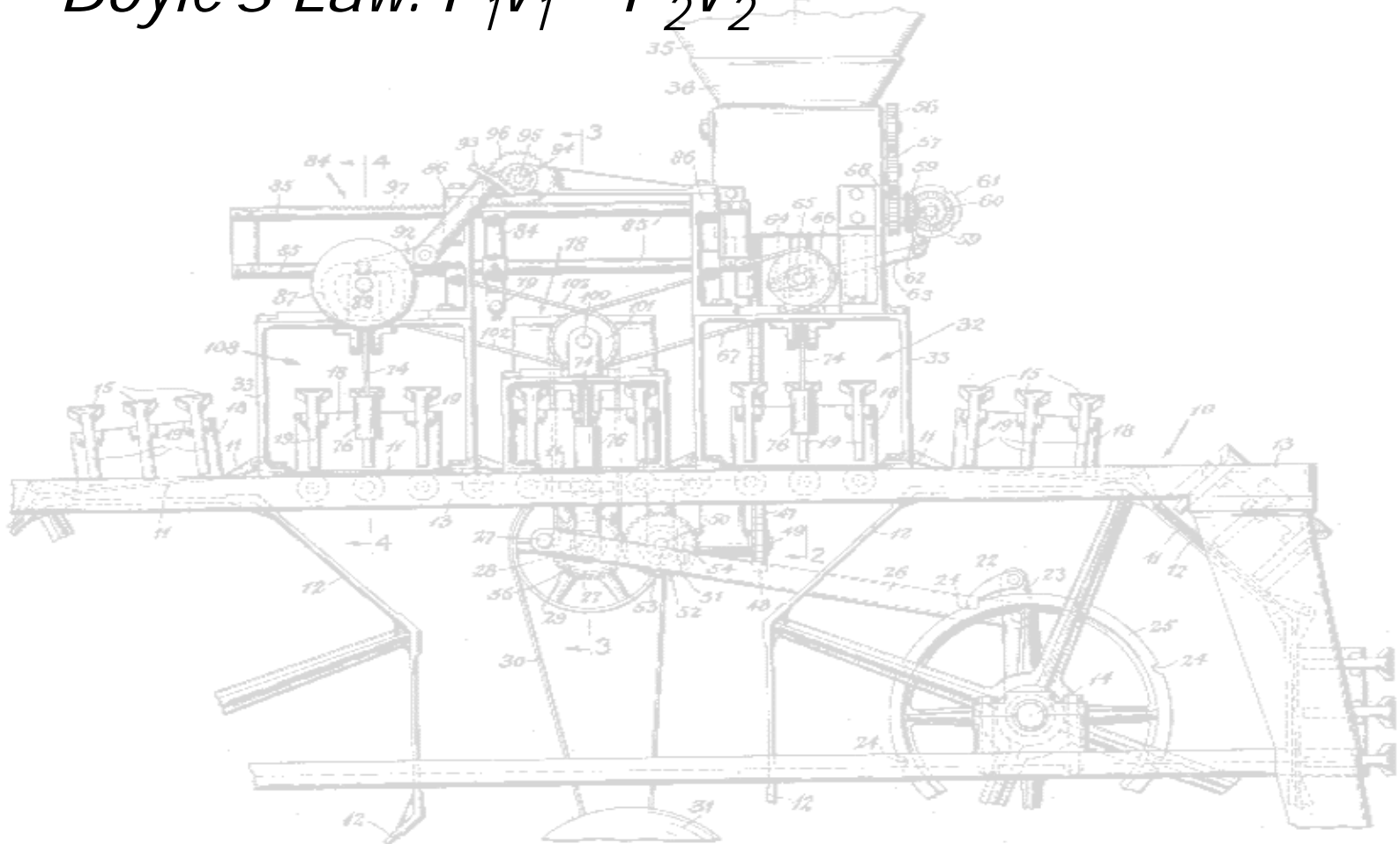
PNEUMATIC SYSTEMS

- *Pneumatic power systems are very popular in industry*
 - *High force, economical linear motion*
 - *Non-flammable, compressible, storable medium*
- *Pneumatics are not as well suited to generating proportional motion*

