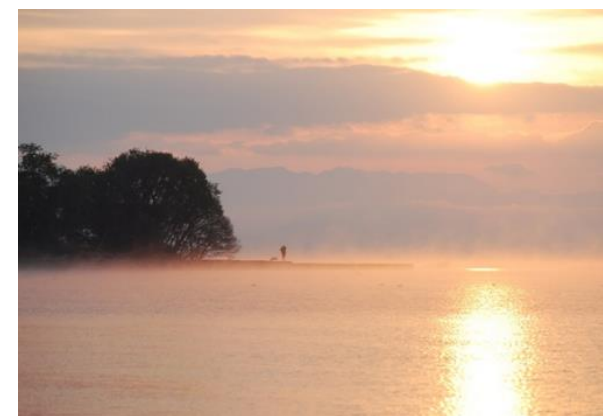


Development Examples and Potential of Plate Forging

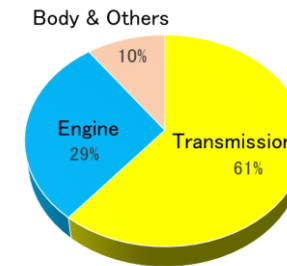


HEIAN MFG. CO., LTD.
AKIHIRO MAEDA

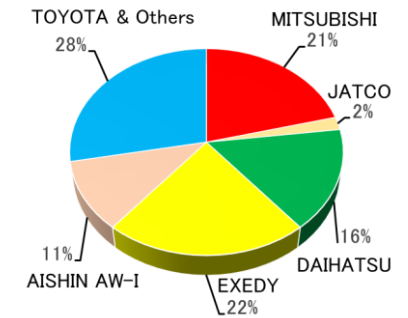
- Press-forming Company, the history of the manufacturing for establishment of a business 82 years.
- Integrated production system from Development to Sheet metal press-forming, Welding, Painting & Machining.
- Unique press-forming technologies, Plate forging & Precision press-forming, using Large TRF Press.

Establishment	July, 1939
Capital	60 Million Yen
Number of employees	160
Location	Takashima City, Shiga Prefecture
Main Business	Manufacture of car parts
Main Products	T/M, Engine, Body parts etc.
Main Customers	MITSUBISHI, TOYOTA, DAIHATSU, AW-I, EXEDY, etc.

■ Main Products



■ Main Customers



< Main Facility >

Press Equipment

- Large TRF Press : 2500t(servo), 1500t, 800t
- Progressive Press : 300t, 400t, 500t
- Small Press : 60t~110t etc.

Die-manufacturing Equipment

- CAD/CAM System, Wire-Cut Machine etc.

Welding(Arc-W, PW, EBW etc.), Painting(Cation ED), Machining

- ### # Development & Evaluation: CAE, 3D measuring Machine, Contour measuring Machine etc.



