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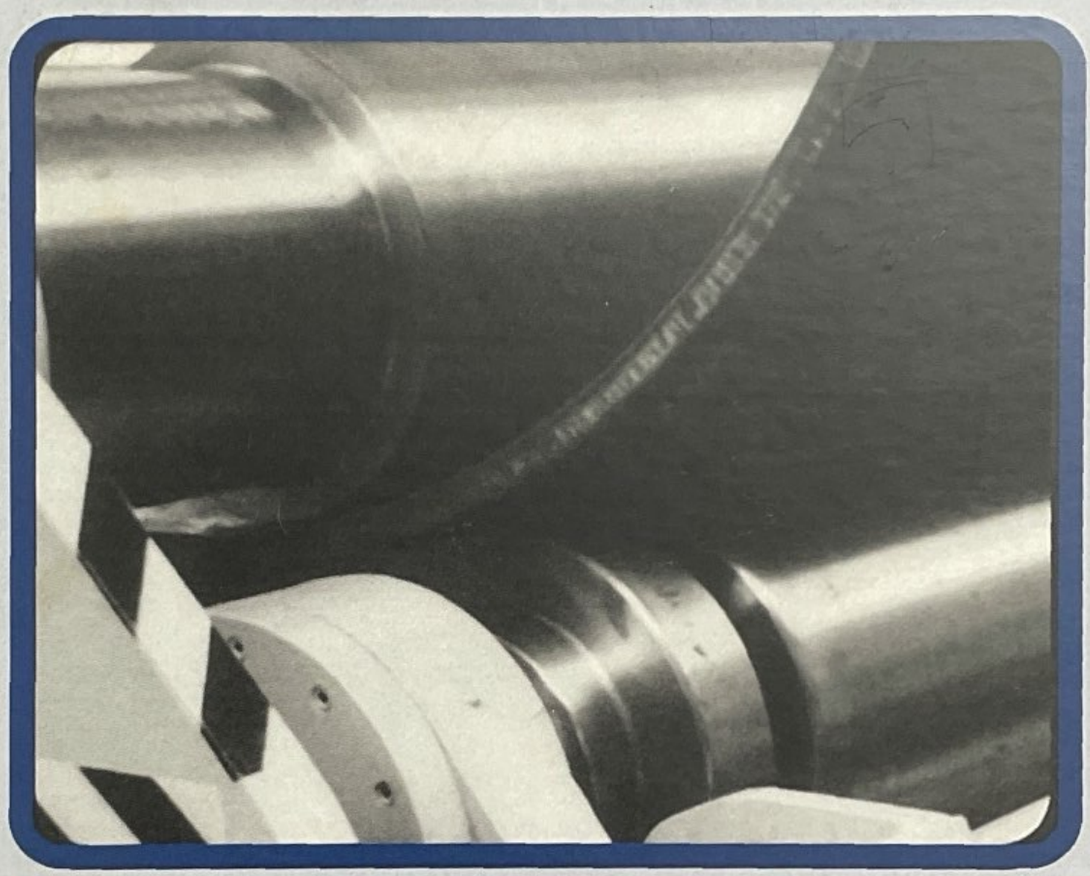
ROLL BENDING



DIGEST

INFORMATION FOR:

- 3 Roll Pyramid
- 3 Roll Initial Pinch
- 3 Roll Pinch Pyramid
- Four Roll Double Initial Pinch

INCLUDES:

- Procedures
- Trouble Shooting
- Rules of Thumb
- Nomenclature
- Features

1st Edition, Compiled by A. Weaver

SHEET & PLATE

ROLL BENDING

DIGEST

FOR: Operators
Managers
Designers
Engineers

Compiled by:
A.Weaver

1821 Matherly Road - Liberty - KY 42539

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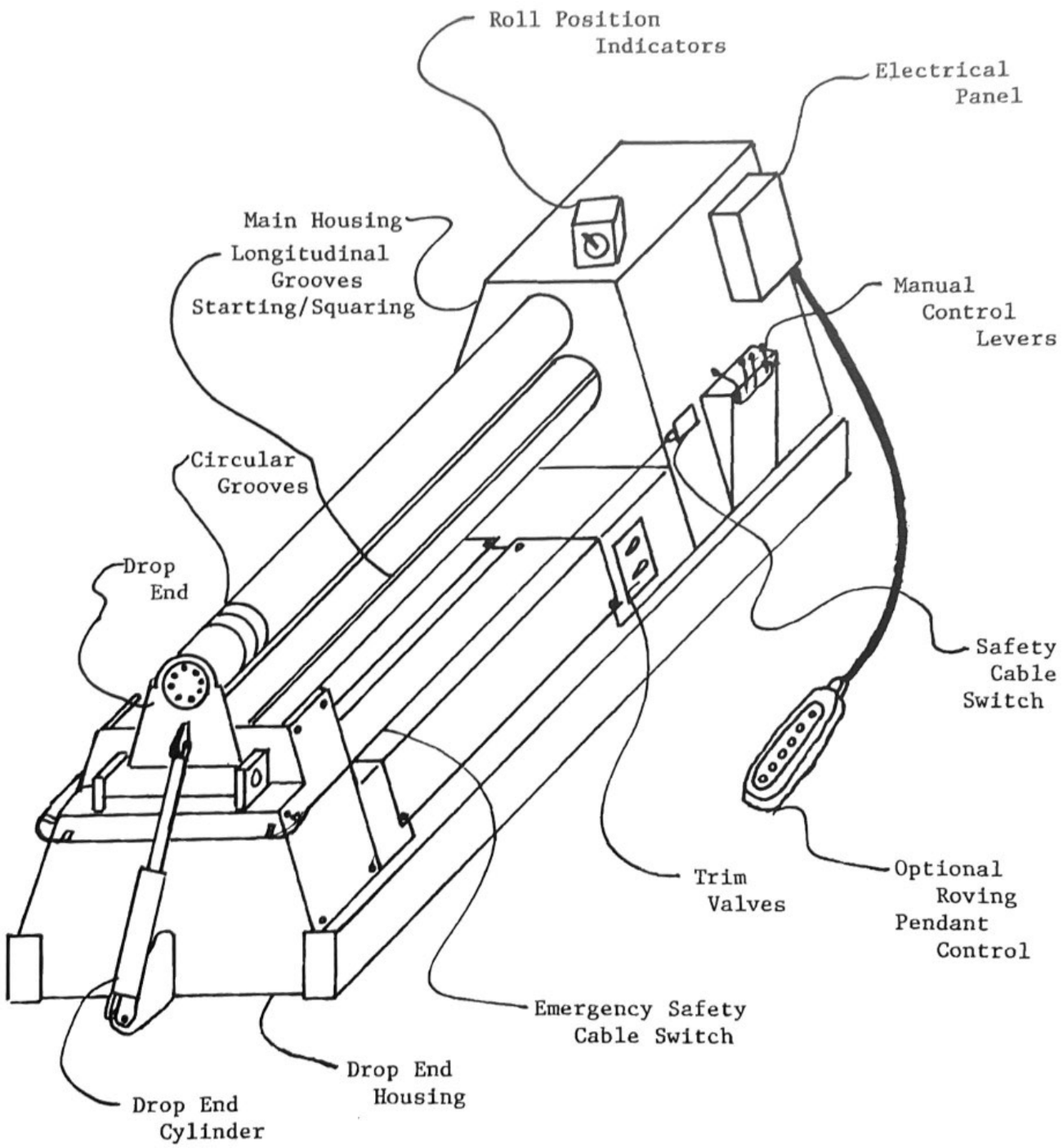
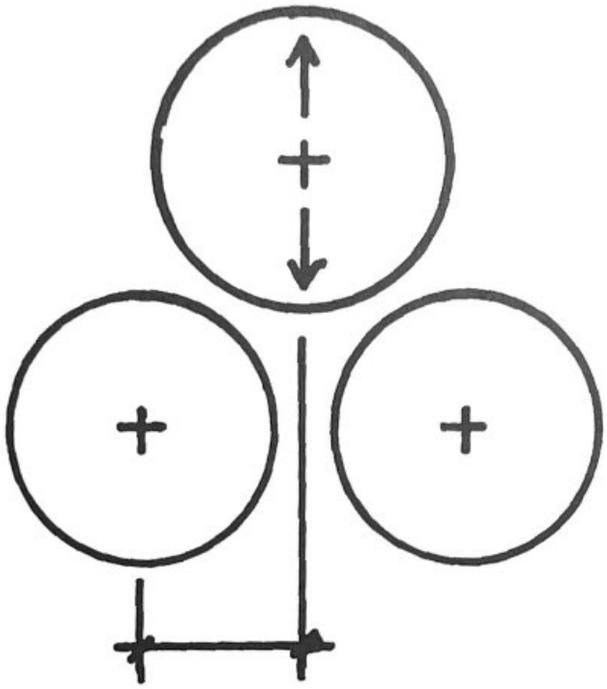
ROLL NOMENCLATURE