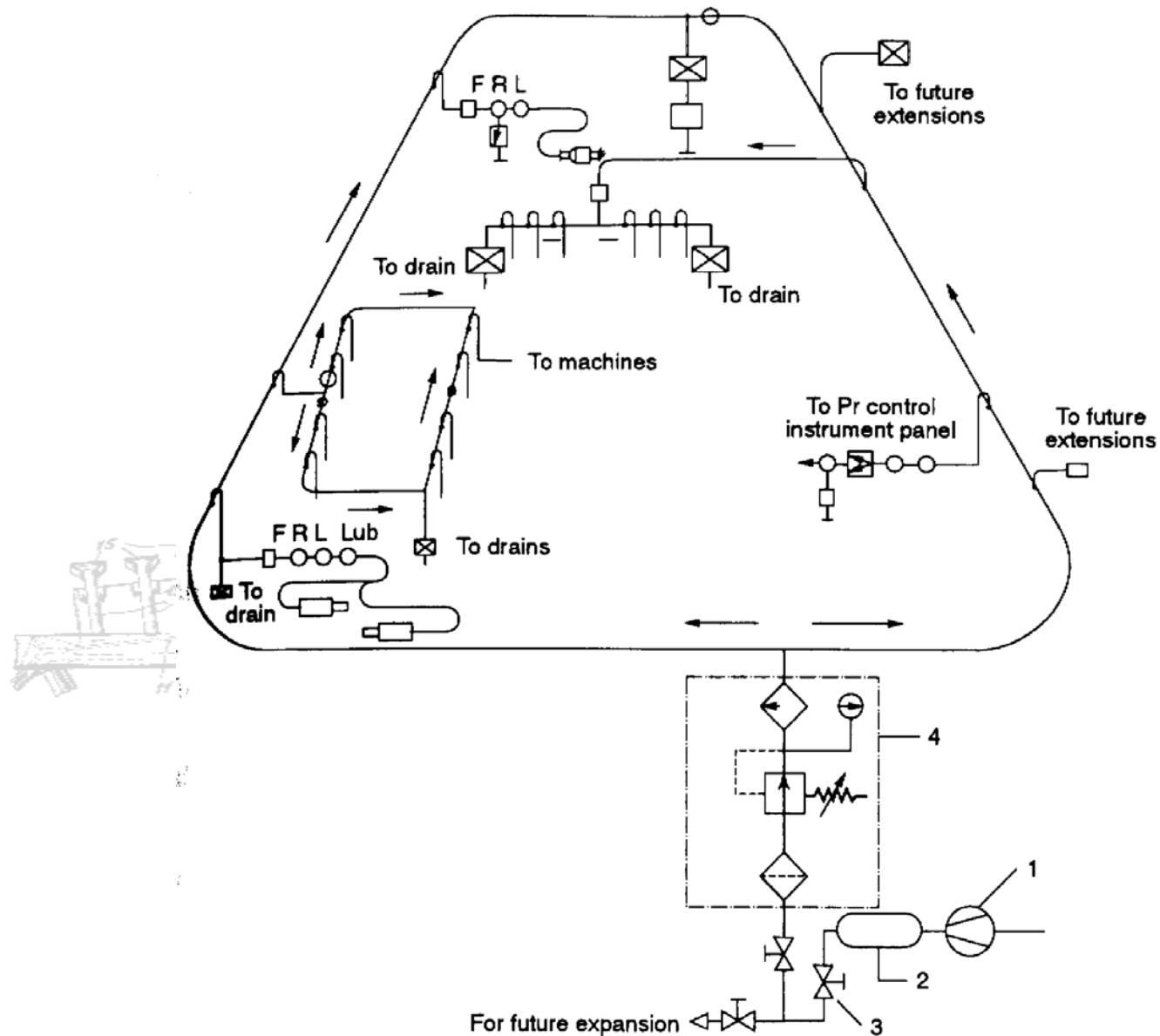


PNEUMATIC SYSTEMS

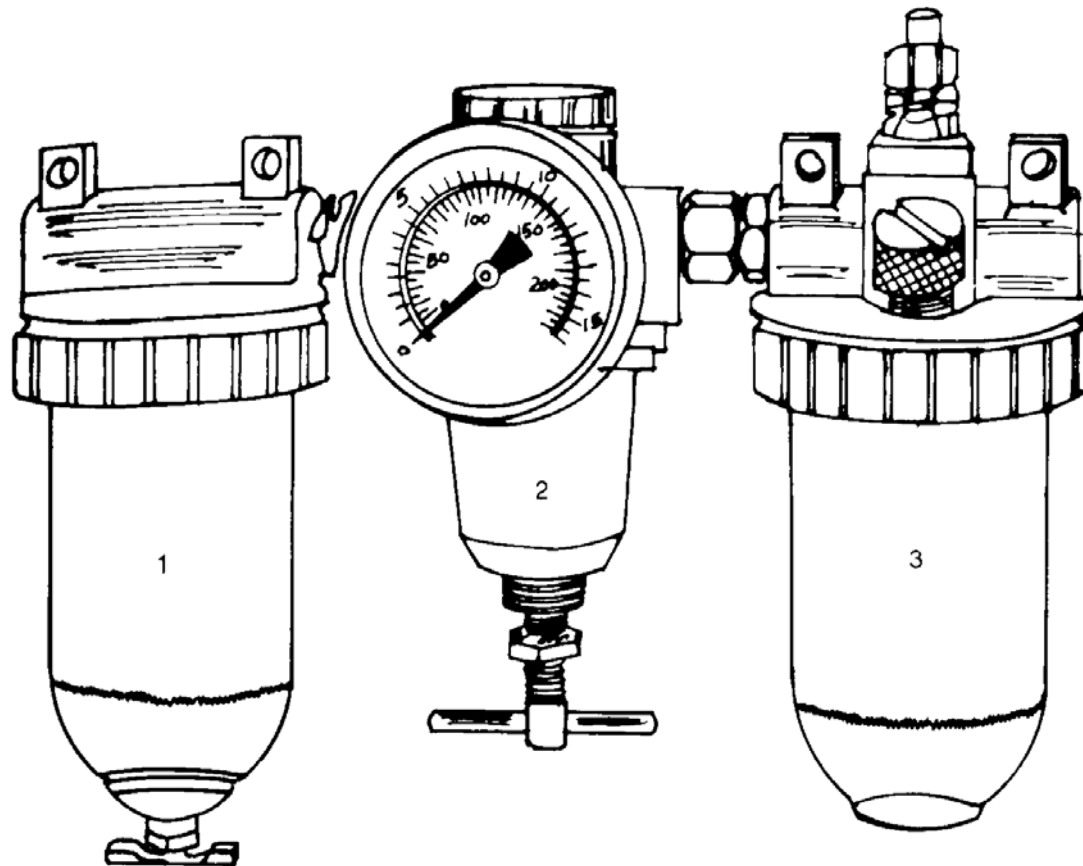
- *Gas Law: $PV=mRT$*
- *Boyle's Law: $P_1V_1 = P_2V_2$*



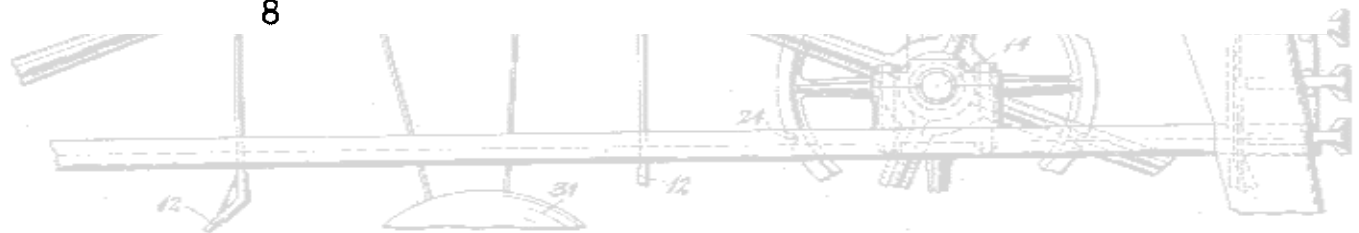
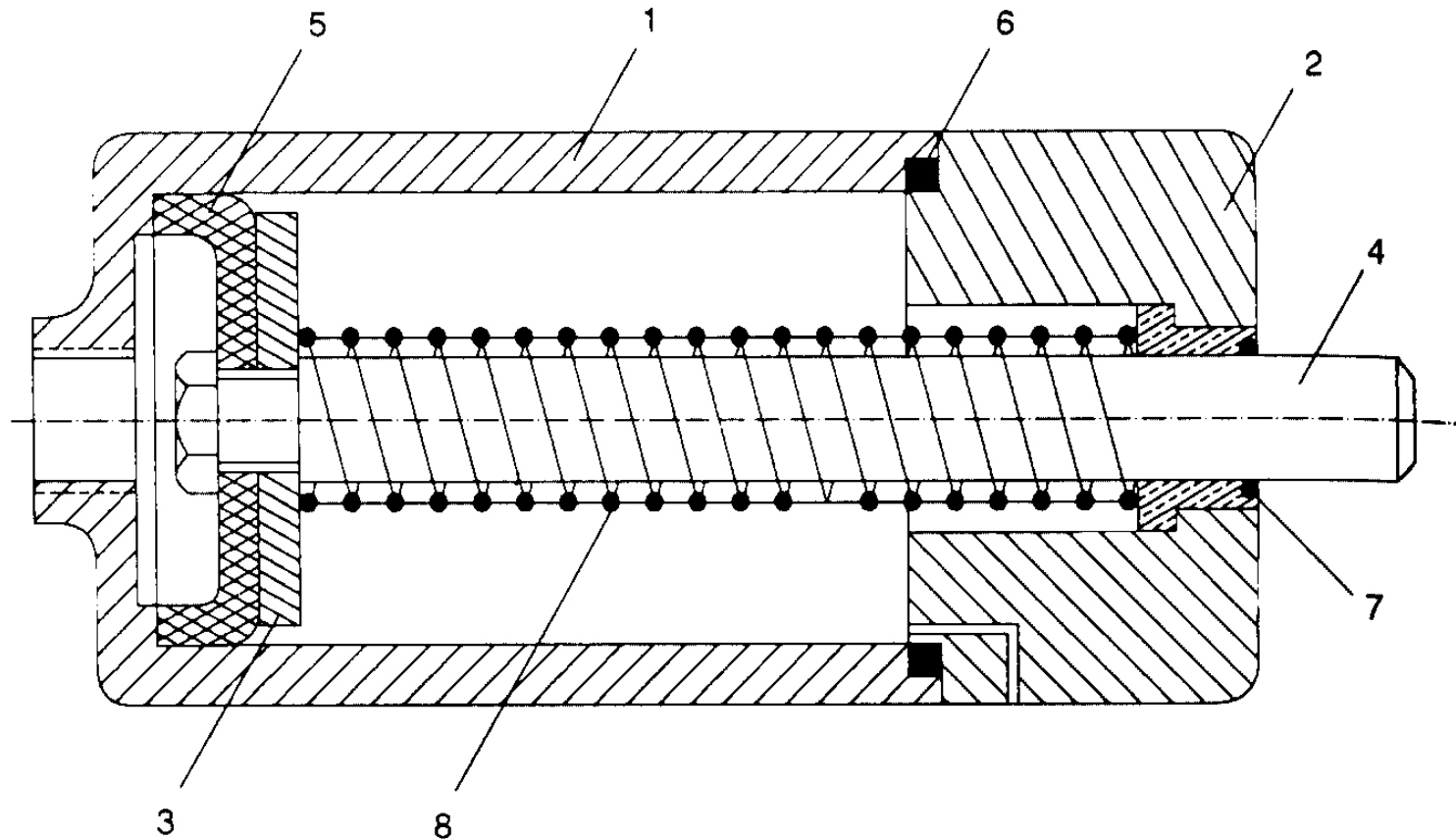
PNEUMATIC SYSTEM LAYOUT