Oil Pan



Ring Gear integrated Drive Plate



O/D Clutch Hub



Secondary Piston

< Major Prizes >

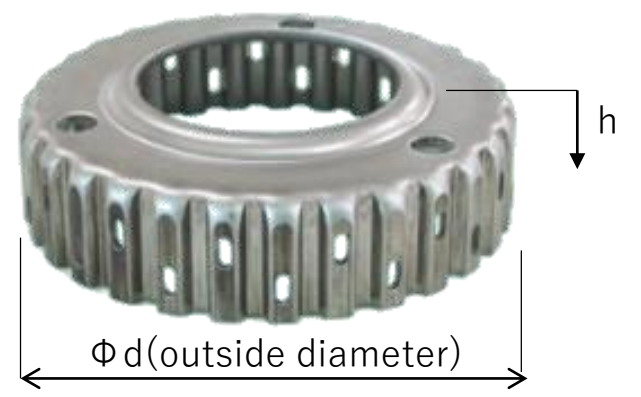
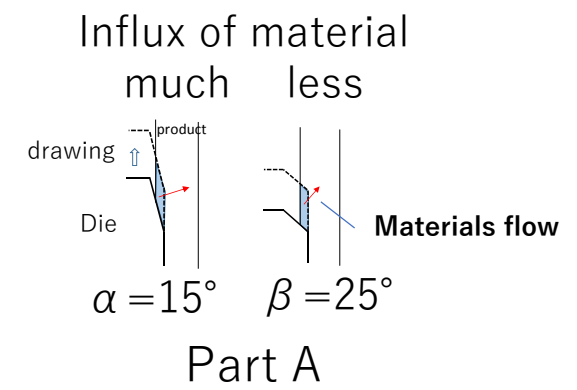
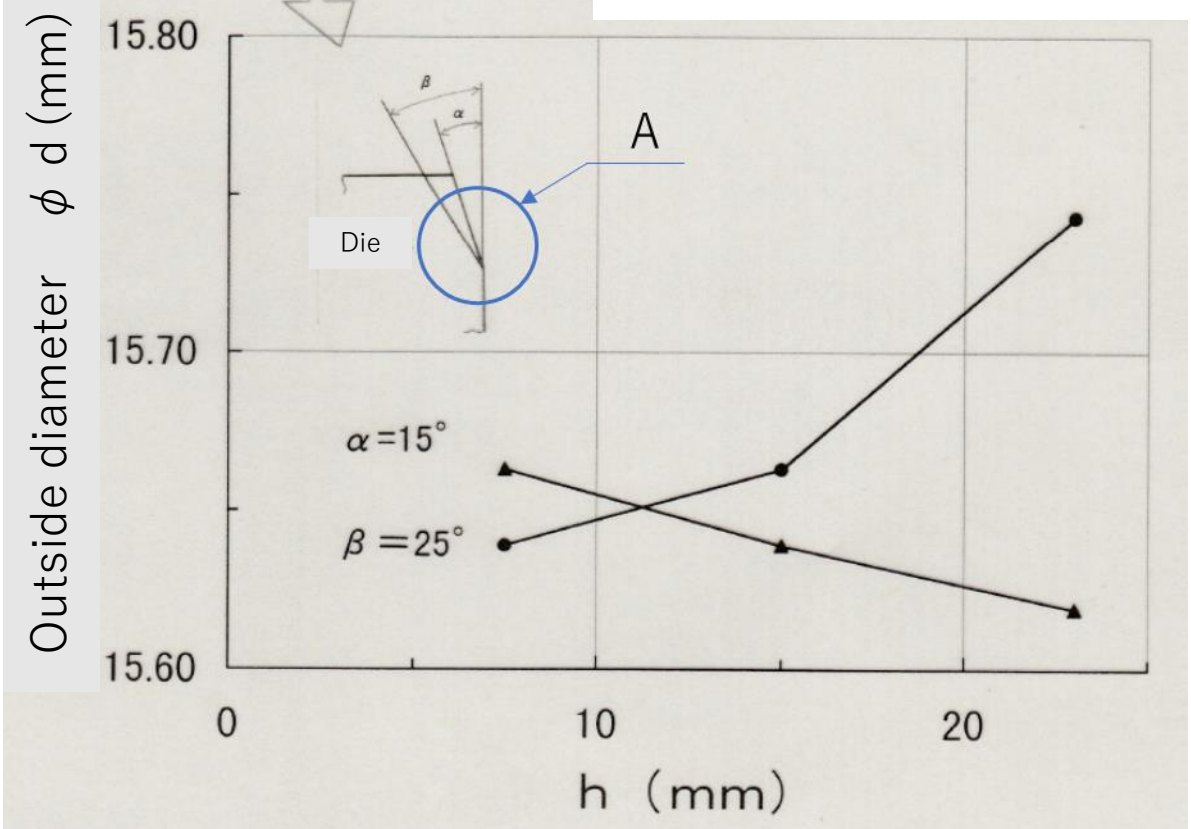
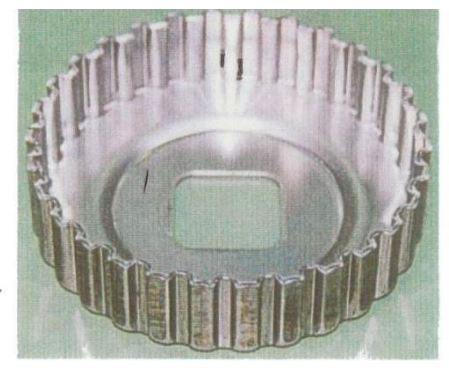
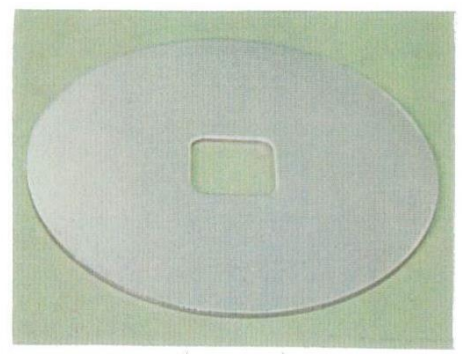
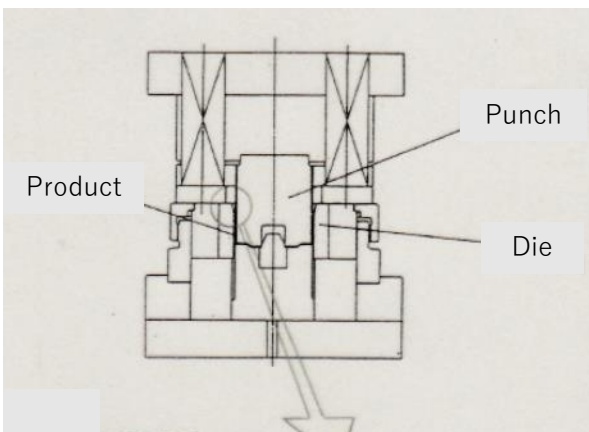
- “JSTP Medal for Innovative Technology”(1997) /Japan Society for Technology of Plasticity
- “Japan Manufacturing Grand Prize”(2015) /Ministry of Economy, Trade & Industry
- “Super Manufacturing Award/Car parts”(2013) /Nikkan Kogyo Shimbun,LTD., MONOZUKURI.NIPPON.conf.