==========PYRAMID TYPE==========

ADVANTAGES

Economical

High capacity for given roll size

Uniform rolling

Ability to roll angle and flat bar with attachments

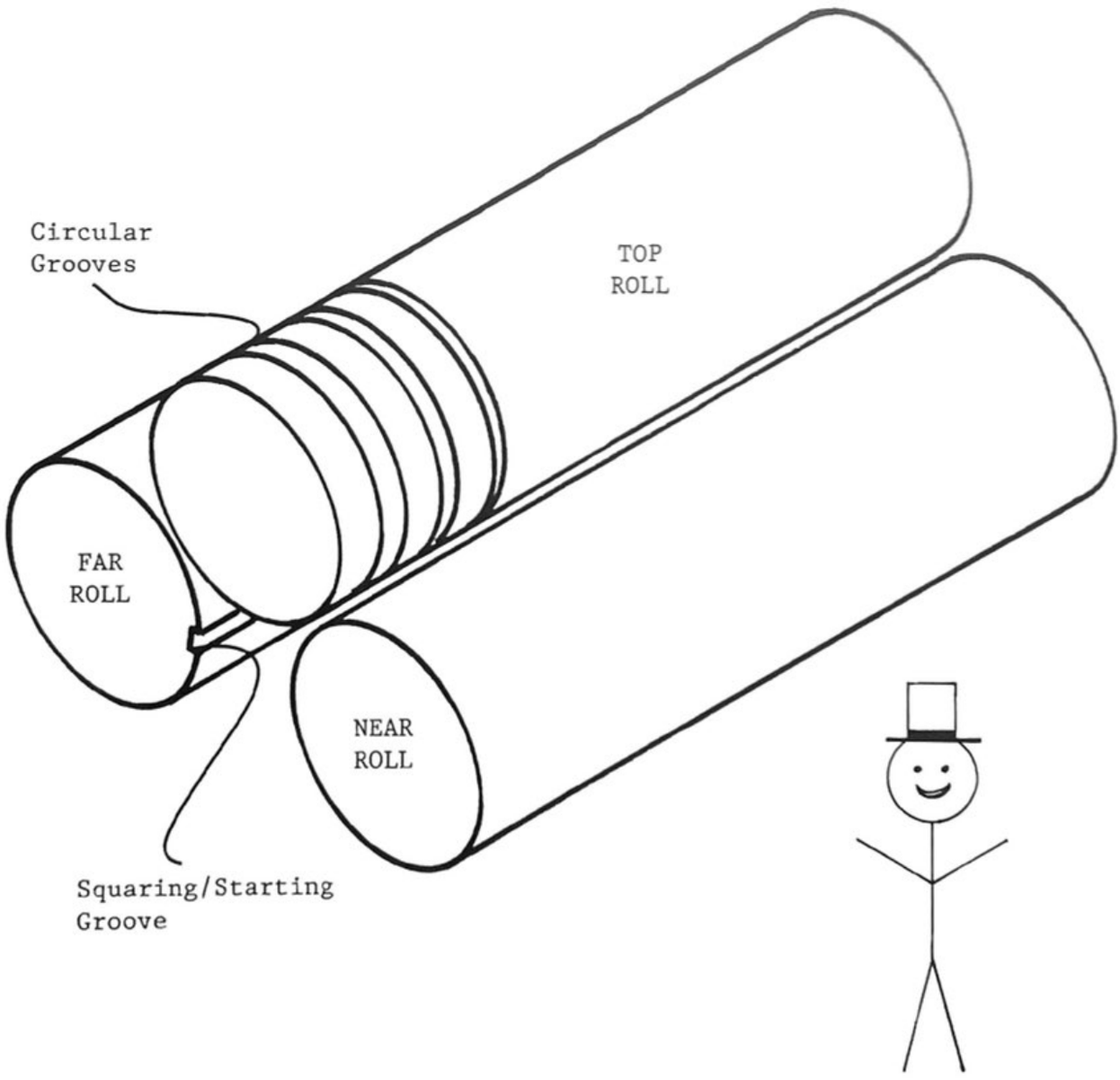
Good cone rolling

DISADVANTAGES

Leaves a relatively long flat on leading and trailing edges

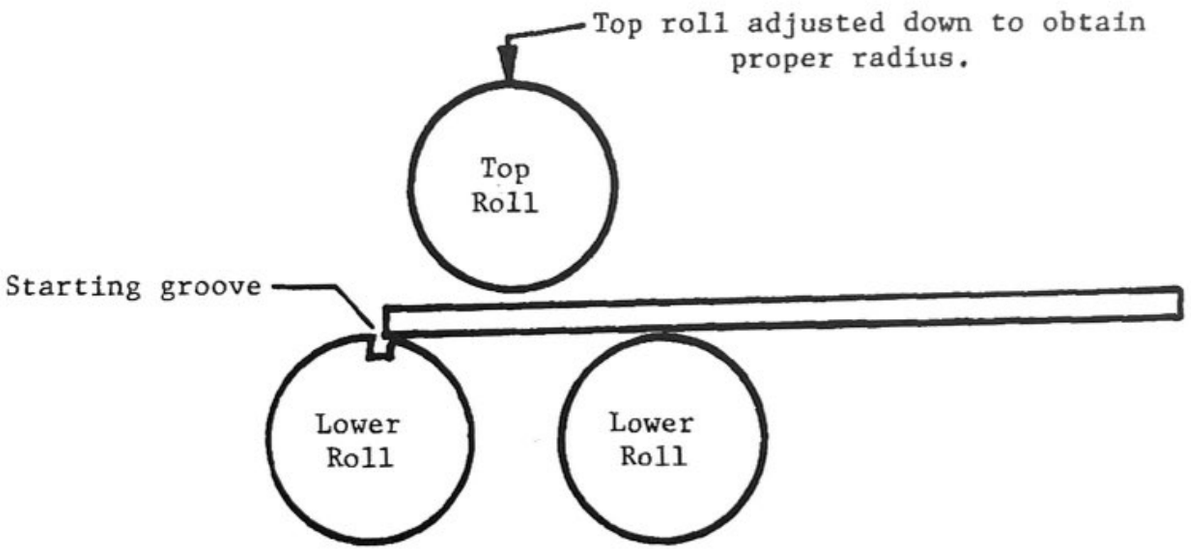
ROLL NOMENCLATURE

PYRAMID

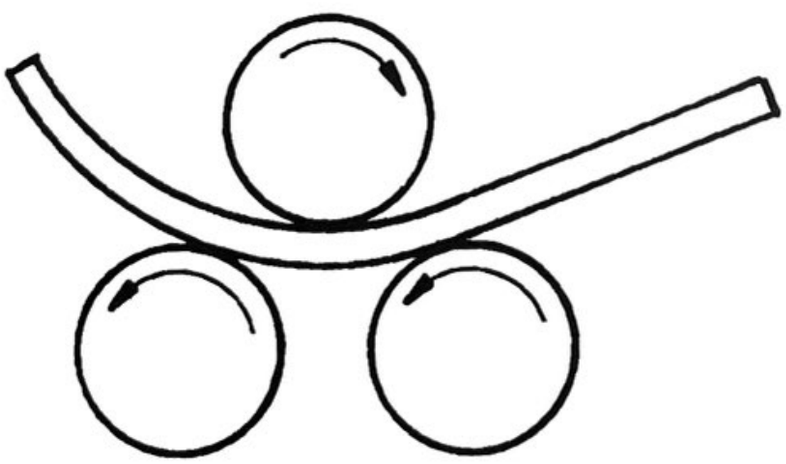


ROLLING CYCLE

PYRAMID ROLL



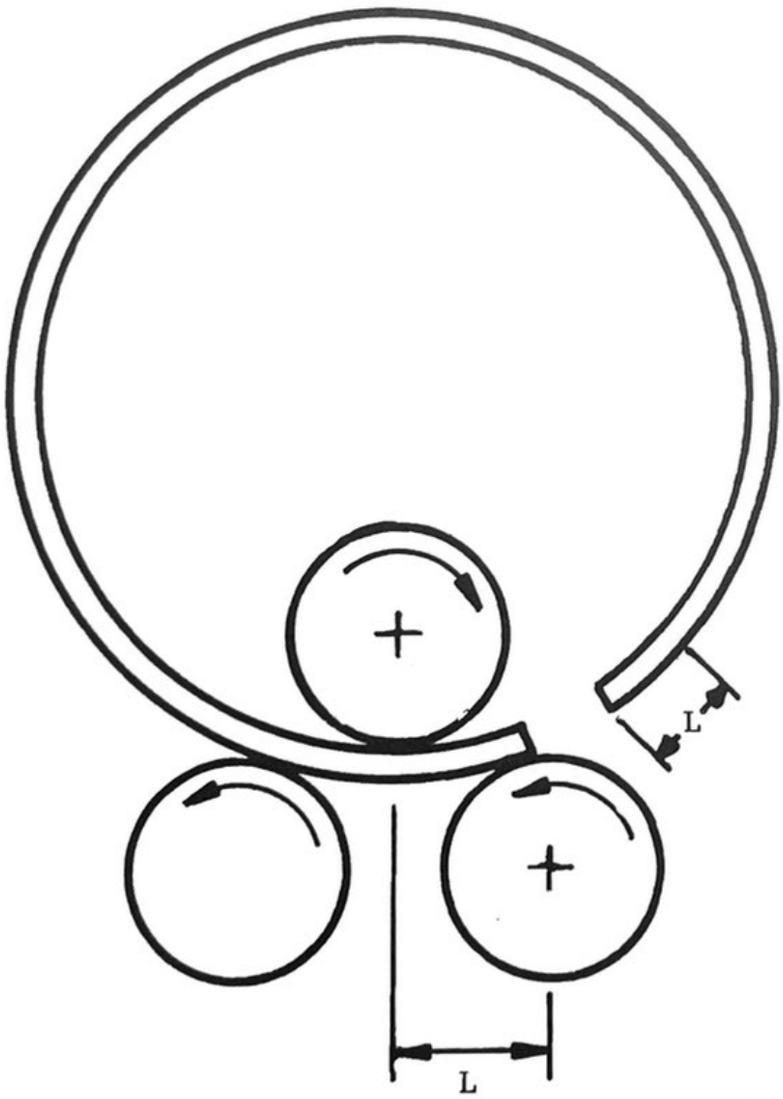
Work piece is entered into roll against starting groove.



Rolls are rotated to feed work piece through.

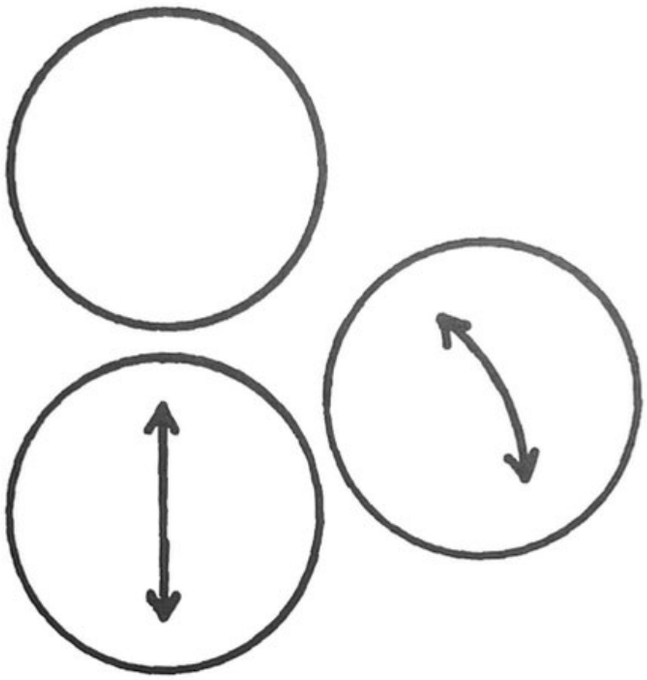
ROLLING CYCLE

PYRAMID ROLL
continued



L = length of flat

Rolled to completion.



==========INITIAL PINCH==========

ADVANTAGES

Rolls minimal flats (approximately 1½ to 2 x metal thickness) on leading and trailing edges

Good cone rolling capabilities

Good control of work piece

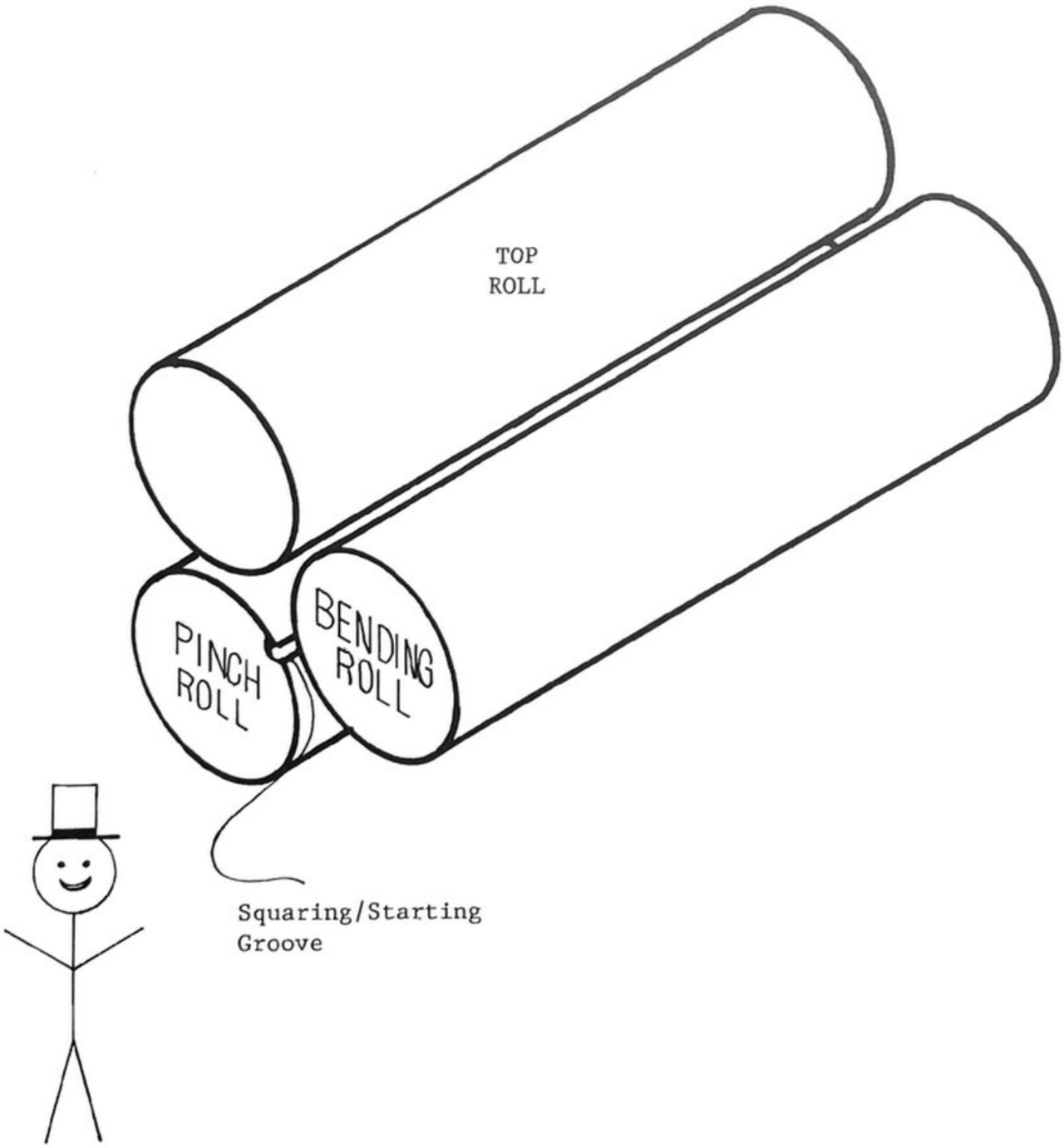
DISADVANTAGES

For proper formation work piece must be removed and re-entered in the opposite side of machine