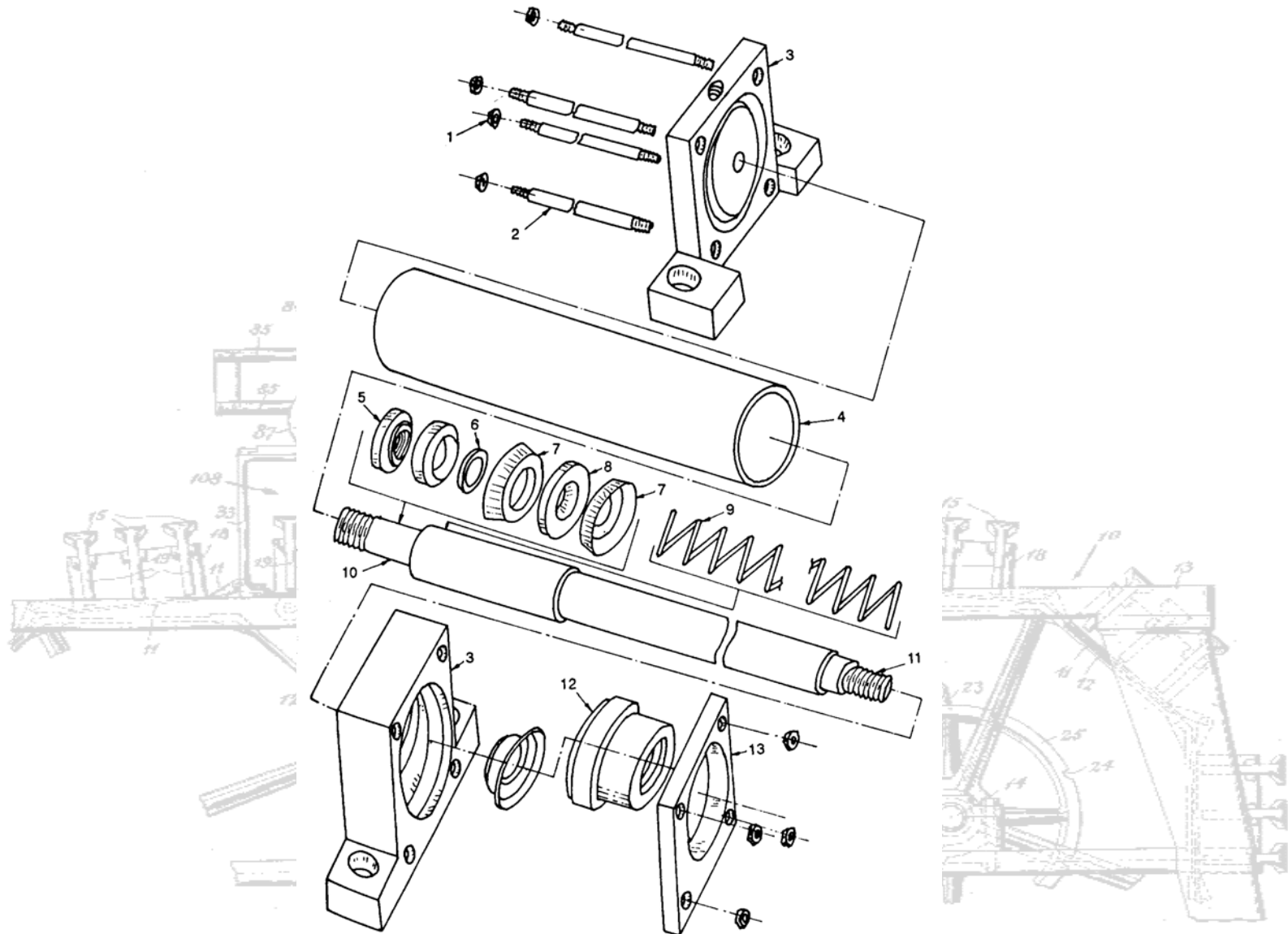
AIR PREPARATION



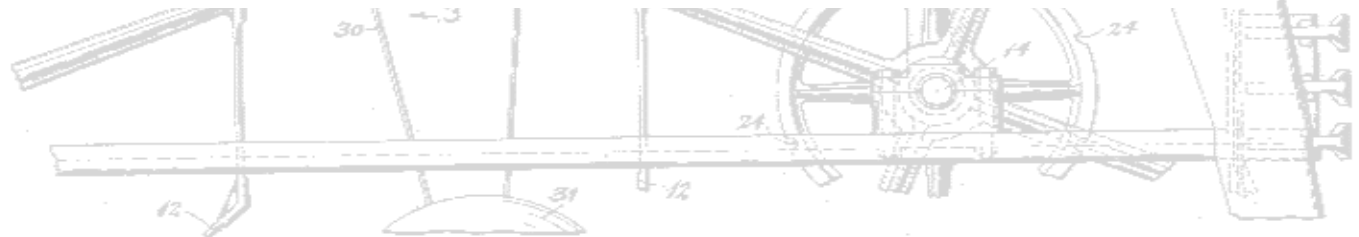
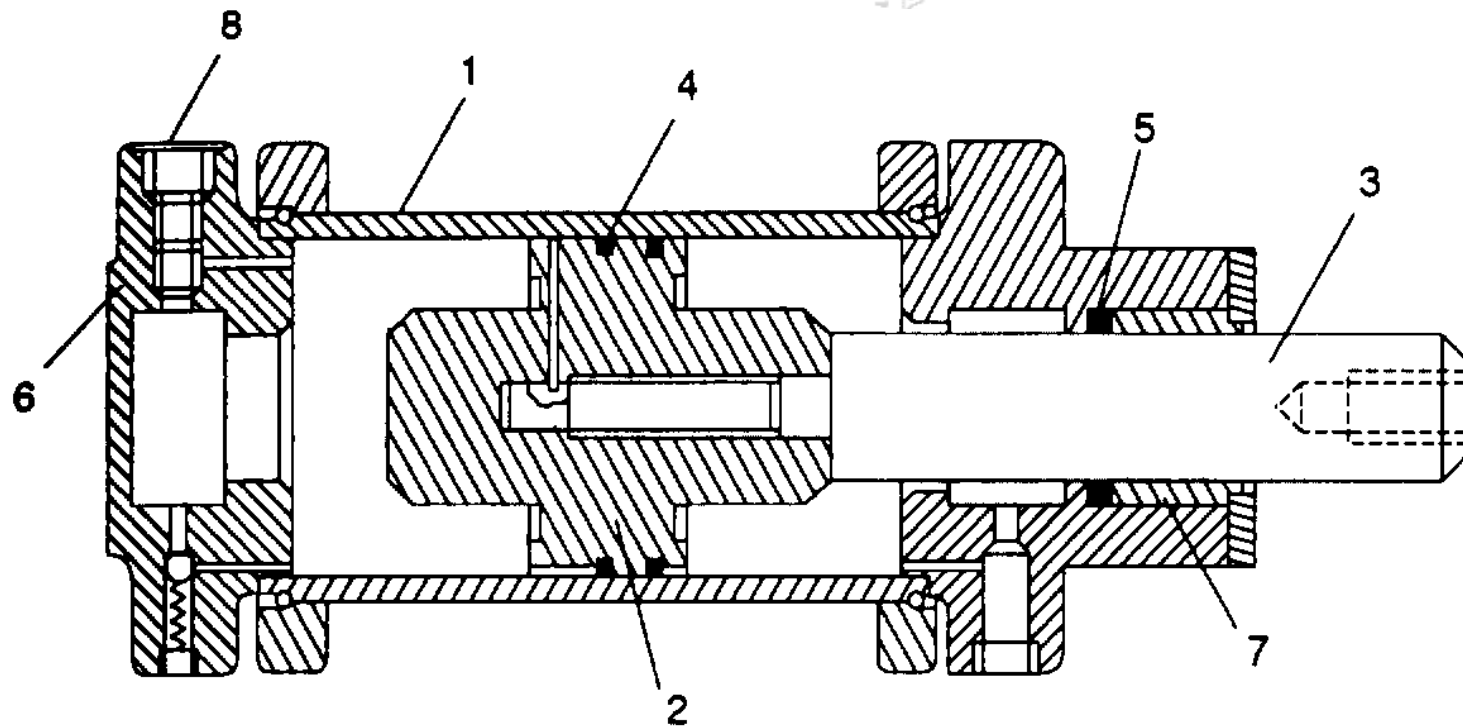
SINGLE-ACTING CYLINDER



