

The Project

The machine chosen for this course project is a high-speed rotary wire nail machine made by Enkotec in Skanderborg. The machine uses wire to produce nails in many different sizes and one particular nail size is chosen to be the basis for your calculations.

Engineering:

1. Analyze the machine and find out how it works in details.

2. Calculate the power needed to produce a specific nail with an output of 2000 nails/min (see the attached nail drawing). Use a safety factor 2 for this purpose.
3. Dimension and choose the different drive elements to rotate the machine parts at the correct speeds. The choices must be based on the known machine dimensions and your own calculations. You may estimate reasonable efficiencies, center distances and masses.
4. Choose one AC motor to drive all rotating machine parts (except the fan) with a minimum startup time of 4 seconds. Use the estimated masses from above to calculate the machine startup time.
5. Use Mathcad or Excel for the calculations

Nail manufacturing steps (see figure 1):

The wire is delivered to the nail machine by a wire pay off (not shown).

- Pos 1 - The wire is being straightened in a straightener with rollers.
- Pos 2 - The wire is driven forward by two feeding rollers.
- Pos 3 - The wire is cut into specified blank length by rotating knives.
- Pos 4 - The blanks are accelerated to create a distance between them by the insertion manipulator and pushes them into the dies.
- Pos 5 - The blanks are stopped by the positioning roller.
- Pos 6 - After the blanks are being rotated 90 degrees CW by the die ring the head roller forms the head of the nail by cold forming.
- Pos 7 - The two die rings hold and squeeze the blanks when the head is formed.
- Pos 8 - A ventilating fan for cooling the machine.
- Pos 9 - A Sensor senses at the exit tray to prevent a build up of nails

The Machine:

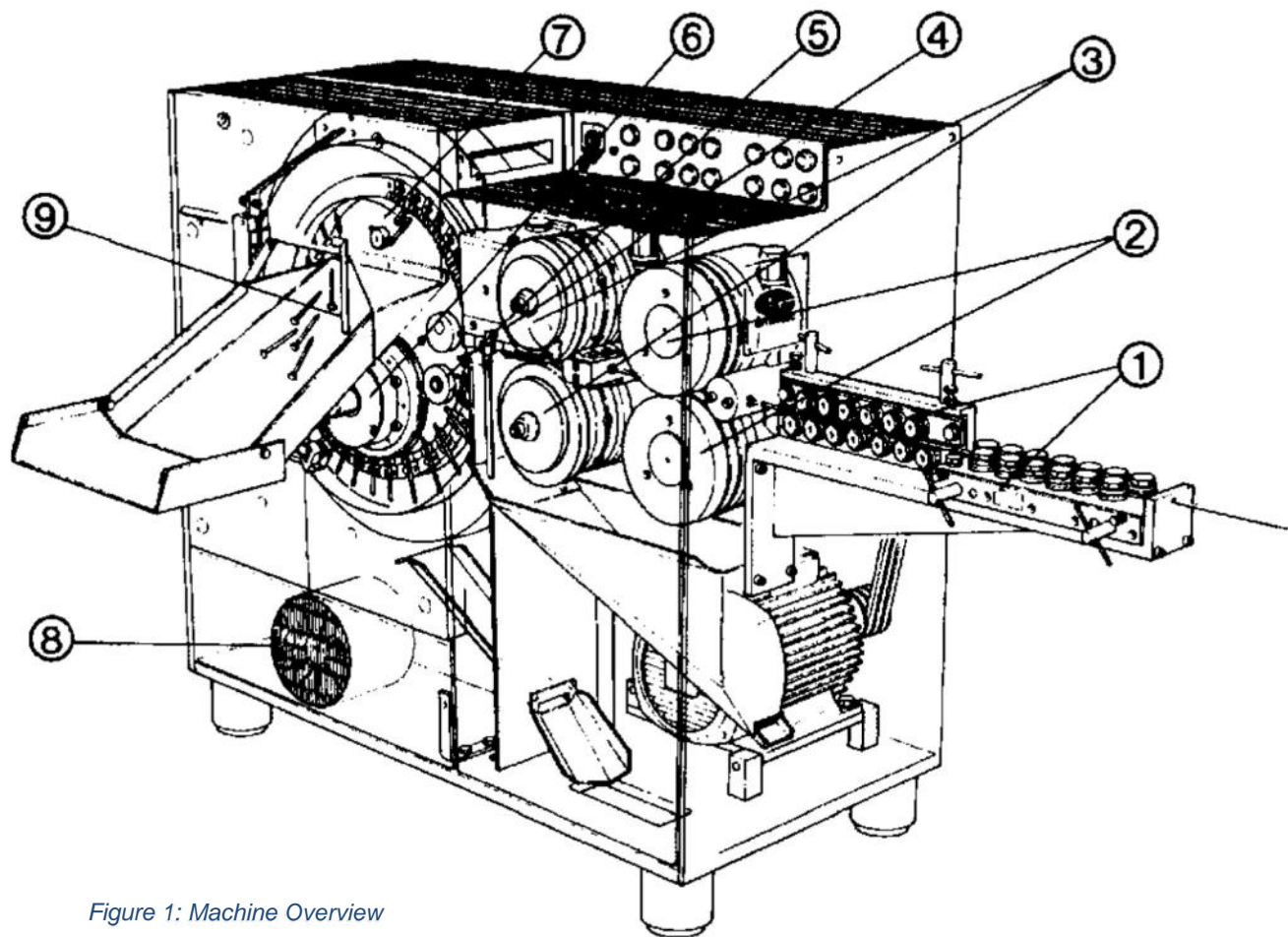


Figure 1: Machine Overview

Machine Data:

Output:
Wire yield strength:

2000 nails/min
300 MPa

Description	Position	Size	Speed
Straightener	1	030 mm x 26	
Feed Rollers	2	0160 mm x 2	100% of the wire speed
Rotating Knives - 8 pcs	3	0160 mm x 2	
Insertion Manipulator Rollers	4	030 mm x 10	140% of the wire speed
Positioning Roller	5		
Head Roller	6	0200 mm x 1	105% of the die ring speed
Die Ring - 60 dies	7	0600 mm x 2	
Ventilating fan	8		
Sensor for exit tray	9		



Figure 2: Nail Machine

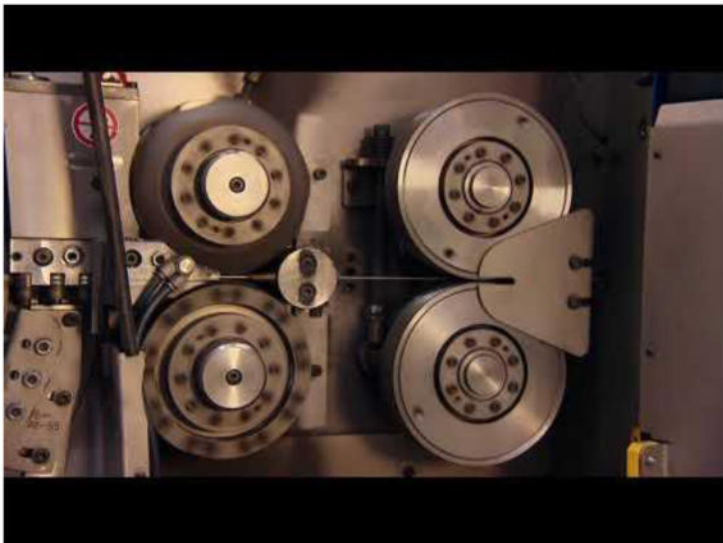
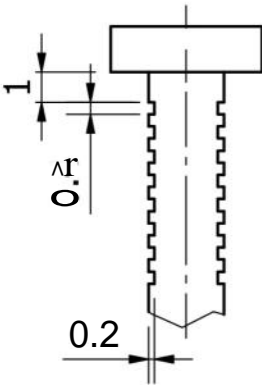
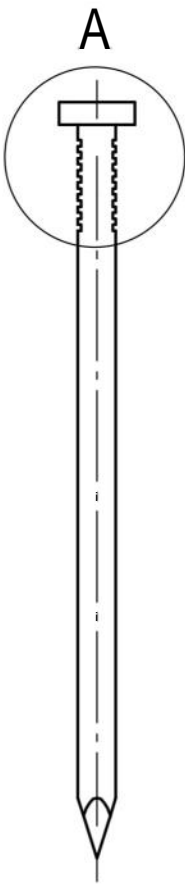
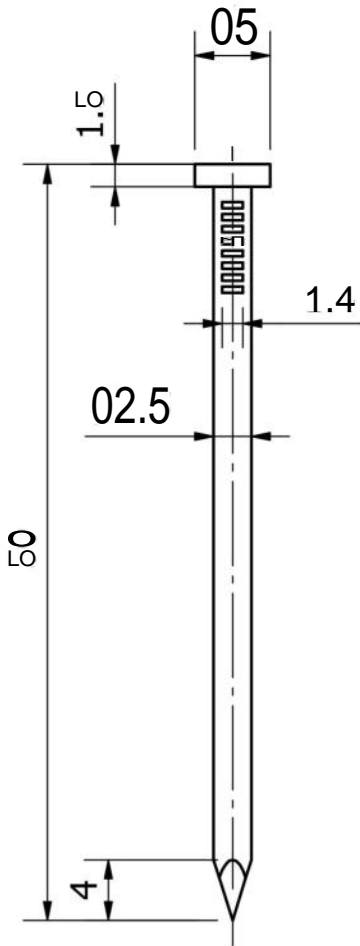