Small opening between pinch and top rolls

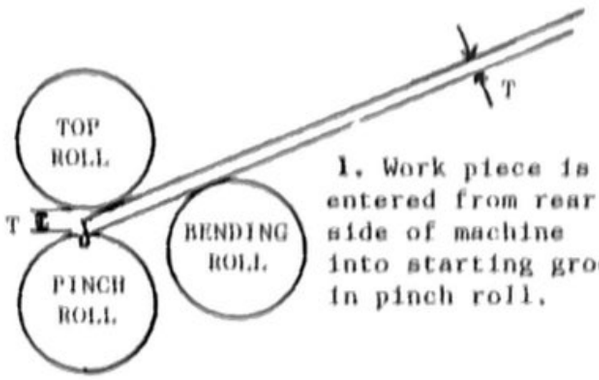
ROLL NOMENCLATURE

INITIAL PINCH

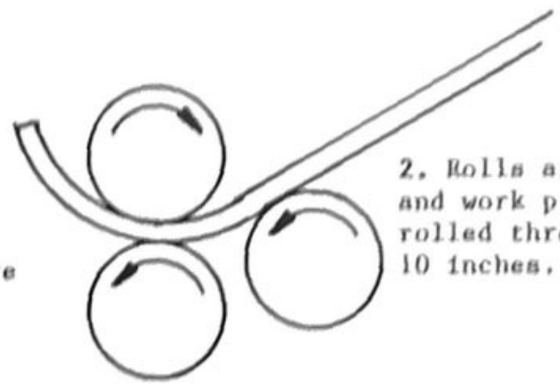


ROLLING CYCLE

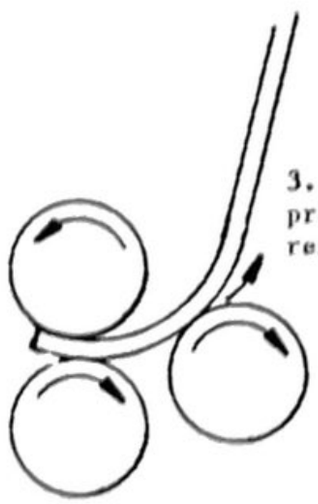
INITIAL PINCH ROLL



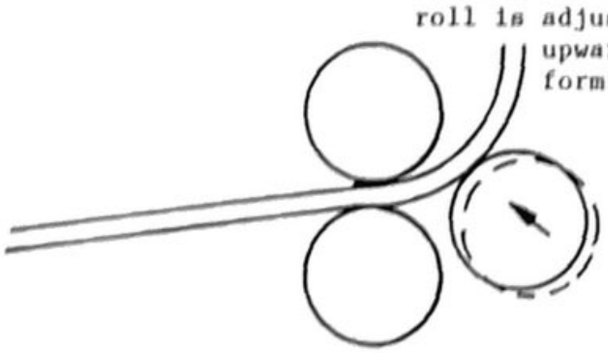
1. Work piece is entered from rear side of machine into starting groove in pinch roll.



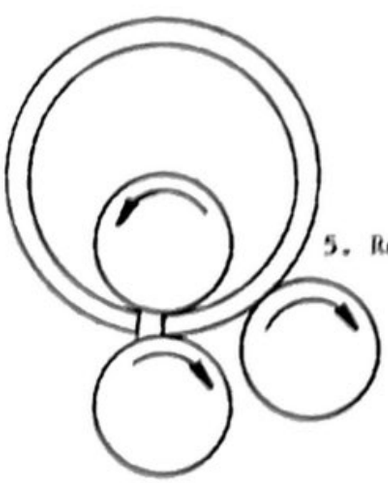
2. Rolls are rotated and work piece is rolled through 4 to 10 inches.



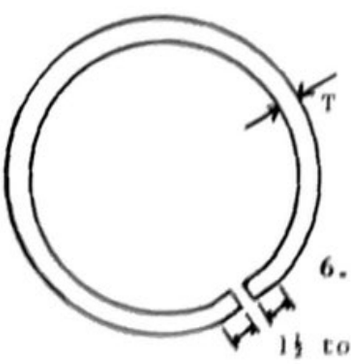
3. Rolls are reversed and pre-bent work piece is removed.



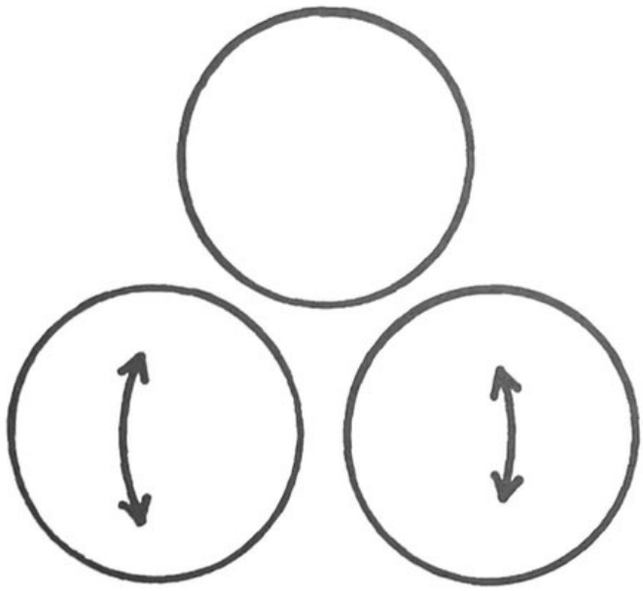
4. Work piece is re-entered and bending roll is adjusted upward to final forming position.



5. Rolled to completion.



6. Completed cylinder.



==========PINCH PYRAMID==========

ADVANTAGES

Minimal flats on both ends with one entry

Easy to operate

Increased capacity when rolling large diameters

Ability to roll angles and flat bar with attachments

Very versatile - symmetrical structural sections and welded/fabricated panels can be formed

DISADVANTAGES

Moderate accuracy

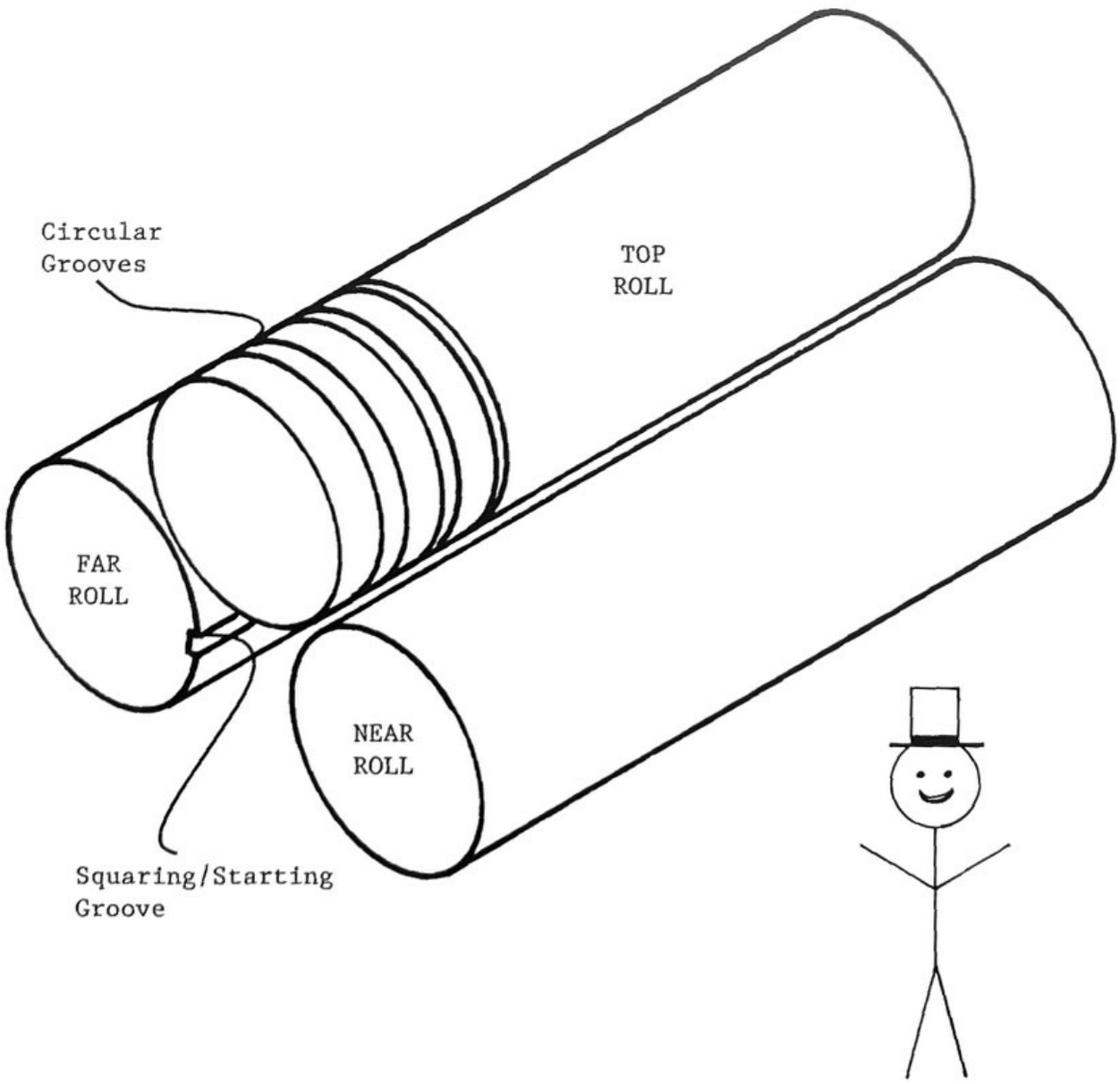
Moderate cone rolling capability and capacity

Can have some flats on large diameters

Can lose control of work piece

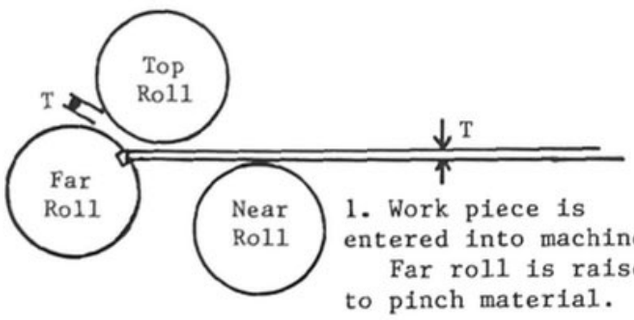
ROLL NOMENCLATURE

PINCH PYRAMID

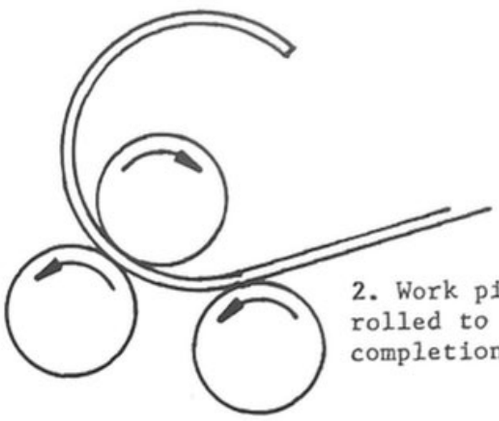


ROLLING CYCLE

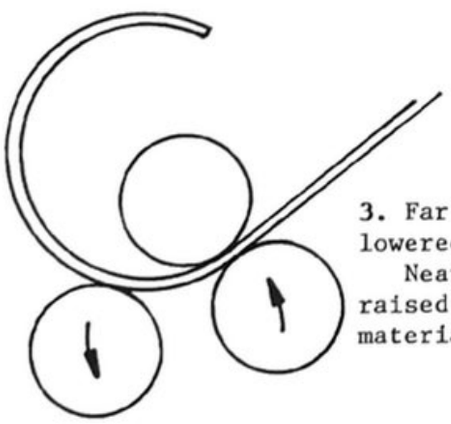
PINCH PYRAMID ROLL



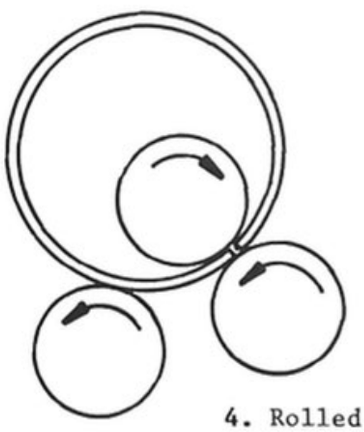
1. Work piece is entered into machine.
   Far roll is raised to pinch material.