年	Normal sheet metal forming	ADC⇒Sheet metal forming	Cast iron⇒Sheet metal forming	Sheet metal unification
85	Deep Drawing	Multipoint PW	Gear Forming	Plate Forging
86	Oil Pan, Ring-projection Welding	Support, Center	UD. Hub, OD. Hub	
87	Rocker Cover	mass production '87/11~		
88	CO2 Weld.	* Projection Welding: 10points at the same time, low cost, low distortion processing		
89	Coining			
90	BRKT			
91	Retainer, Bearing			
92	<ul style="list-style-type: none"> * Oil pan by the deep drawing (Compact car, Large truck, Product machine) * Support Bracket for engine by development technology of welding and production machine * Plate for engine by large press machine * Driver's cavine and Fuel tank by weiding and can-making technology (finished in 2001) 			
93			Clamshell Pipe	Thickend Gear Forming
94			Exhaust Manifold	* 2parts ⇒ Integrated
95			* Cast Iron⇒SUS /Sheet Metal	
96			Structured Catalyst	
97	Rocker Cover	mass production '99/9~	mass production '95/4~	mass production '99/5~
98				
99				
2000				
1				Piston for CVT
2				Near Net Shape
3				
4				
5				
6				
7				
8				
9				
10				mass production '06/4~

Evolving a forming technology(plate forging, precision sheet metal forming), welding and machining technology that we accumulated, Under development in a new production method of construction.

Sintering⇒Sheet metal	Lightweight	High Performance	Cost Reduction	New Techniqe
Sproket	Sensing Ring	Laminated Ring Gear	Planet Carrier	Ring Gear (Press)
Injector Support	Gear, Parking Lock	Compressor Cover	Reverse	Timing Pulley
mass production '10/3~	mass production '10/4~	mass production '10/3~	mass production '20/8~	mass production '08/8~