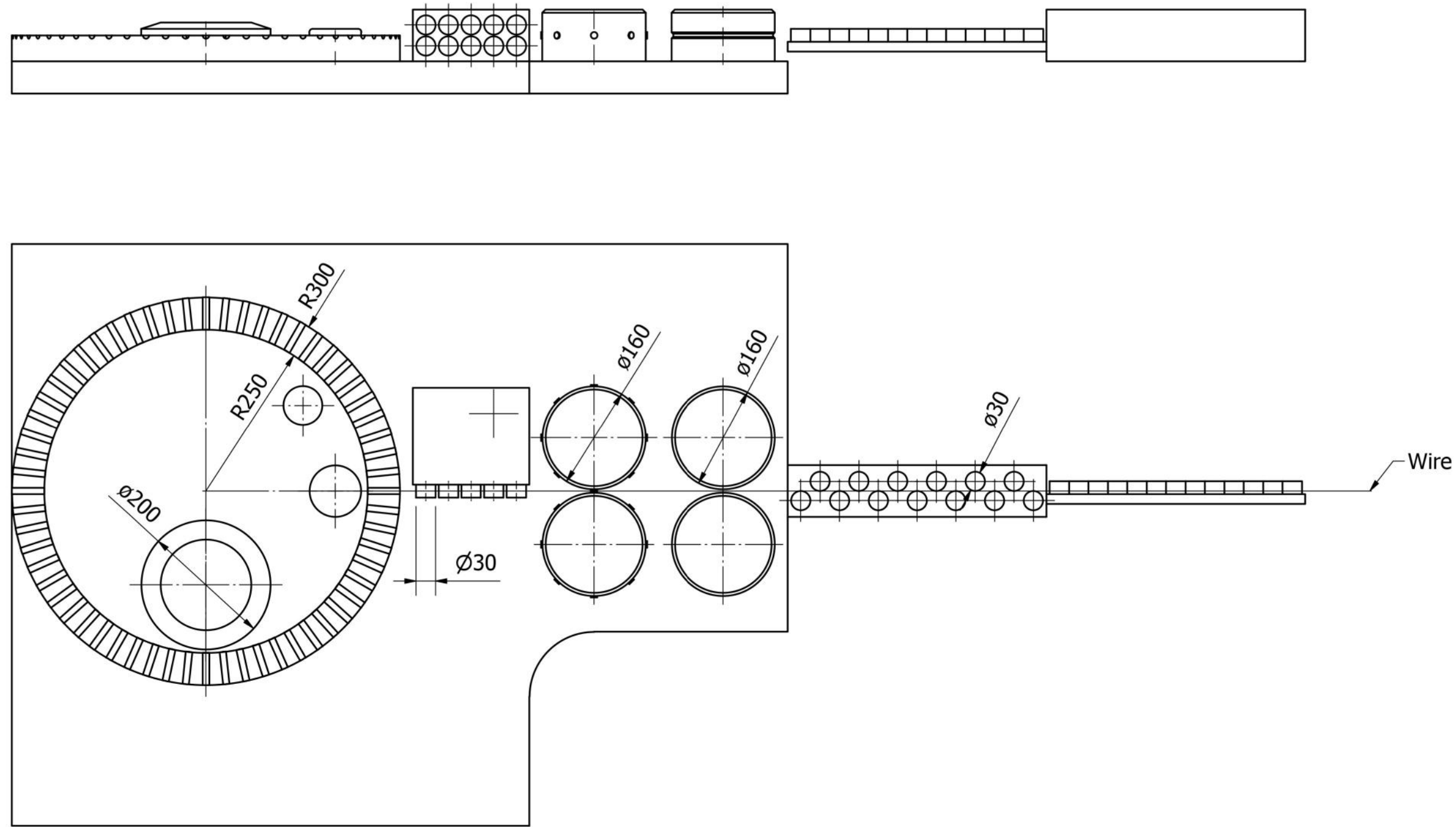
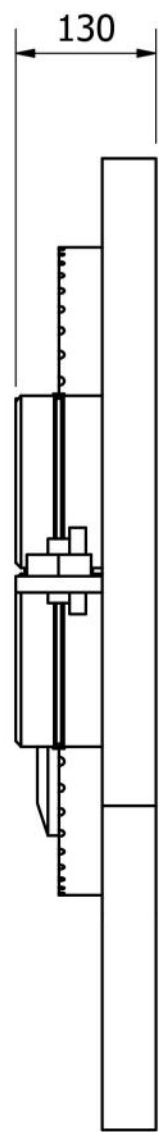