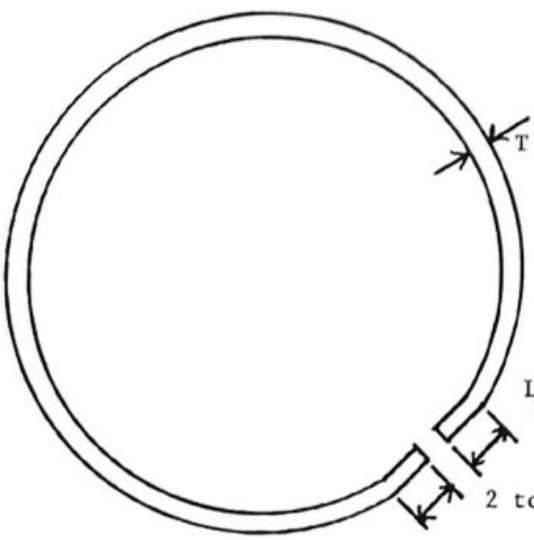
2. Work piece is rolled to near completion.

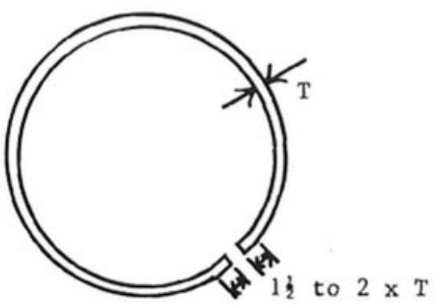


3. Far roll is lowered.
   Near roll is raised to pinch material.

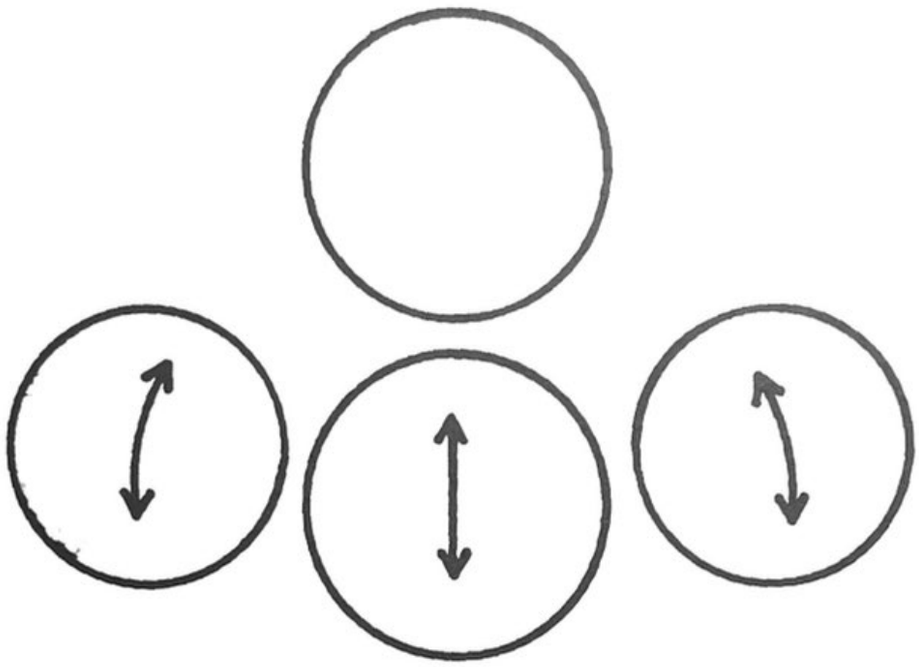


4. Rolled to completion.





Smaller Diameters
≤4 to 6 x Top roll diameter



==========4 ROLL==========

ADVANTAGES

Minimal flats (approximately 1½ to 2 x metal thickness) on both ends with one entry

Can be conveyor fed

Excellent control of work piece

Excellent cone rolling capacities

Readily lends itself to automation

DISADVANTAGES

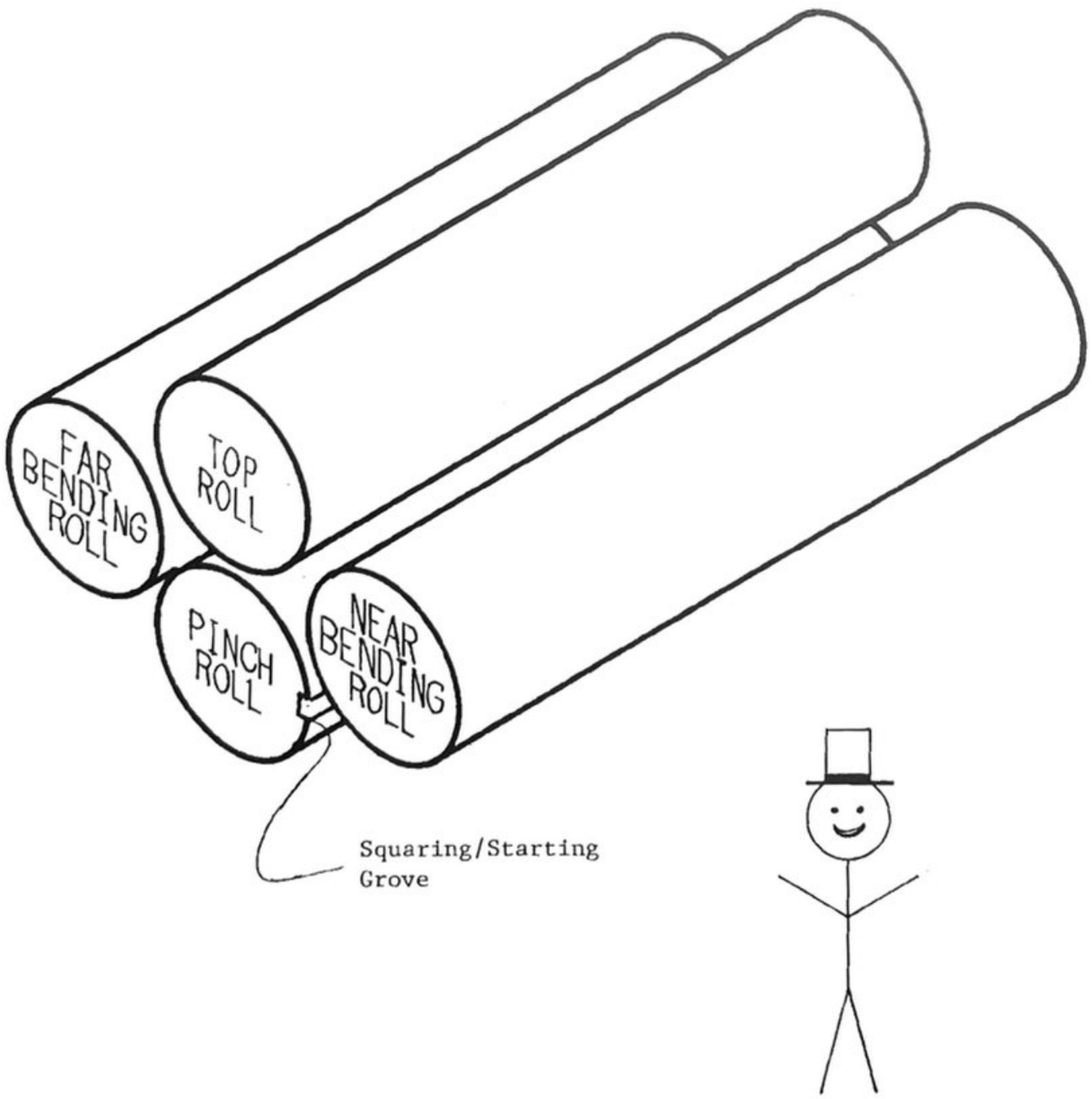
Larger machine

More costly

Can be confusing for the periodic and unskilled worker

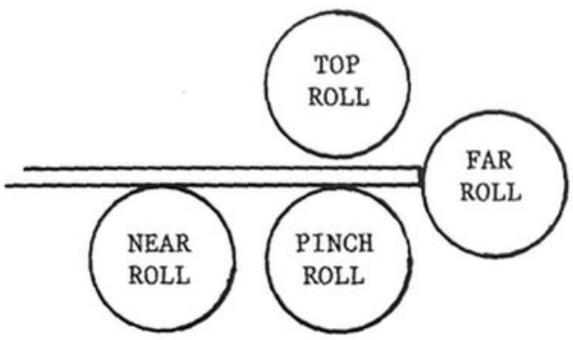
ROLLING NOMENCLATURE

FOUR ROLL DOUBLE PINCH

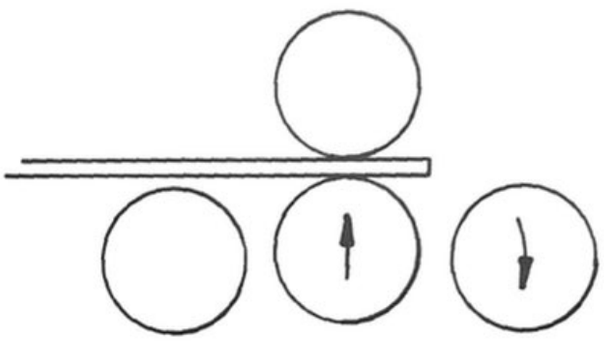


ROLLING CYCLE

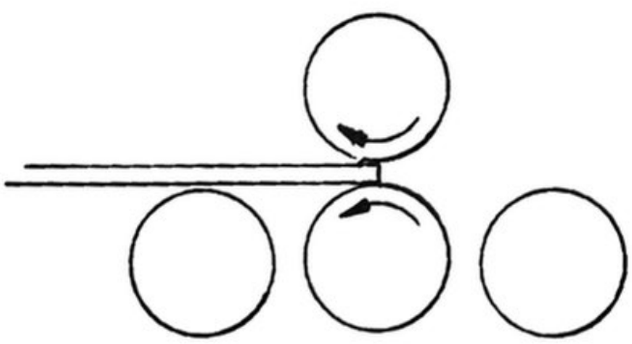
FOUR ROLL PLATE



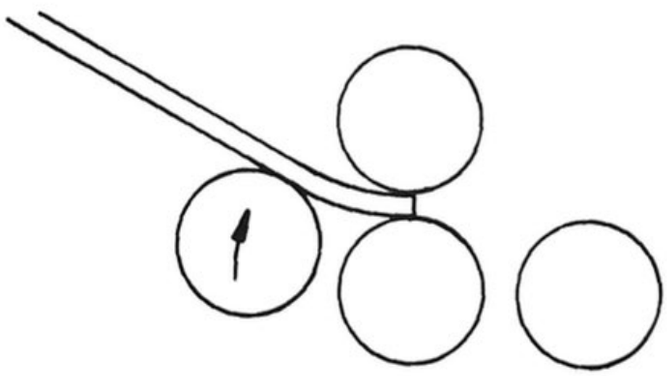
1. Work piece is entered and squared against far roll.



2. Pinch roll is raised to clamp work piece. Far roll is lowered.



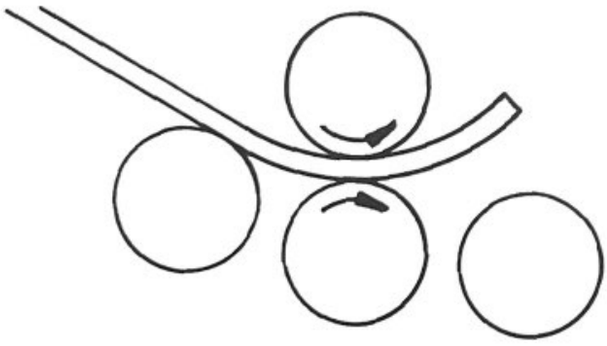
3. Rolls are reversed until leading edge is just short of the center line of the top and pinch rolls.



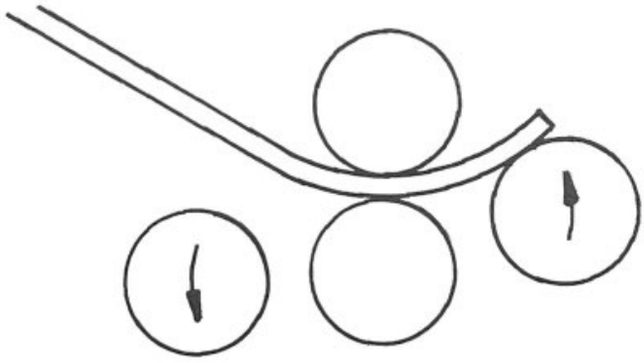
4. Near roll is raised to bending position.