2. Development Examples of Plate Forging / OD. Hub (Gear forming by Deep drawing)

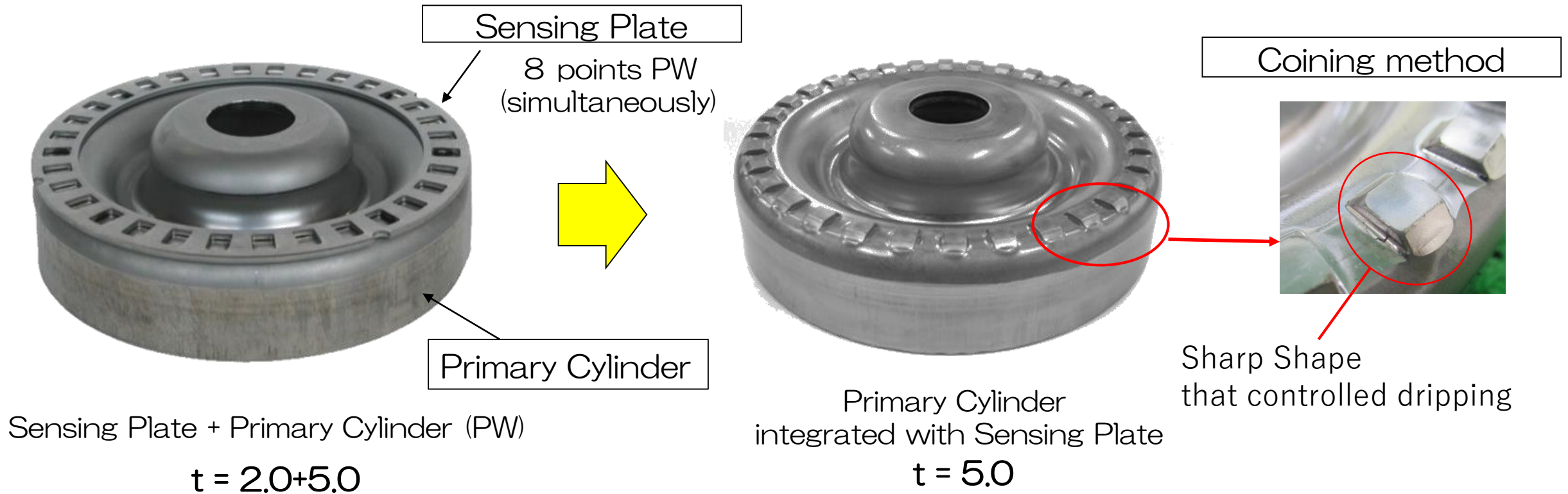


- ### Development Points
- ① Cast iron + Machining ⇒ Press-forming
 - ② Gear forming
 - Non lubricant coating
 - Multi-process forming by deep drawing
 - Continuous forming with TRF-Press
 - ③ Cost : ▲30% Weight : ▲30%

2. Development Examples of Plate Forging / Primary Cylinder

Development Points

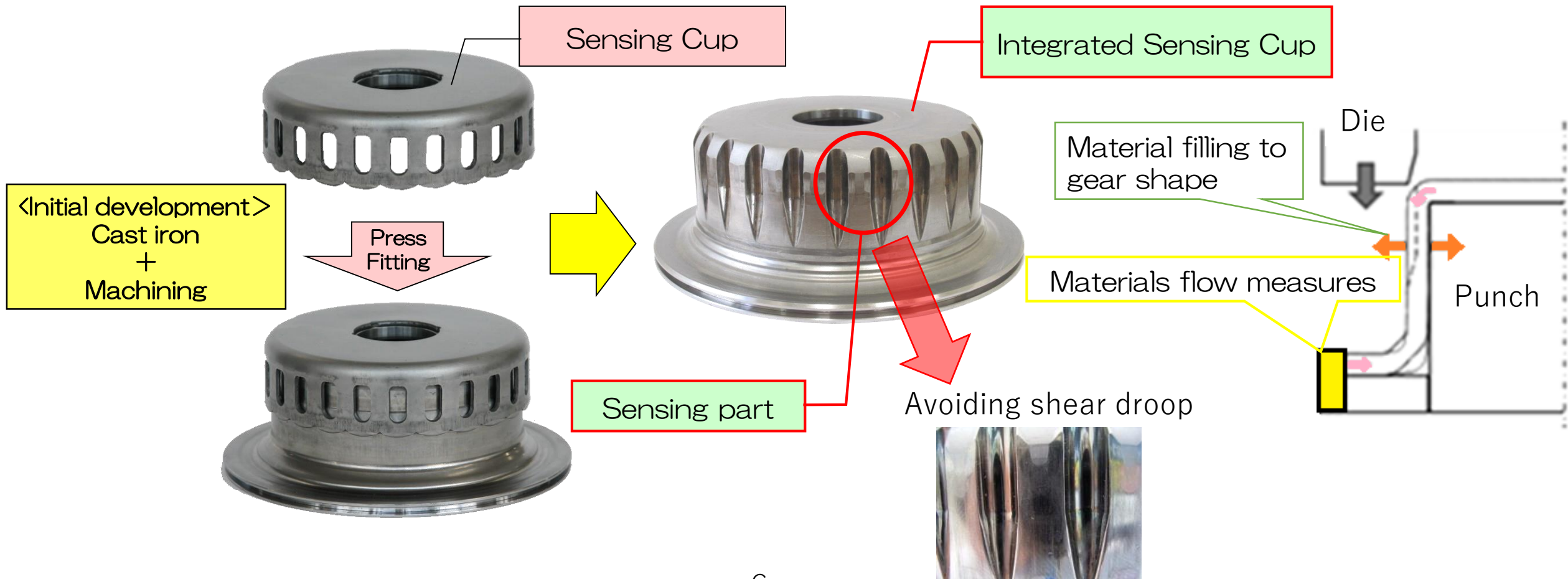
- ① 2 parts → Integrated
- ② Avoiding the shear droop of coining region
- ③ Cost : ▲25% Weight : ▲10%