SINGLE-ACTING CYLINDER

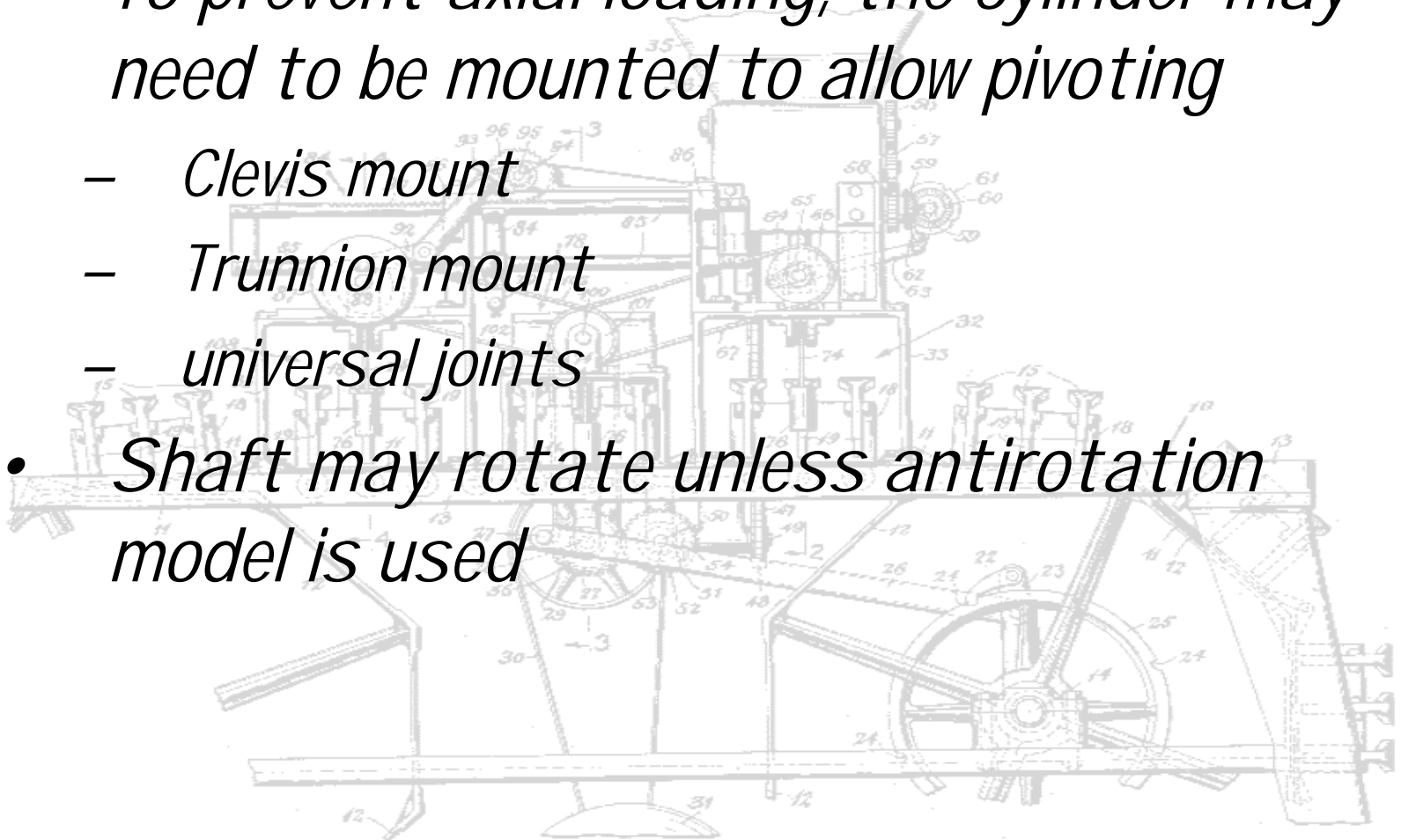


DOUBLE-ACTING CYLINDER

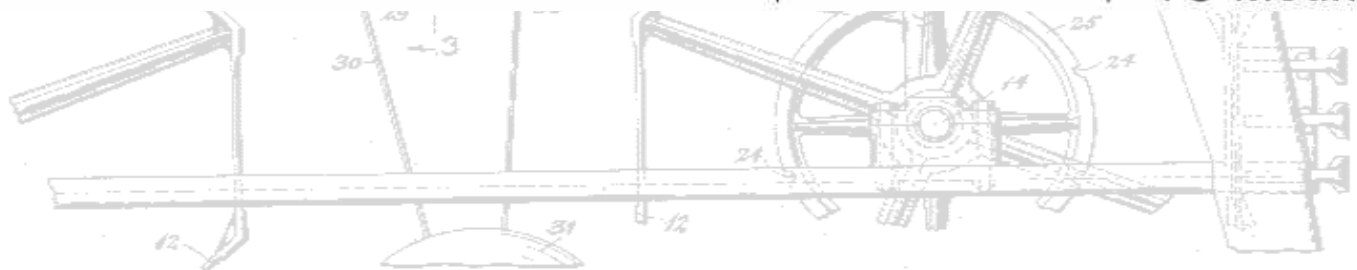
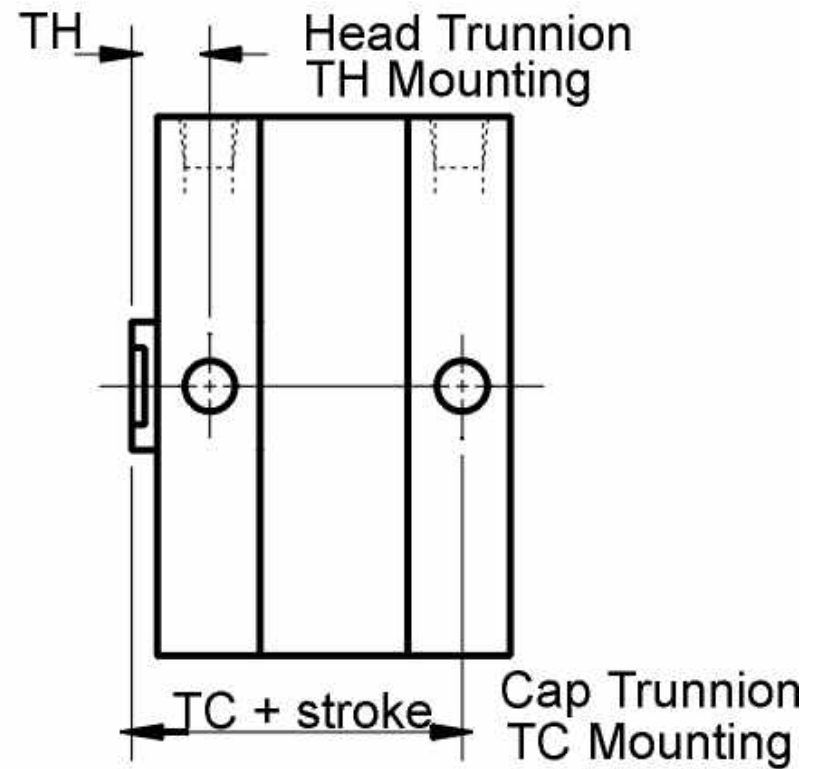
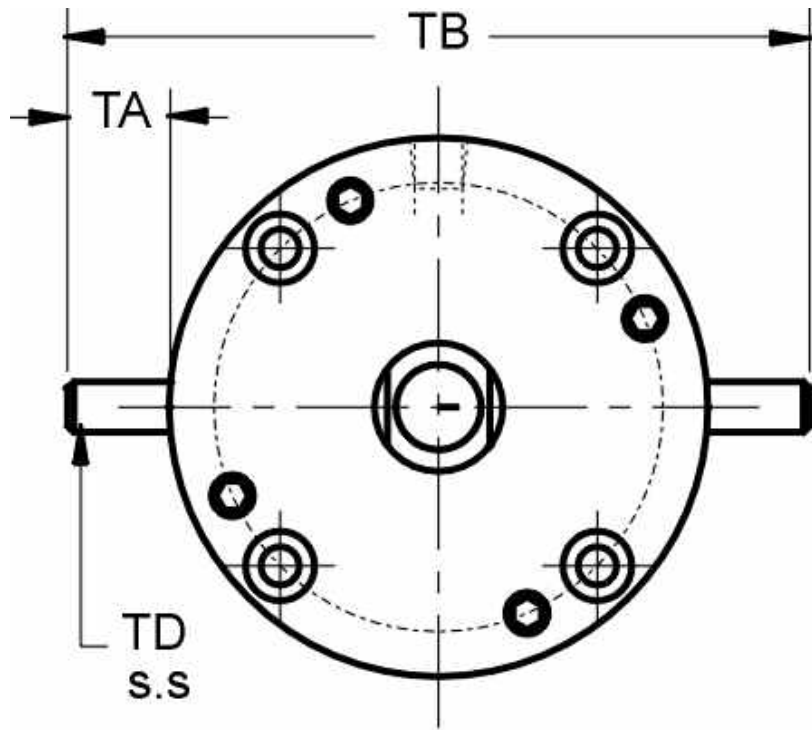


PNEUMATIC CYLINDER MOUNTING

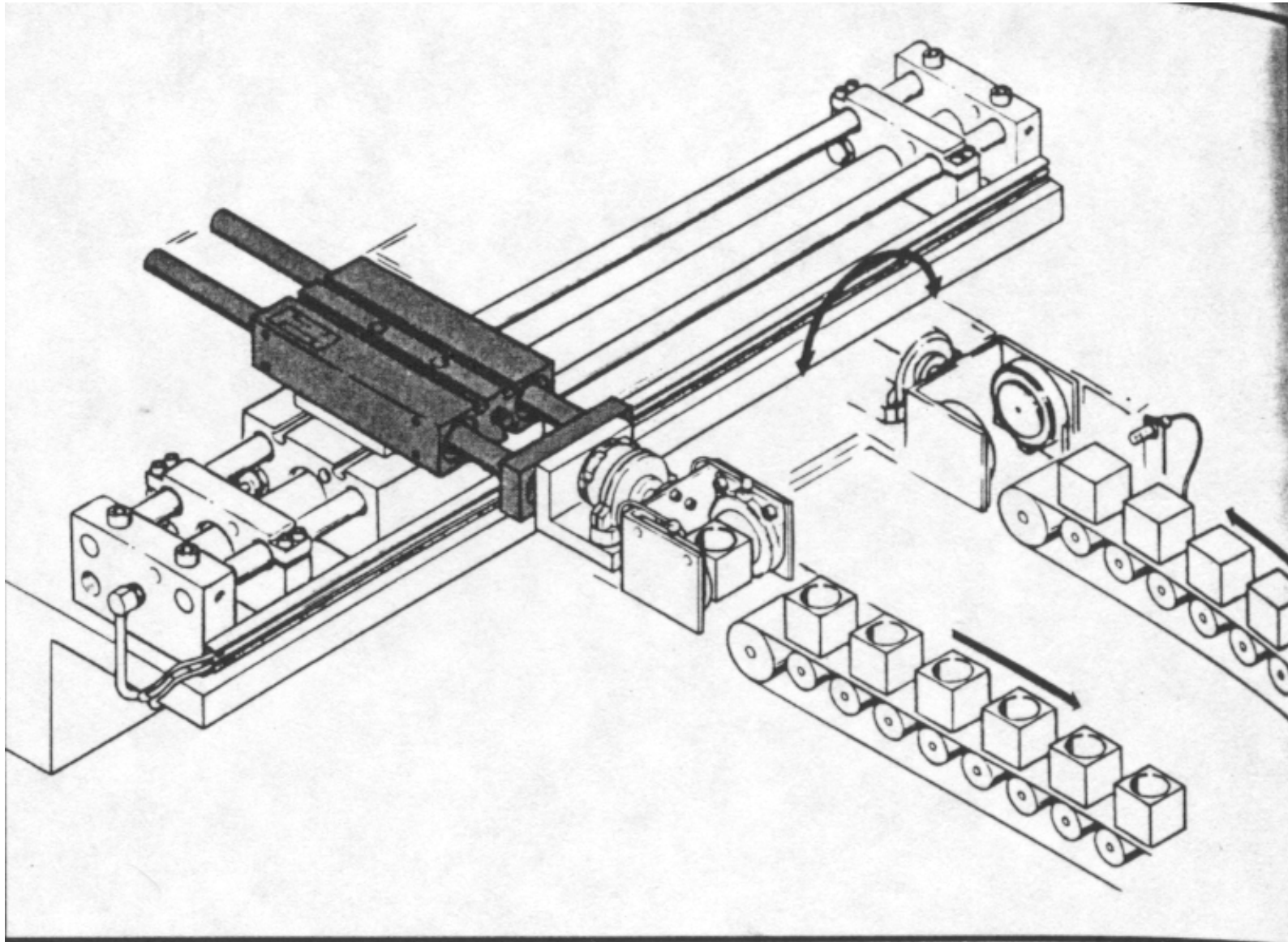
- *Off-axis loading must be prevented*
- *To prevent axial loading, the cylinder may need to be mounted to allow pivoting*
 - *Clevis mount*
 - *Trunnion mount*
 - *universal joints*
- *Shaft may rotate unless antirotation model is used*