ROLLING CYCLE

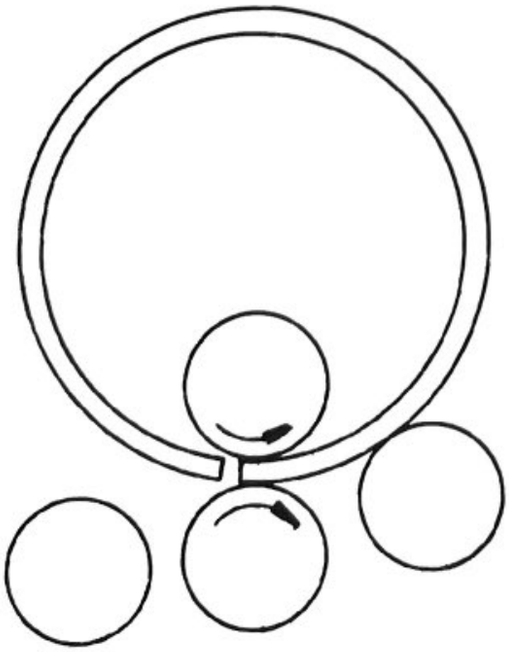
FOUR ROLL PLATE cont.



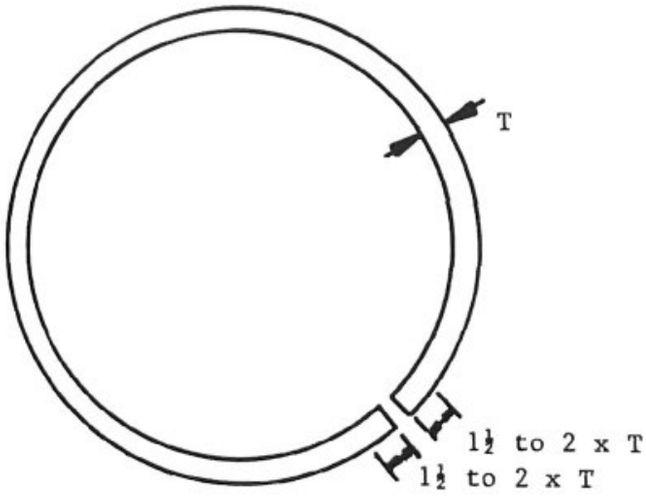
5. Rolls are rotated forward until prebend is complete.



6. Near roll is lowered. Far roll is raised to forming position.



7. Rolled to completion.



8. Completed cylinder.

WORK

PIECE

QUALITY

- WHAT AFFECTS IT

- HOW TO CORRECT IT

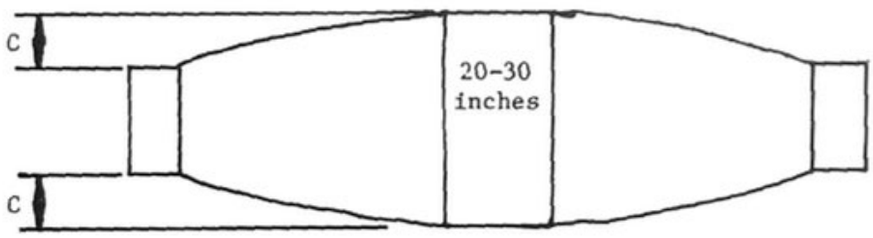
WORK PIECE QUALITY

FACTORS CONTRIBUTING TO WORK PIECE QUALITY

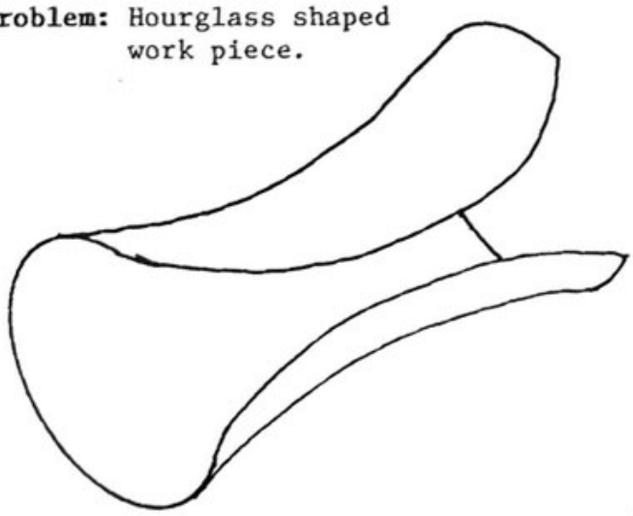
- Variations in metal thickness
- Variation in temper
- Variation in physical characteristics of different heat numbers
- Grain direction
- Uniform cross section of work piece

WORK PIECE QUALITY

ROLL CROWN

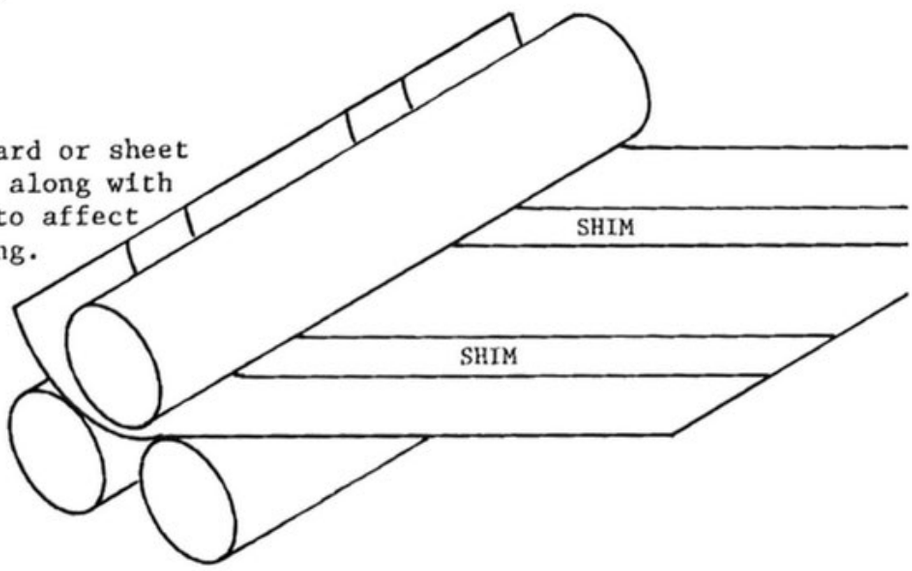


Problem: Hourglass shaped work piece.



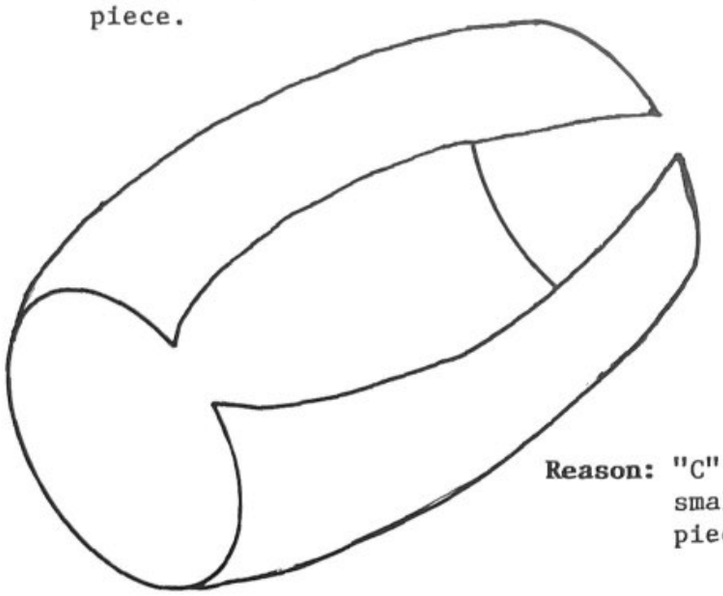
Reason: "C" (roll crown) to much for this size work piece.

Remedy: Roll cardboard or sheet metal shims along with work piece to affect over crowning.



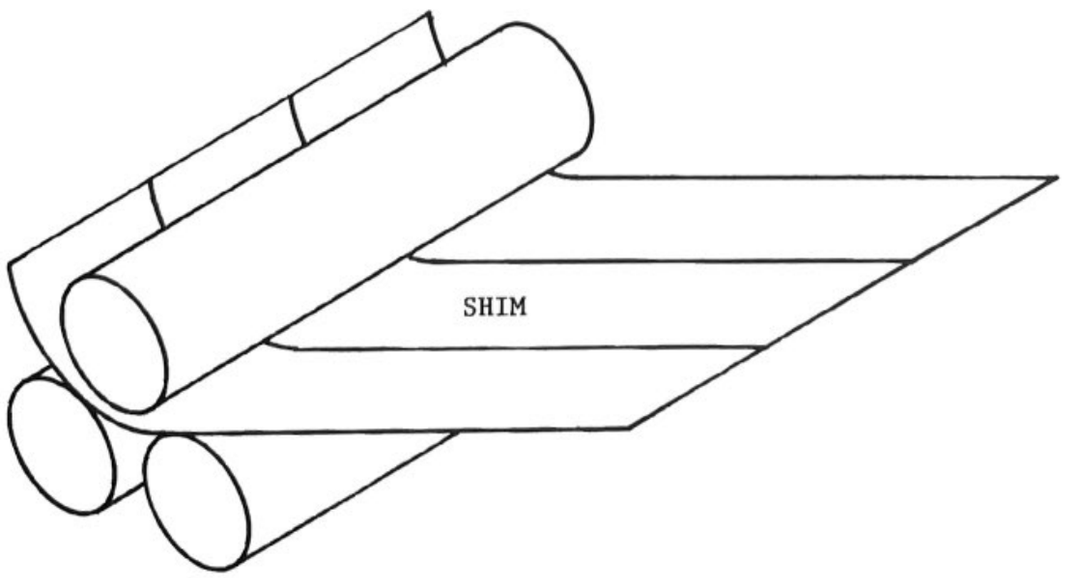
WORK PIECE QUALITY

Problem: Barrel shaped work piece.



Reason: "C" (roll crown) too small for this work piece.

Remedy: Roll cardboard or sheet metal shim along with work piece to offset under crowning.

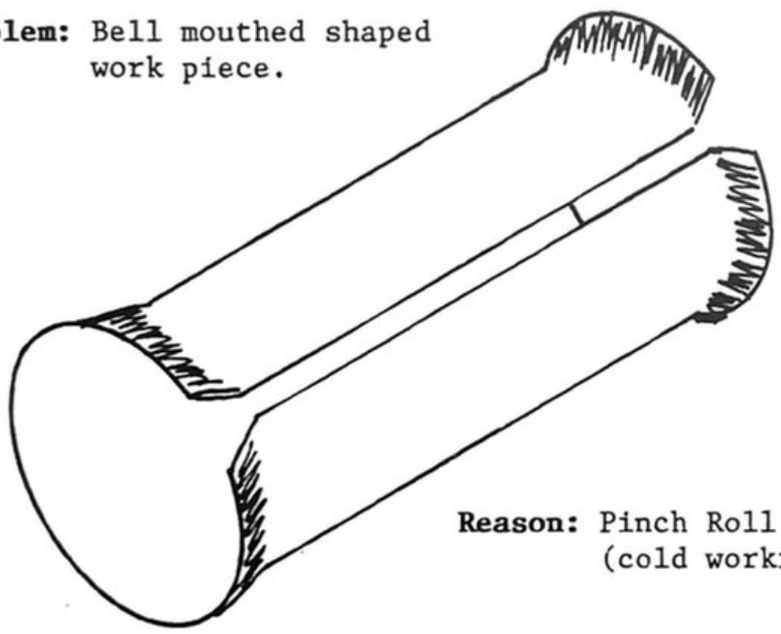


!!WARNING!!

Do not exceed machine capacity!

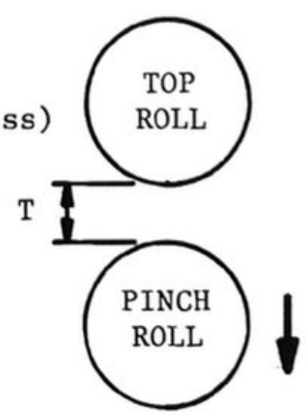
WORK PIECE QUALITY

Problem: Bell mouthed shaped work piece.