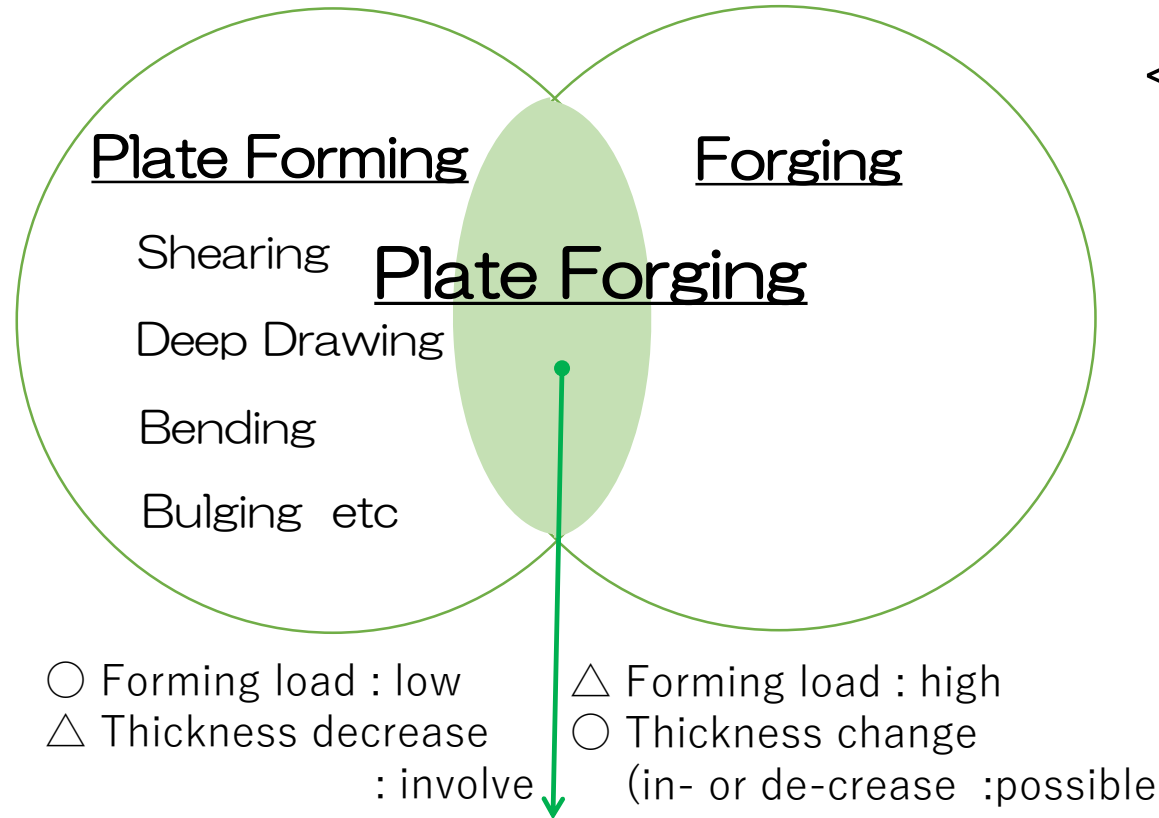
2. Development Examples of Plate Forging / Secondary Piston