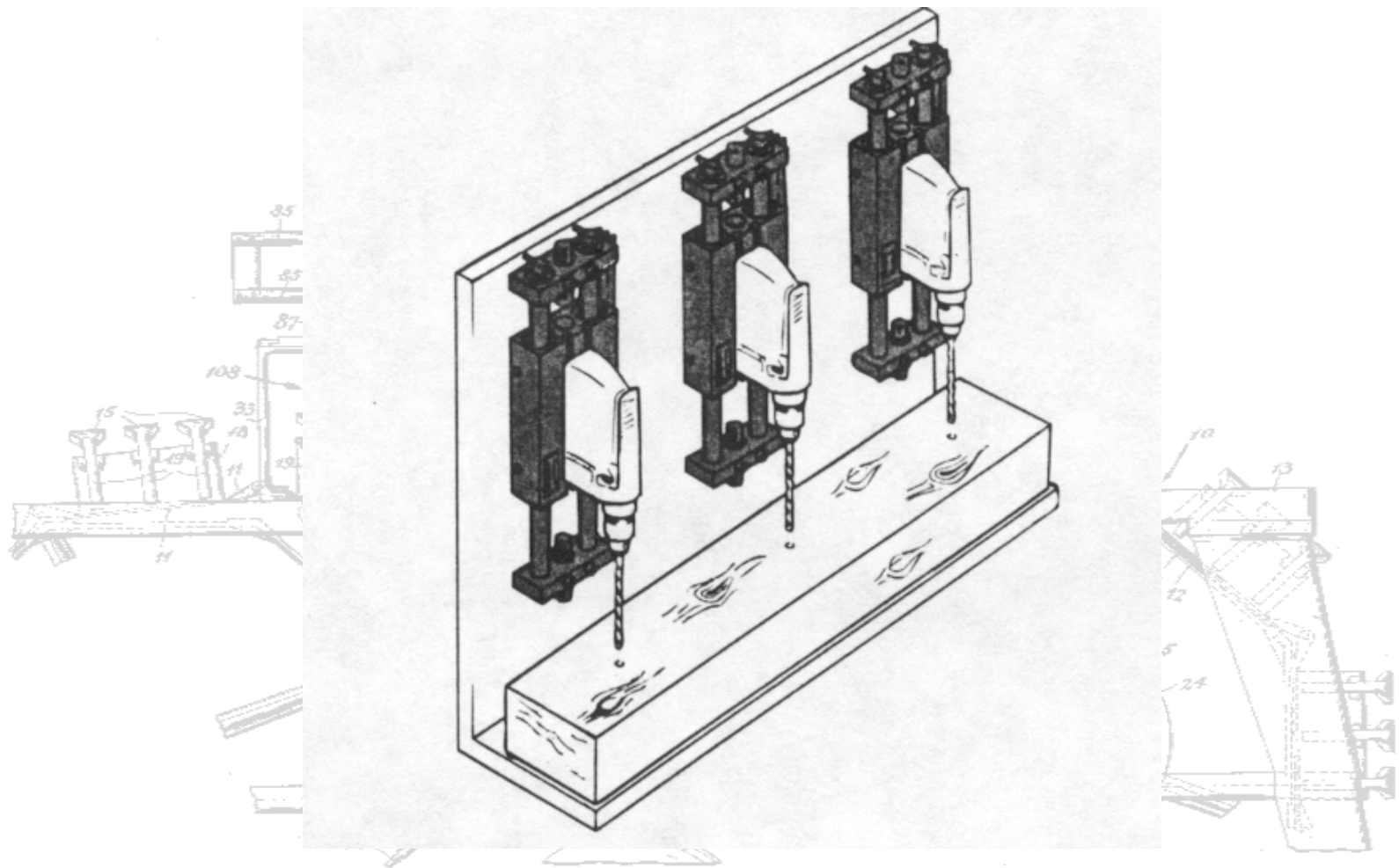
TRUNNION MOUNT



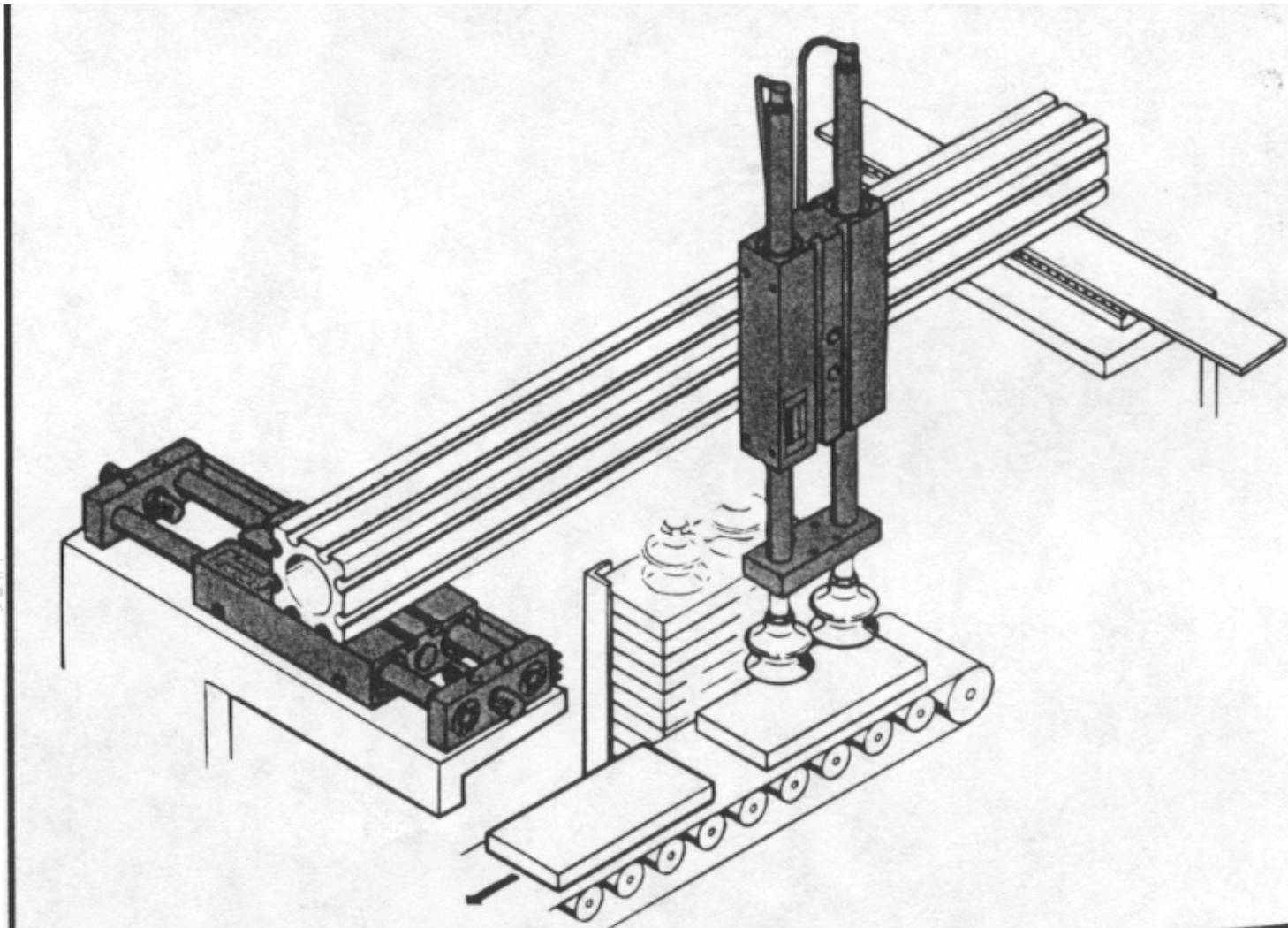
PNEUMATIC TWIN CYLINDERS



PNEUMATIC TWIN CYLINDERS

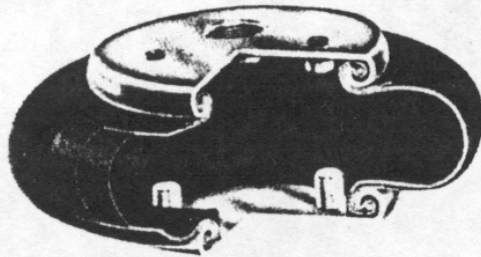


PNEUMATIC TWIN CYLINDERS

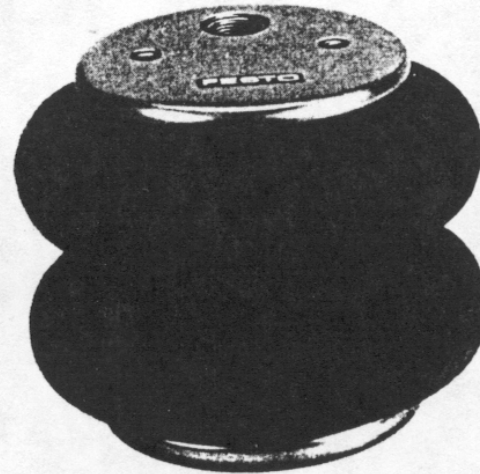
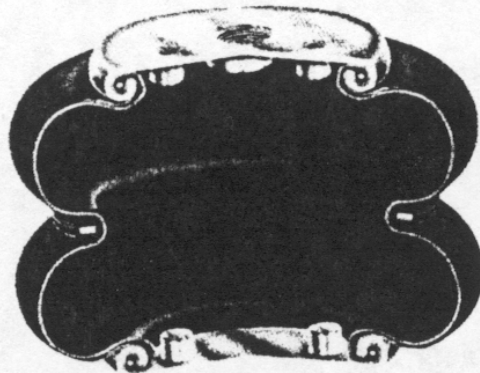


PNEUMATIC BELLOWS

Single Fold Bellows Cylinder