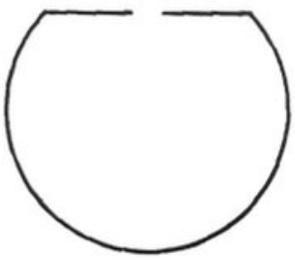
Reason: Pinch Roll pressure too tight. (cold working work piece edges)

Remedy: Lower pinch roll so that opening at end of roll is equal to or greater than T (work piece thickness)

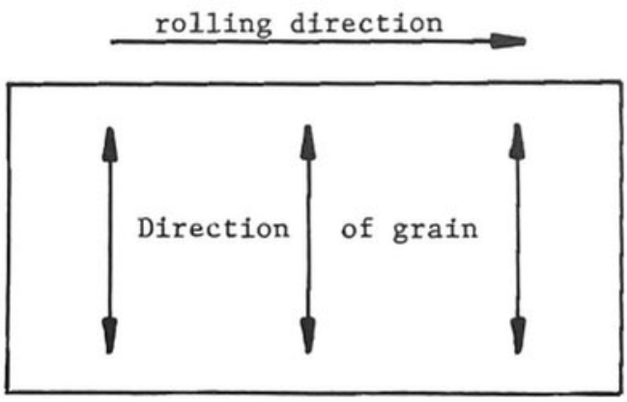


WORK PIECE QUALITY

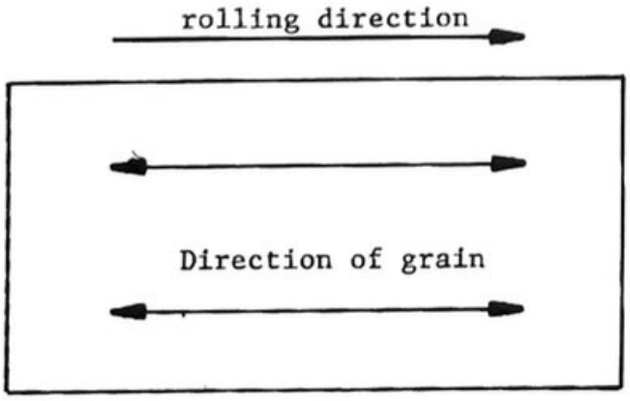
Problem: Flats on leading and trailing edges.

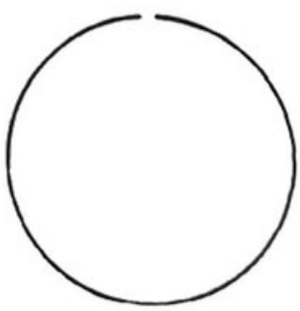


Reason: Rolling transverse or perpendicular to grain.



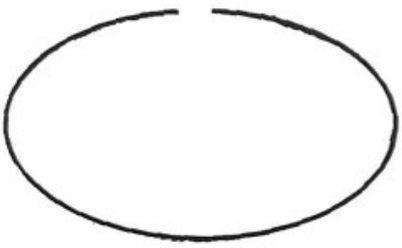
Remedy: Roll in direction of grain.





WORK PIECE QUALITY

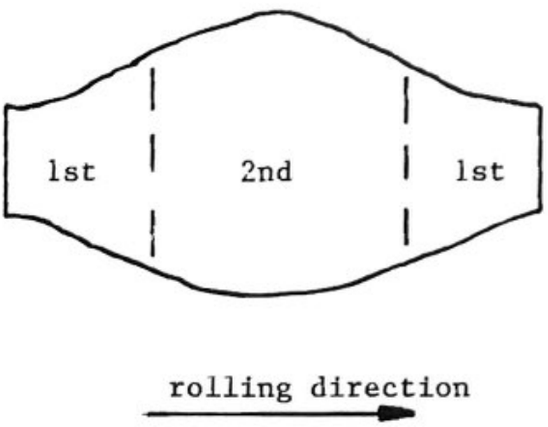
ELBOW GORES & SIMILAR PARTS



Problem: Obround work piece.

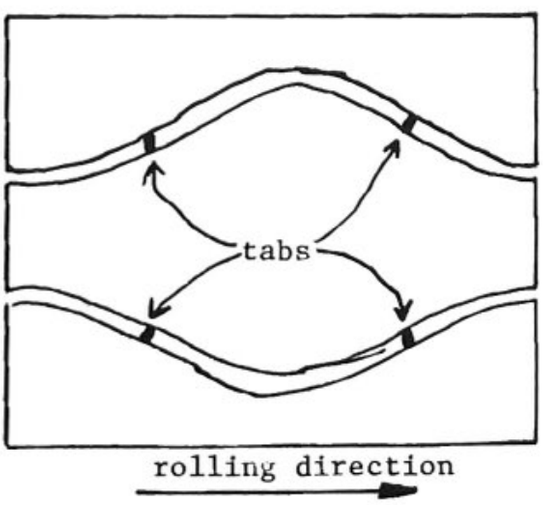
Reason: Unequal cross sections were rolled with one radius setting.

Remedy:



Roll with two radius settings.

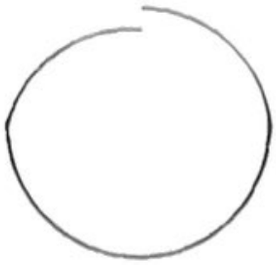
or



Create an equal cross section by connecting parts with tabs.

WORK PIECE QUALITY

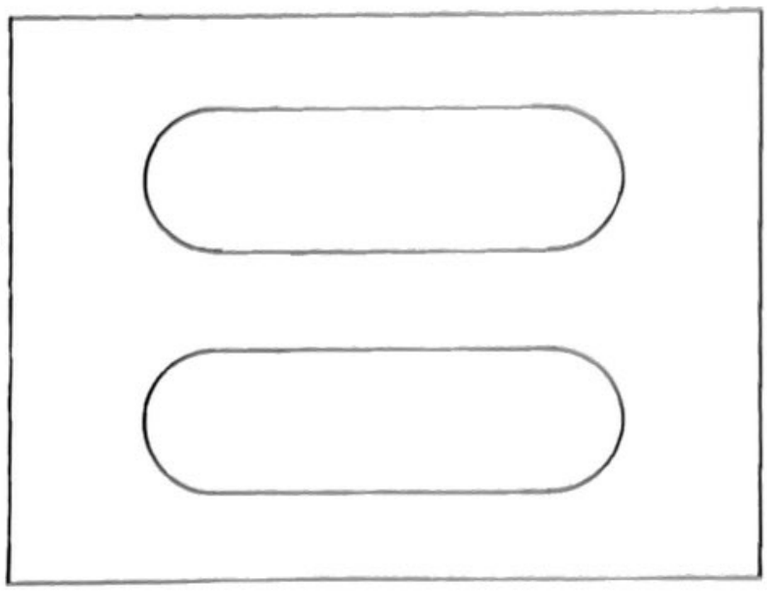
WORK PIECES WITH CUT OUTS

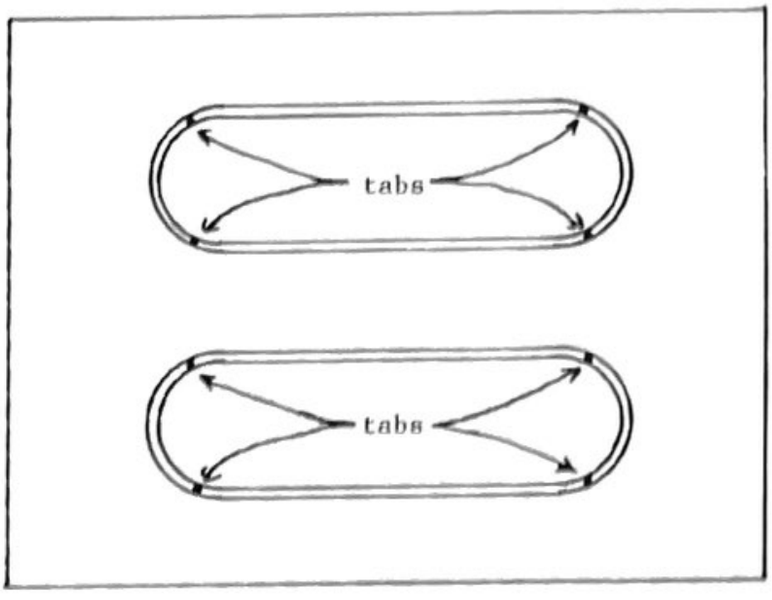


Problem: Obround cylinder.

Rolling direction

Reason: Unequal cross section.

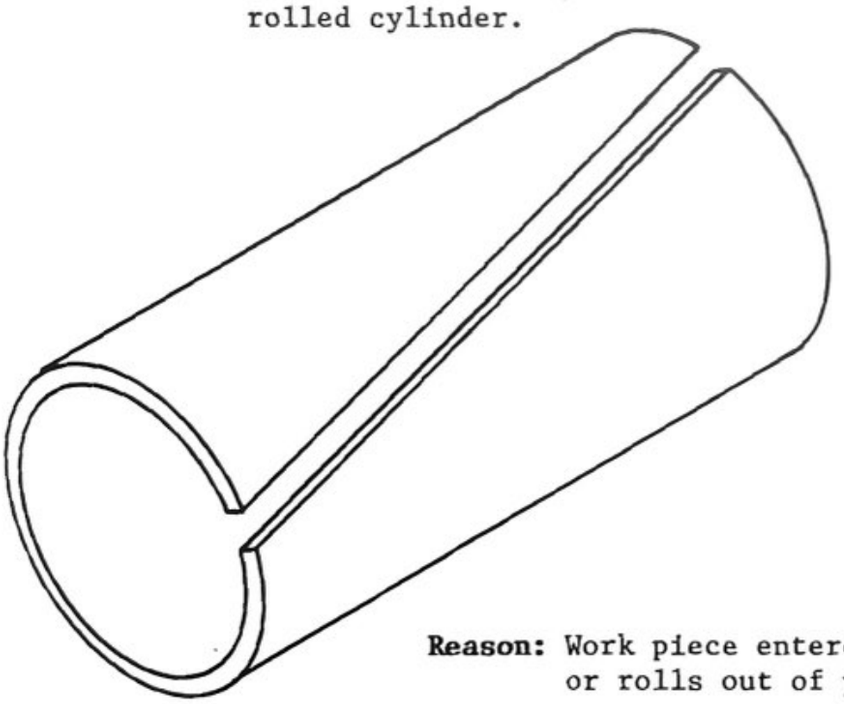




Remedy: Create equal cross sections by connecting drop to work piece with tabs.

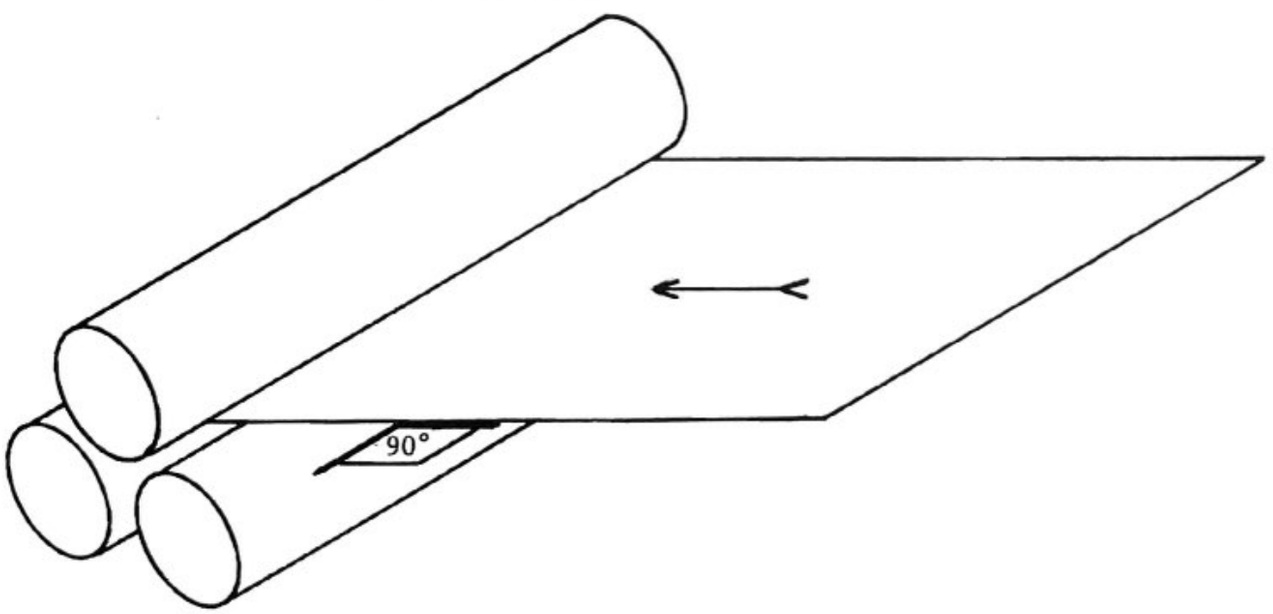
WORK PIECE QUALITY

Problem: Skewed or unequally rolled cylinder.