Development Points

- ① 2 Parts → Integrated
- ② Avoiding the shear droop of a gear forming part
- ③ Cost : ▲25% Weight : ▲10%



3. Potential of Plate Forging

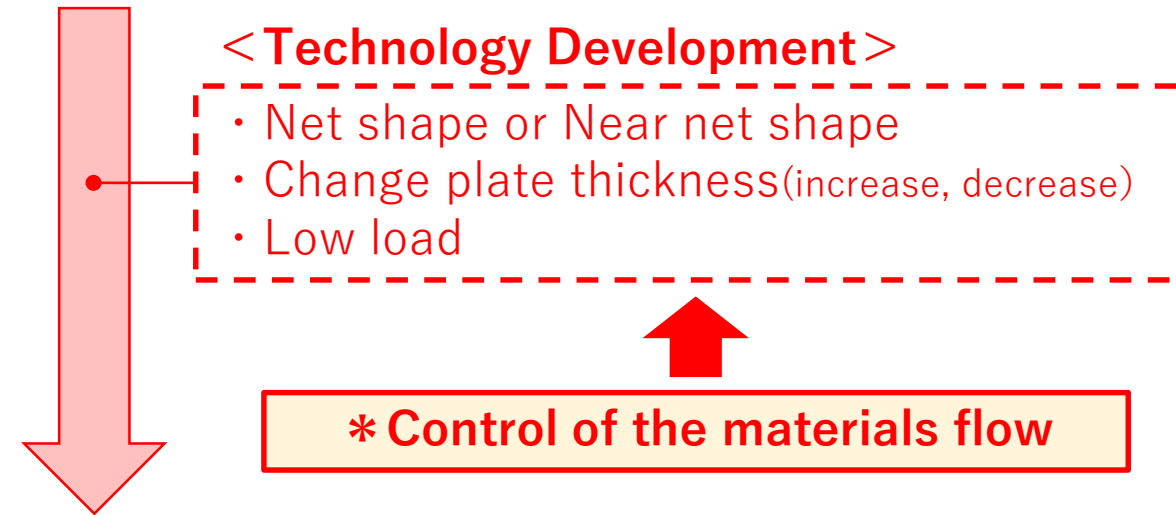


- Low load forming
- Complex and precise shape forming

• High value-added products
(high accuracy, low cost)

< Plate Forging Technology of HEIAN >

- Integrating multiple parts
- Eliminating processes other than press
- Continuous forming with general press



[Own Technology]

- Precision Press-forming
- Partly thickening/thinning
- Thickened gear forming
- Precise shearing, etc.