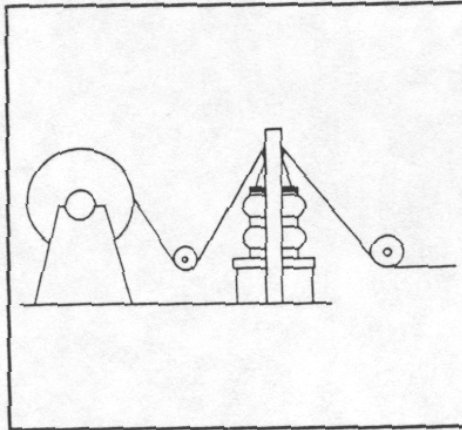


Double Fold Bellows Cylinder

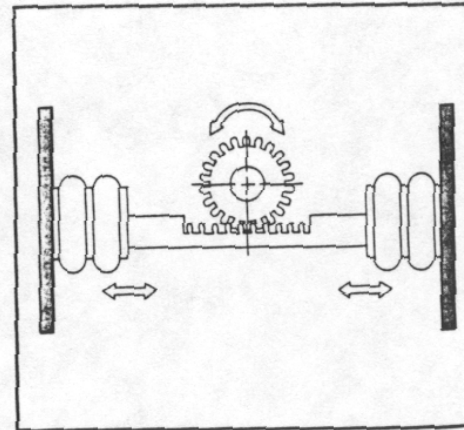


PNEUMATIC BELLOWS

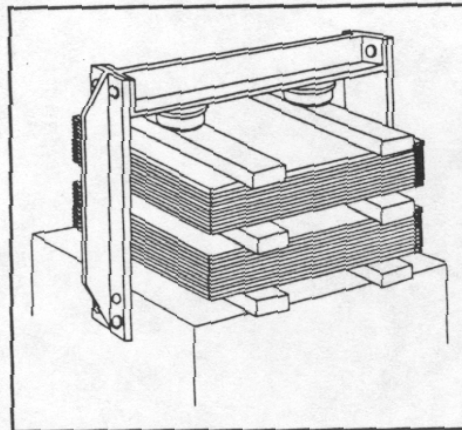
Sample Applications:



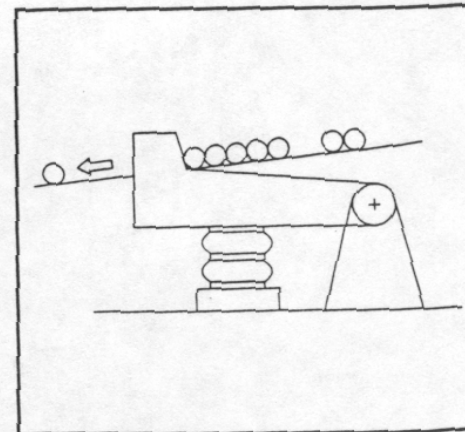
Web Tensioning Device



Rotary Valve

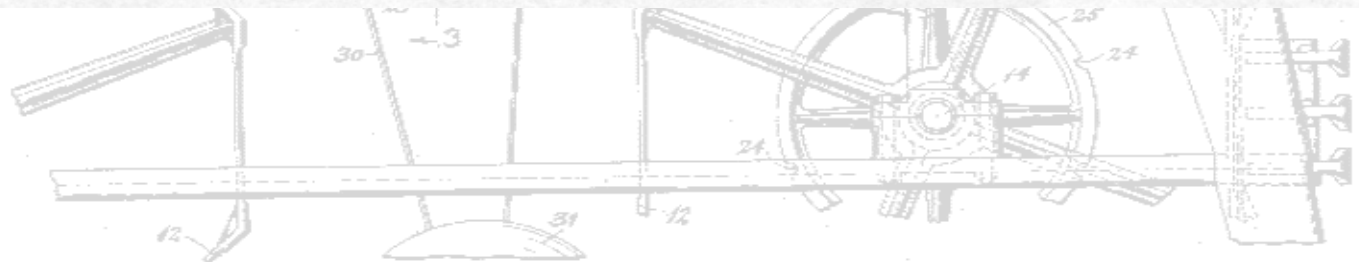
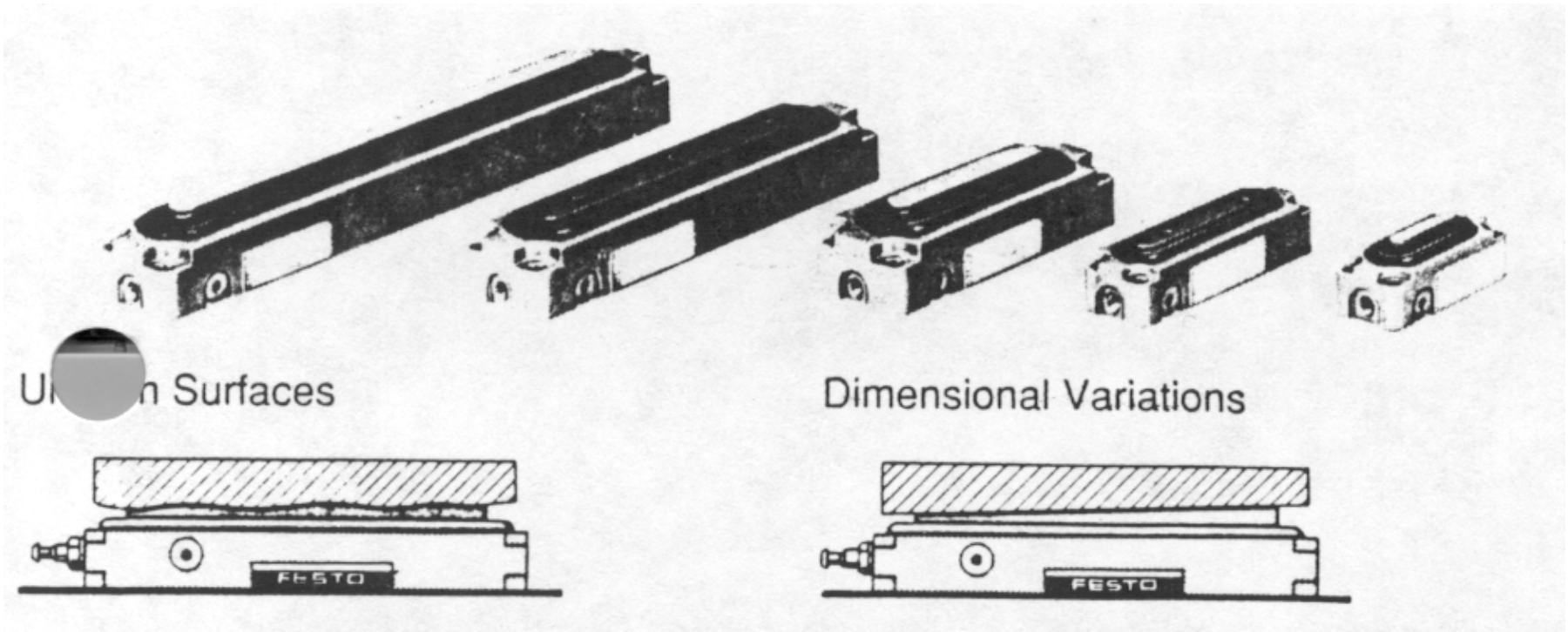