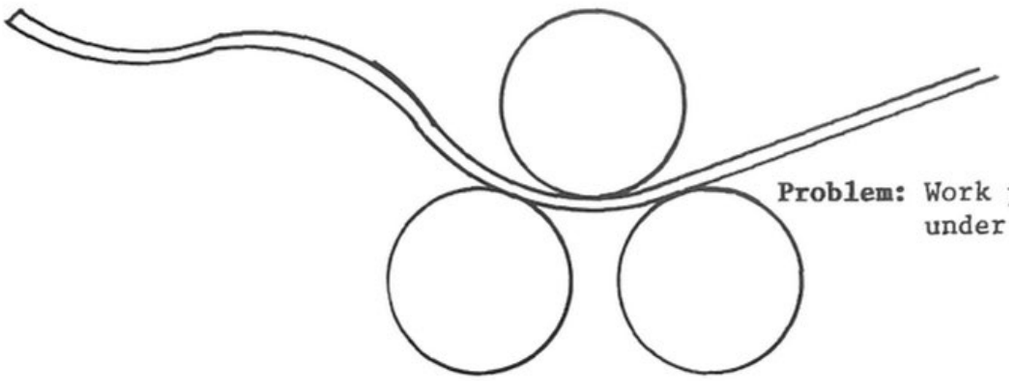


Reason: Work piece entered unsquare or rolls out of parallel.

Remedy: Align rolls.
Enter work piece squarely and in center of rolls.

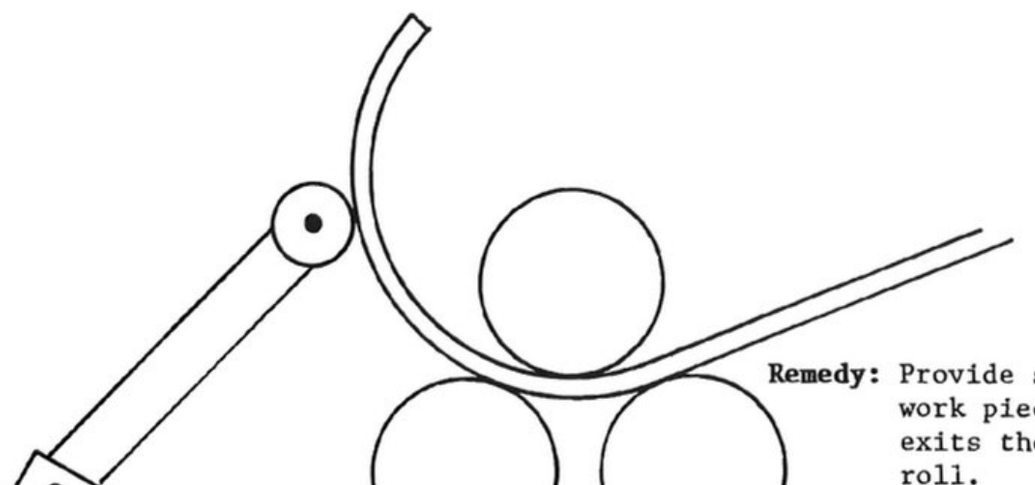


WORK PIECE QUALITY



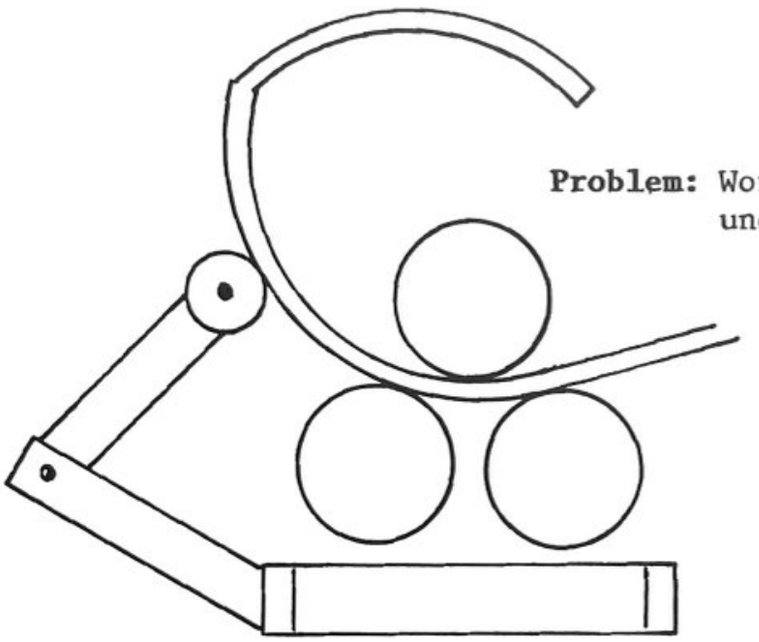
Problem: Work piece unbends under its own weight.

Reason: Material strength insufficient to support its own weight.



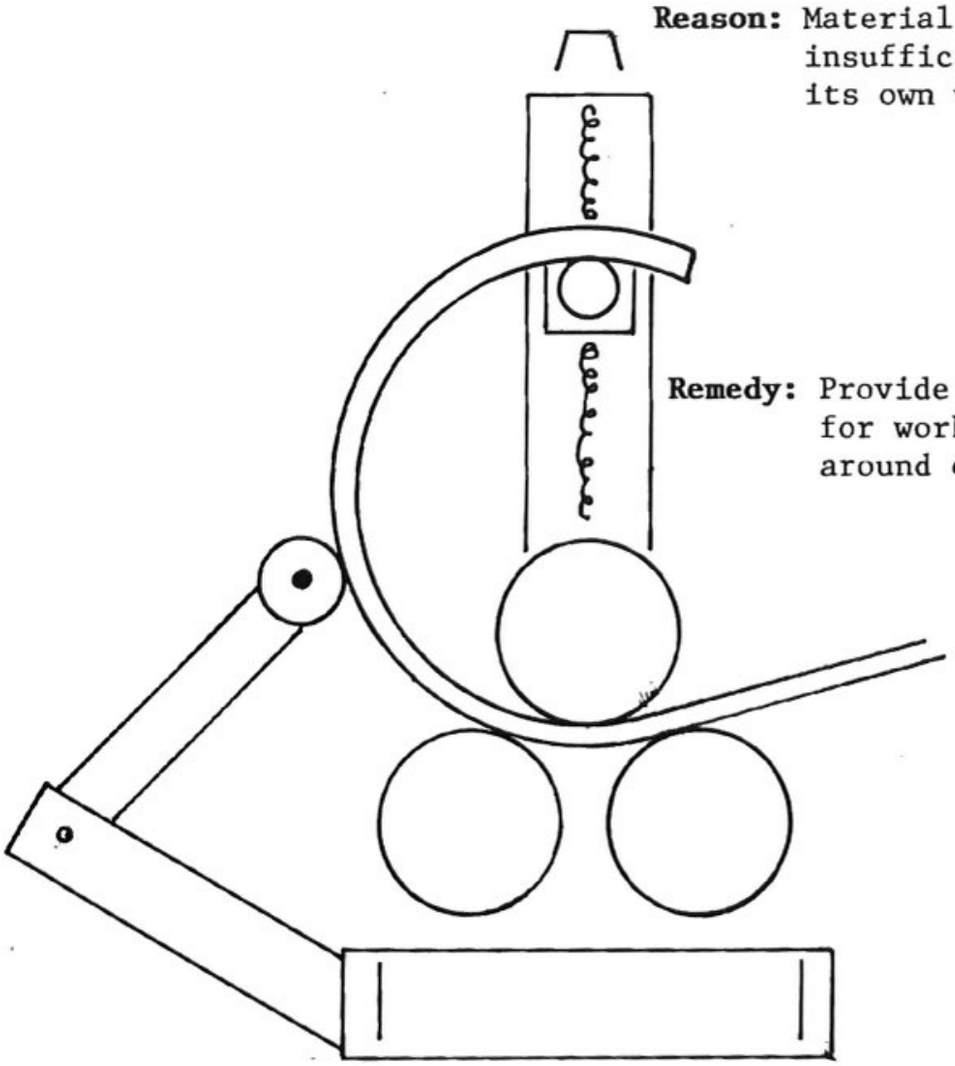
Remedy: Provide support for work piece as it exits the forming roll.

WORK PIECE QUALITY



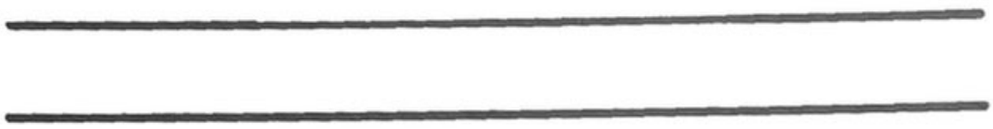
Problem: Work piece collapses under its own weight.

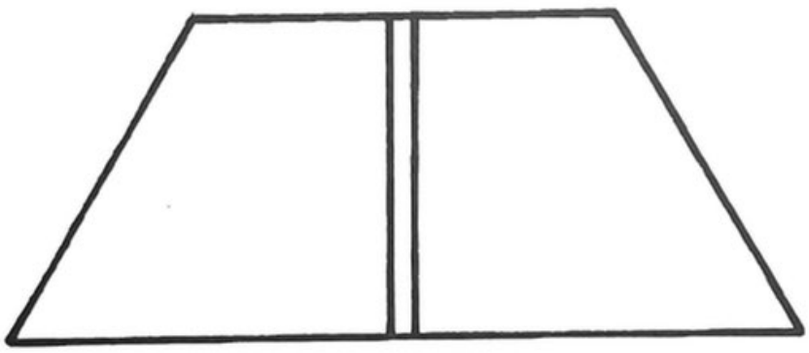
Reason: Material strength insufficient to supports its own weight.

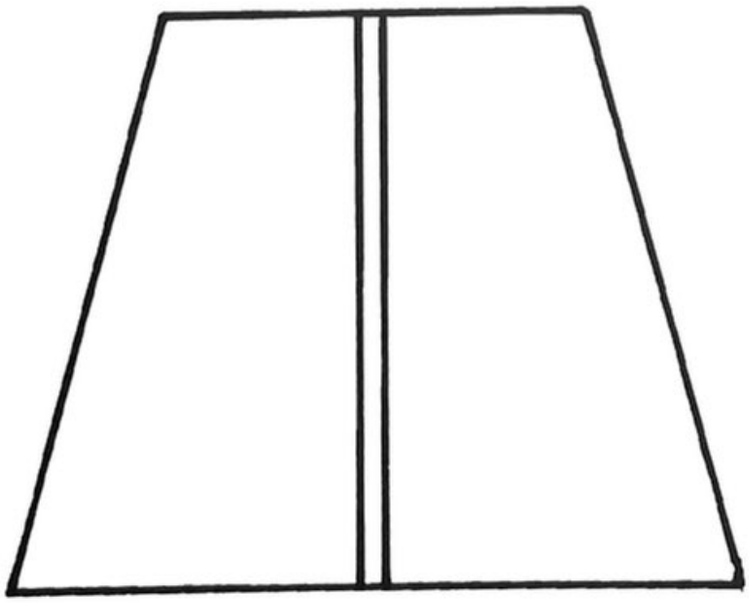


Remedy: Provide overhead support for work piece as it comes around overhead.