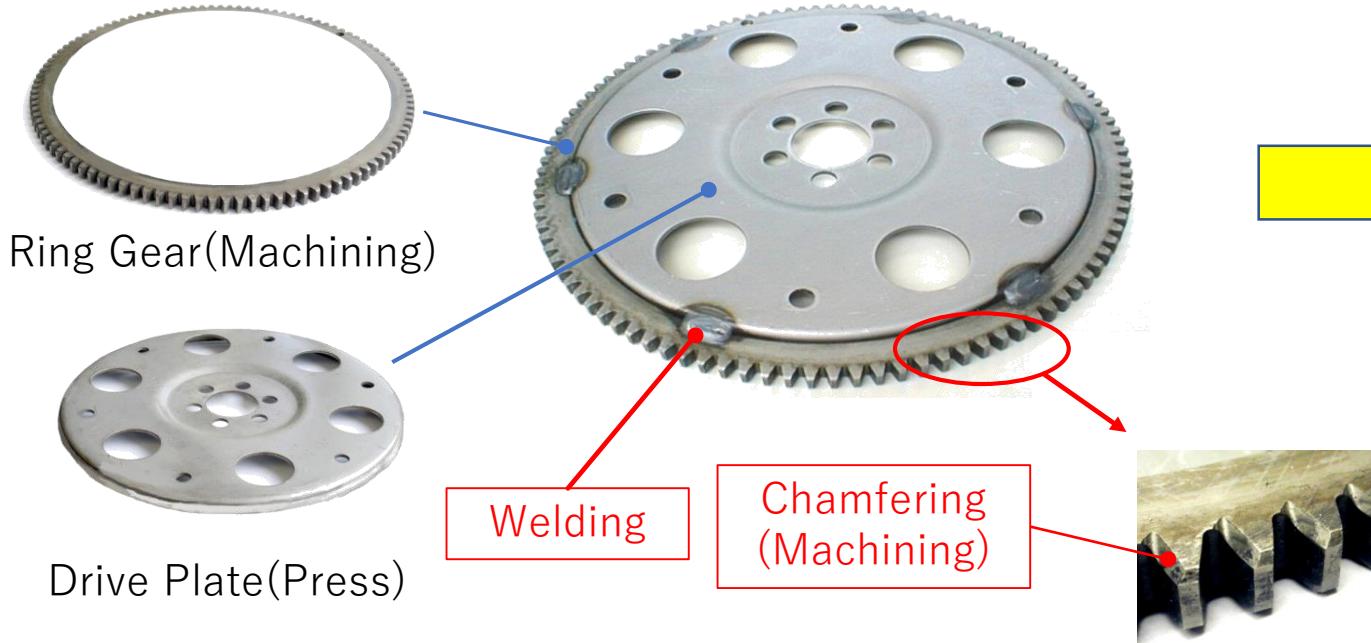


2500tTRF(servo) Press

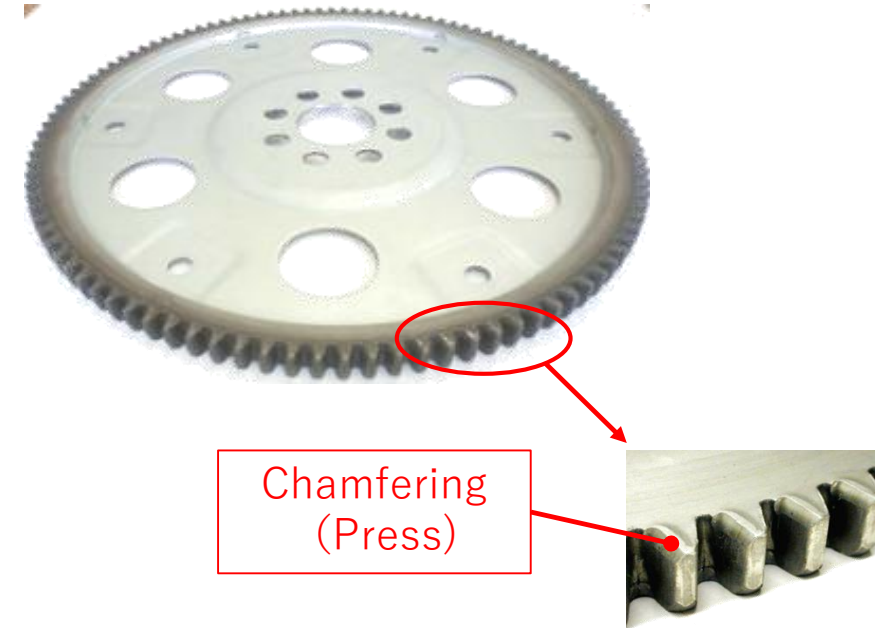
3-1) Expansion of Plate Forging Field



Ring Gear + Drive Plate (Welding Assembly)



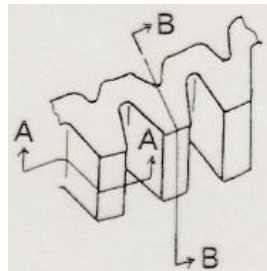
Ring Gear integrated Drive Plate



Development Point

- ① 2 parts → Integrated (Eliminate welding process)
- ② Partly thickening gear forming
- ③ Continuous forming with TRF Press
(Eliminate machining process such as chamfering etc.)
- ④ Cost : ▲35% Weight : ▲10%