Gluing Press



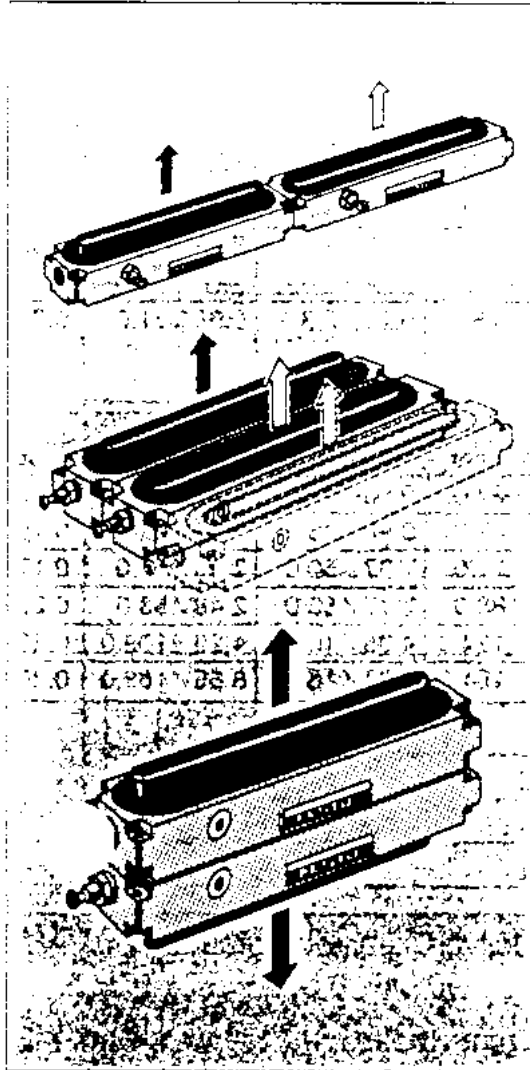
Hinged Actuated Gravity Gate

PNEUMATIC BELLOWS

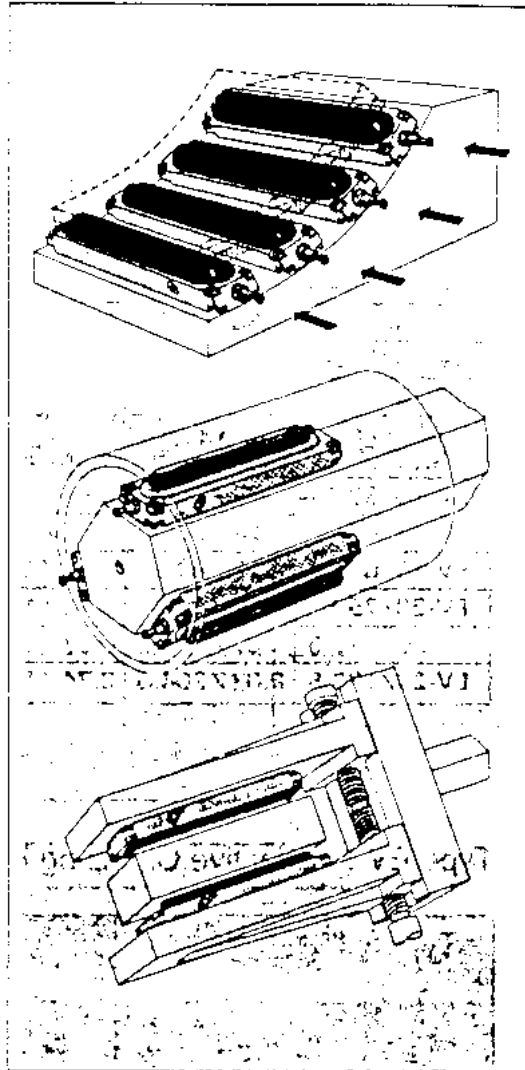


PNEUMATIC BELLOWS

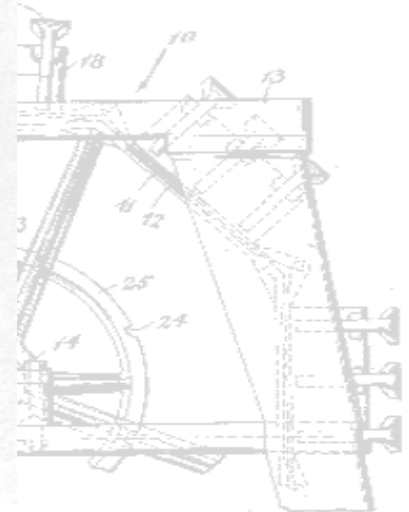
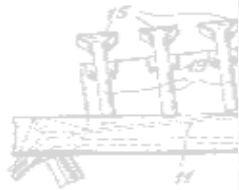
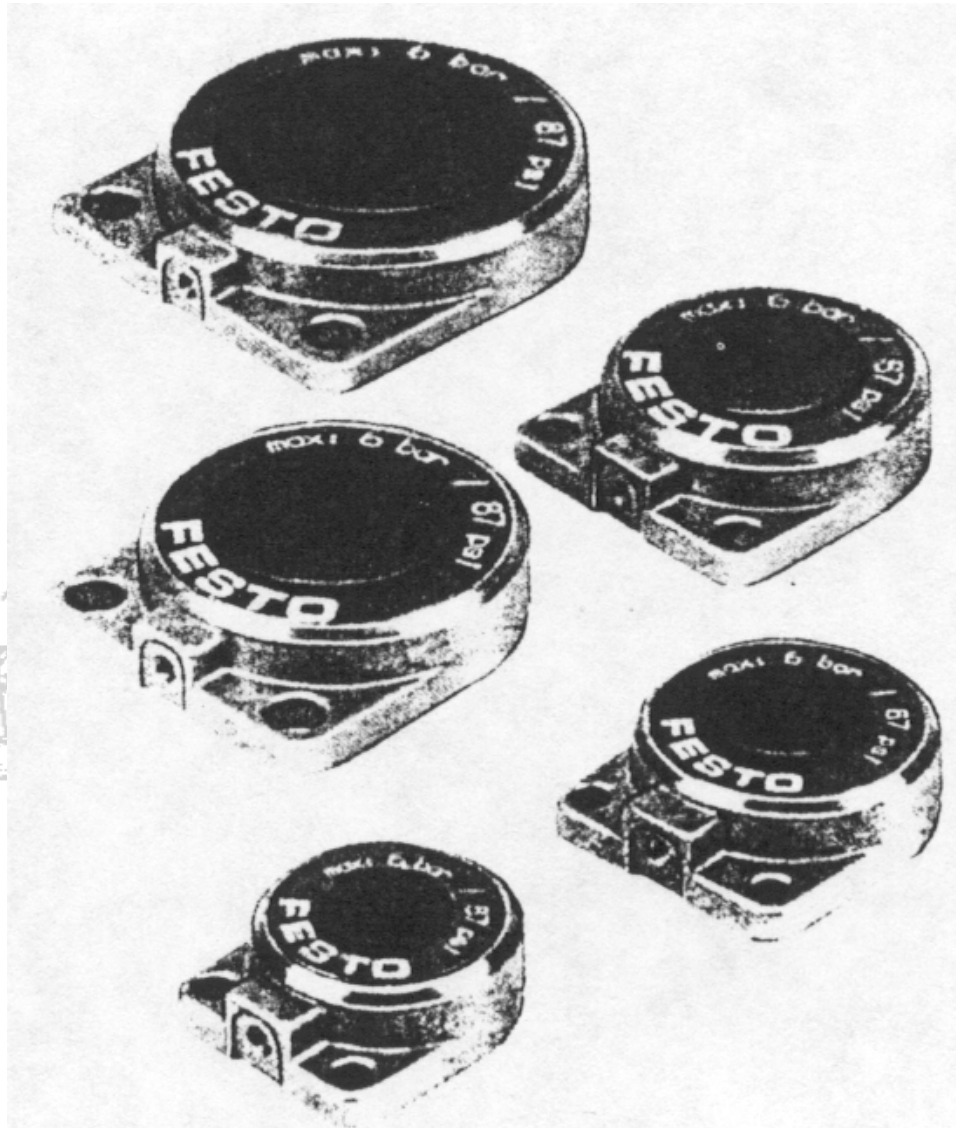
Mounting Versatility