CONE ROLLING PROCEDURES

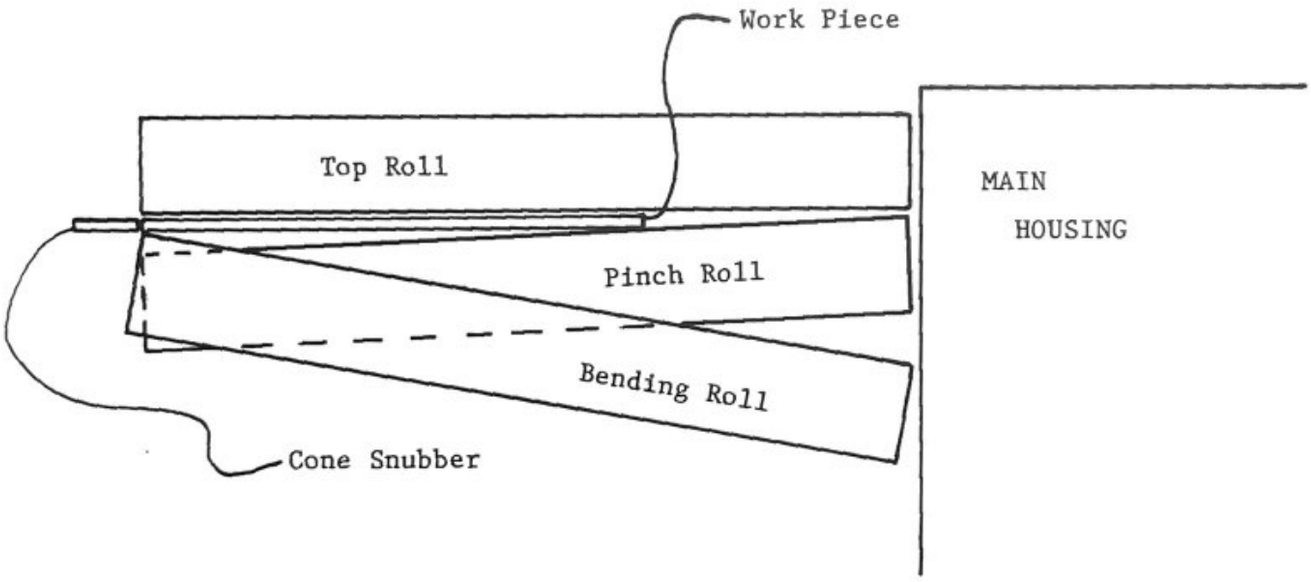






CONE ROLLING PROCEDURE

INITIAL PINCH & 4 ROLL MACHINES



1. Angle Pinch Roll to grip long end of work piece.

2. Angle Bending Roll to form small end of work piece to a tighter radius.

3. Enter work piece with small end of cone blank against cone snubber.

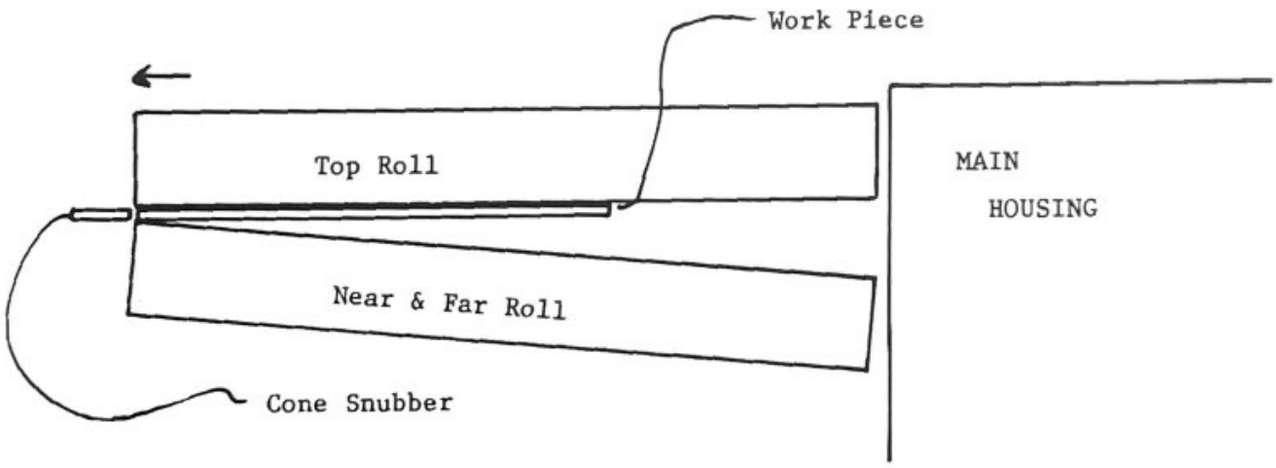
4. Raise Bending Roll to set radius.

5. Feed work piece through to obtain approximately half of bending required.

6. Raise Bending Roll for final pass & reverse to complete bend.

CONE ROLLING PROCEDURE

PYRAMID & PINCH PYRAMID



1. Angle Top Roll (on Pyramid) or both lower rolls (on Pinch Pyramid) to form small end of work piece.

2. Enter work piece with small end of cone against cone snubber.

3. Raise lower rolls (Pinch Pyramid) or lower top roll (Pyramid) to obtain about half of radius required.

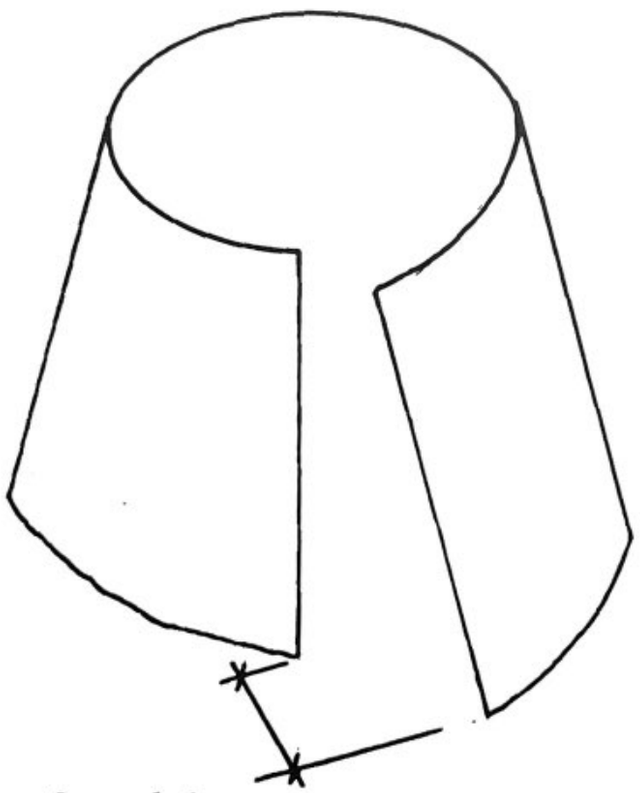
4. Roll piece through.

5. Adjust rolls for final radius.

6. Roll reverse for completion.

CONE QUALITY

Problem: Skewed ends.



Reason: Work piece formed in one rolling direction.

Remedy: Roll partially in one direction and complete rolling in opposite direction.

RULES

TO

ROLL

BY

SOME RULES OF THUMB

MINIMUM ROLLING DIAMETERS

Wrought Iron / 1010 Mild Steel	1.1 x Top Roll Diameter
Mild Steel, i.e. M-1020	1.2 x Top Roll Diameter
Cold Rolled Sheet or Thin Galvanized Sheet, i.e. 20-28 ga.	1.5 x Top Roll Diameter
Soft Aluminum	1.1 x Top Roll Diameter
Tempered Aluminium, i.e. 6061T6	2 x Top Roll Diameter
Soft Copper	1.1 x Top Roll Diameter
Half Hard Copper	1.5 x Top Roll Diameter
Stainless Steel, Monel, Etc.	1.2 to 1.4 x Top Roll Dia.
A.R. Plate, T-1, Other Super Alloys	2 or more x Top Roll Dia.

BENDING CAPACITIES

- When bending steel of double thickness, approximately 5.2 times the forming pressure is required when the rolls are of the same diameter and spacing.

- With the same thickness and yield strength of material, bending pressure is reduced to .39 when roll spacing is doubled.

- When yield strength of same thickness material increases, forming pressure increases on a direct 1 to 1 ratio.

- When calculating cylinder blank length, multiply .8 x metal thickness, add the inside diameter, multiply x pi.

TIPS

- For best quality cylinders, always push work piece against (Do not pull across) the Bending roll whenever possible.

- For best quality cylinders support work piece uniformly before, during, and after forming cycle.

- It is always easier to open up (increase diameter) of finished work piece a bit than to close it (pull together)-in fact in most cases the work pieces open up a bit by the normal handling between work stations. (stress relieves)

  *Meaning: it is generally better to roll a bit tight (small) than too loose. (Large)

- On four-roll machines use only 3 rolls at a time for best work piece quality.

- Orient work piece on raw material so the work piece is rolled with the grain. (not across grain)

- When large cutouts are cut into work pieces prior to forming, tab leading and trailing edge. (not sides)

MACHINE FEATURES TO CONSIDER

- Manual lever-type control valves can have better control characteristics.

- Analog-type mechanical indicators generally are sufficiently accurate and more economical.

- Controls with presets can be very advantageous for large volumes of identical parts.

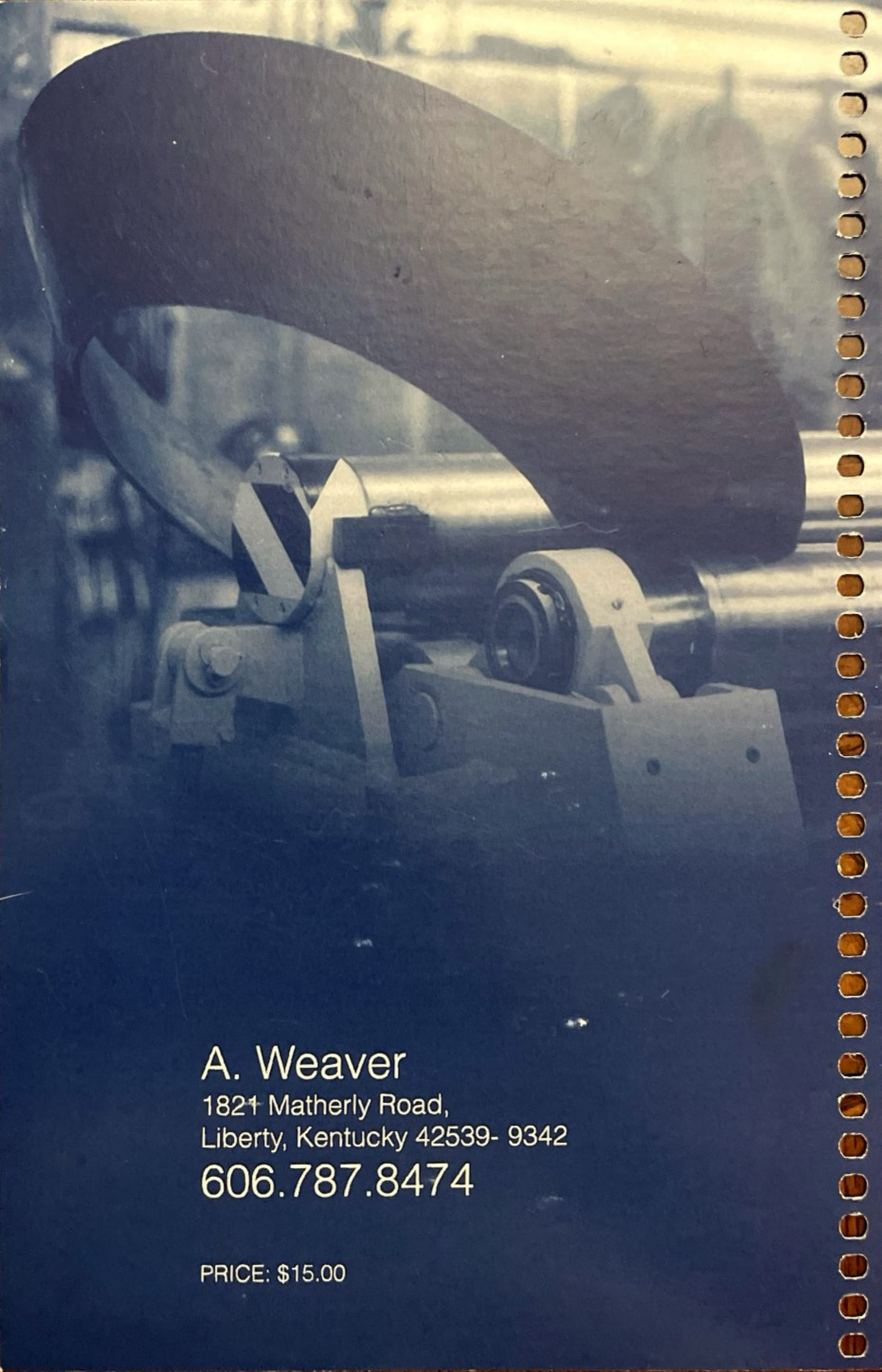
- Hardened rolls should be seriously considered when Rolling:
  * Flame-Plasma or Laser Cut Parts
  * Stainless Steel
  * Abrasion Resistant Steels
  * High Strength Steels
  * Super Alloys
  * When cone rolling any material

- Hardened and polished rolls should be considered whenever rolling material with polished or fine finished surface.

- Side and overhead support should be considered when large diameter, light gauge work pieces are formed.

- In general a little automation in rolling machines increase productively substantially. (Resist the inclination to over automate.)

- Seriously evaluate your part families and have rolls crowned for your largest volume parts. (If this is not known then roll should probably be crowned for 2/3 capacity.)



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