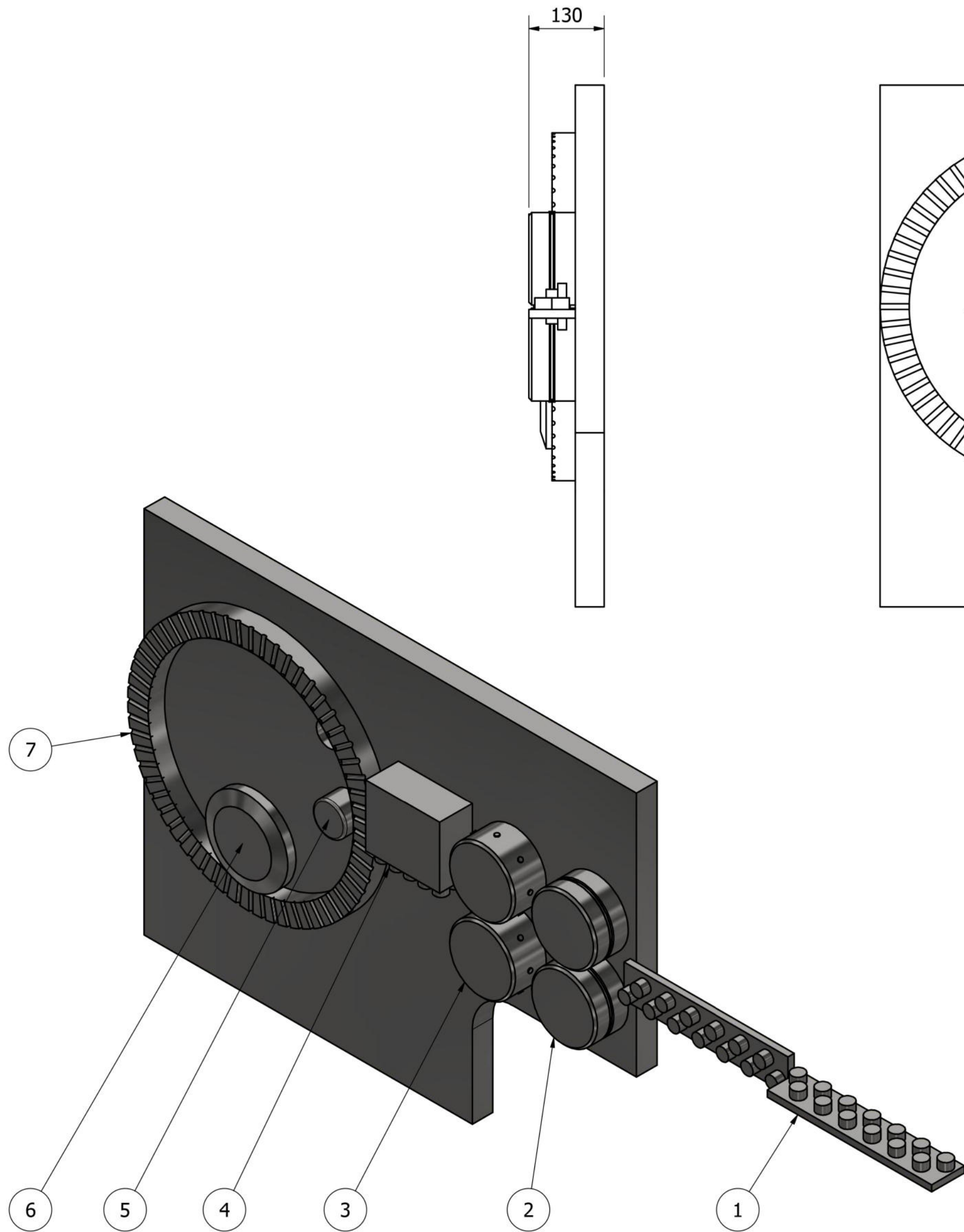