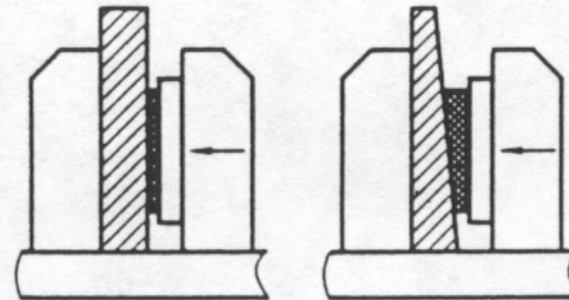
Application Examples



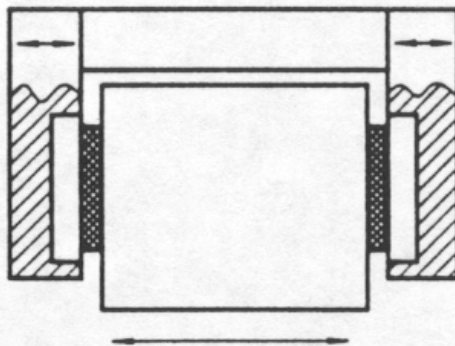
PNEUMATIC BELLOWS



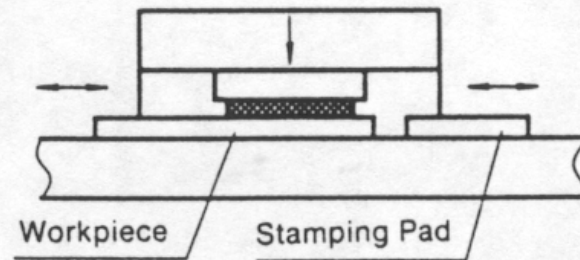
PNEUMATIC BELLOWS



Clamping
slanted and uneven parts

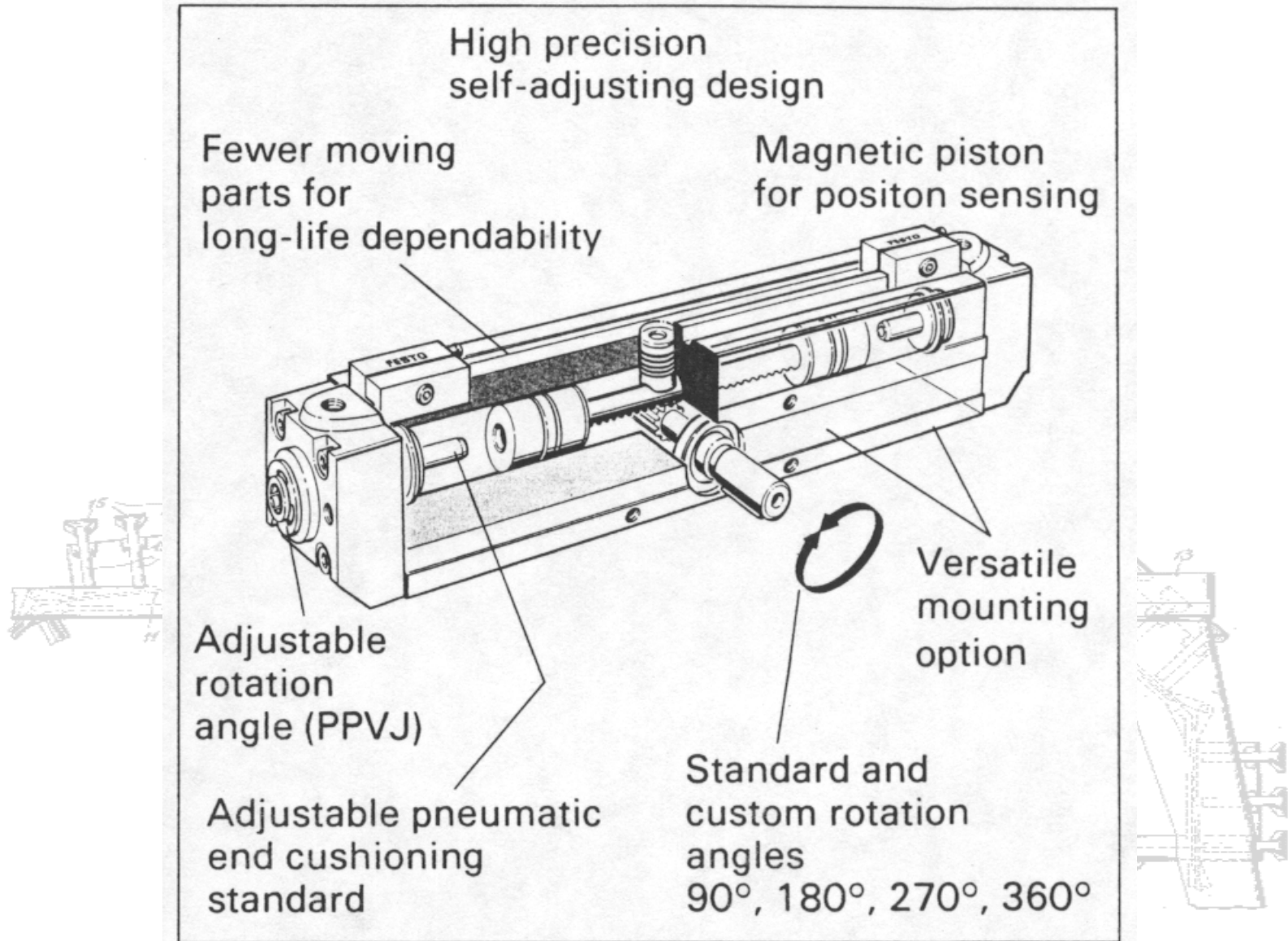


Gripping
gently or with force

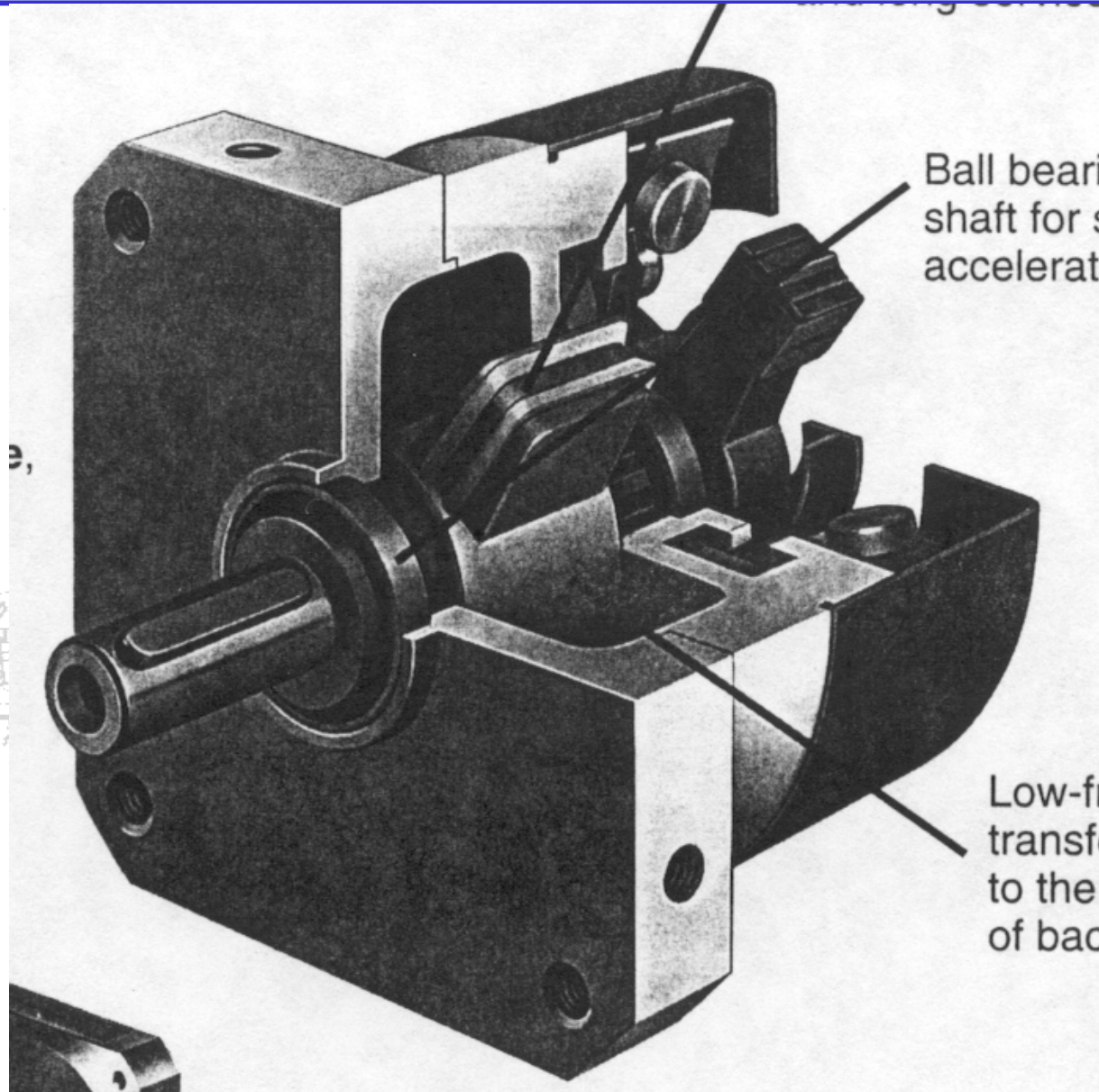


Stamping
in tight spaces

PNEUMATIC ROTARY ACTUATORS



PNEUMATIC ROTARY ACTUATORS



PNEUMATIC ROTARY ACTUATORS