Figure 3: Production Video

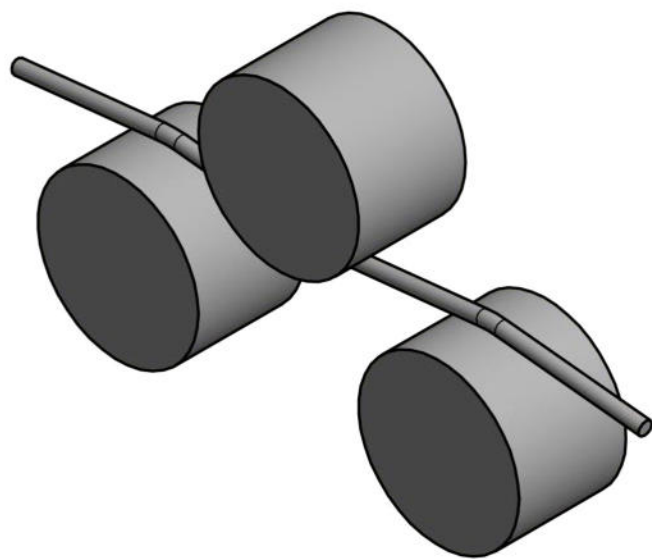
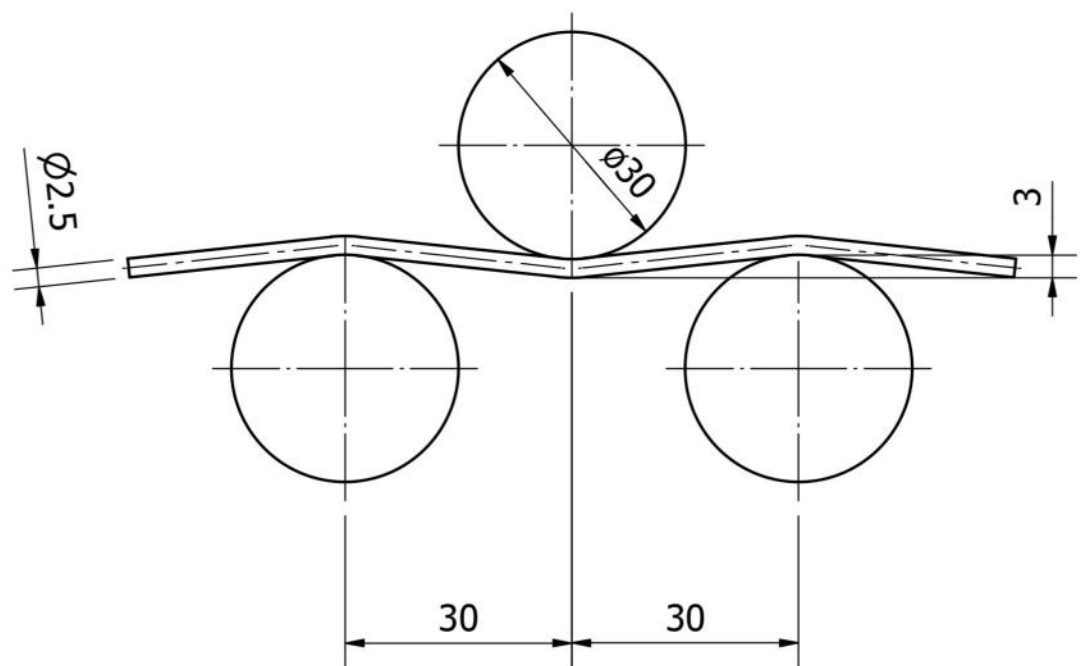
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			MATERIAL	Generic
		SIZE	TITLE	Nail Drawing
		A4	ADDITIONAL TITLE	Simplified
DATE		SCALE	DRAWING NUMBER	SHEET REV
DRAWN BY		2 : 1		
APPROVED BY				



			MATERIAL	Steel, Mild
			TITLE	Main Plate
		SIZE	ADDITIONAL TITLE	Simplified
DATE		SCALE	DRAWING NUMBER	SHEET REV
DRAWN BY		1 : 7		
APPROVED BY				



			MATERIAL	Generic
		SIZE	TITLE	Wire Straightener
		A4	ADDITIONAL TITLE	Simplified
		SCALE	DRAWING NUMBER	SHEET REV
DATE		1 : 1		
DRAWN BY				
APPROVED BY				