	Pre-formed Parts	Reduction Ratio : $\alpha = 40\%$	$\alpha = 56\%$
外観			
A-A			



3-1) Expansion of Plate Forging Field



< Characteristics of Thickened Gear Forging >

1. Preform of gear forming by draw forming
2. Accelerate buckling in forging process by preforming
3. Secure gap in forging process by buckling
4. Avoid blockage closed forging by the existence of gap



High Precision Gear Forging with General Press

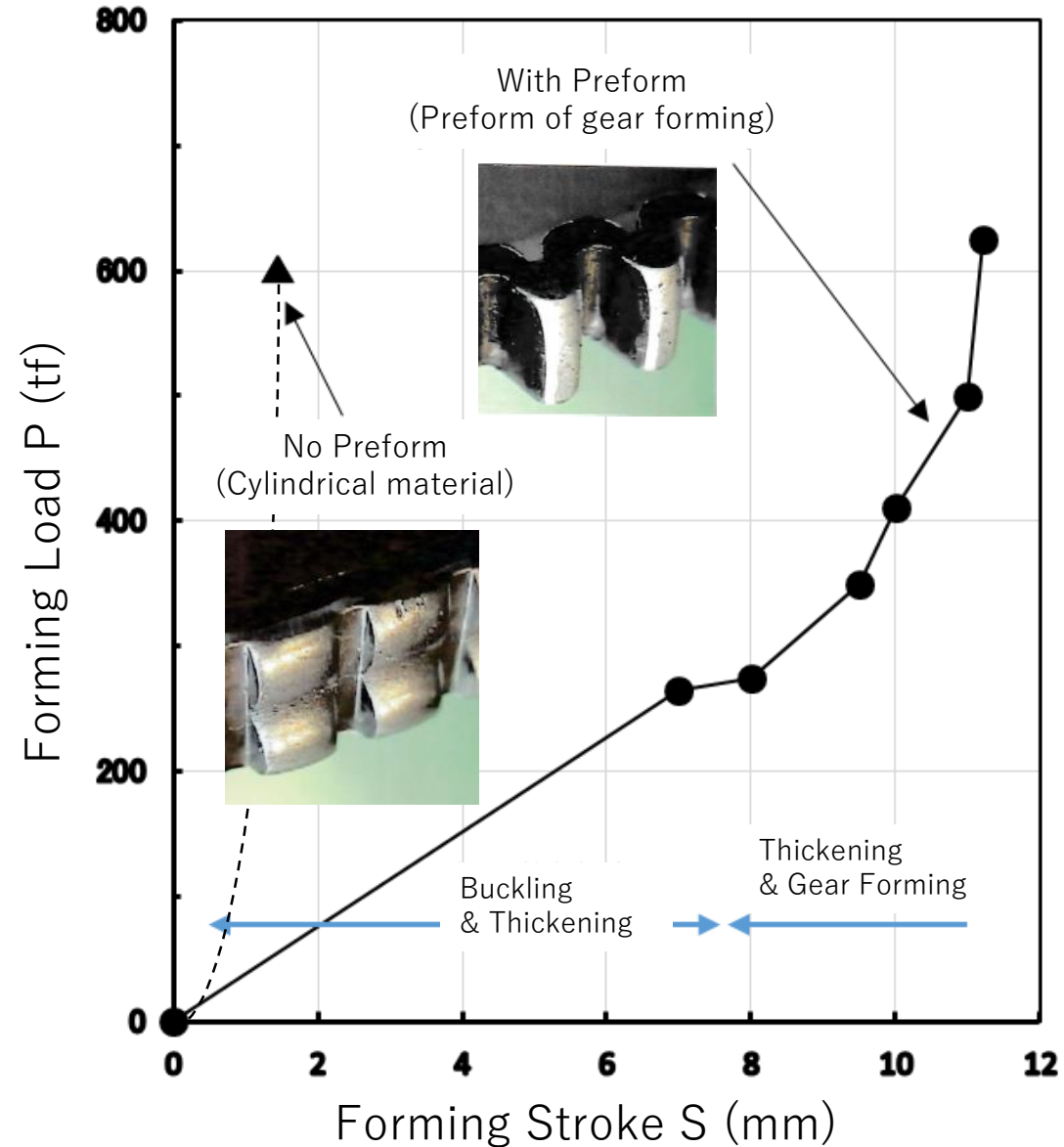
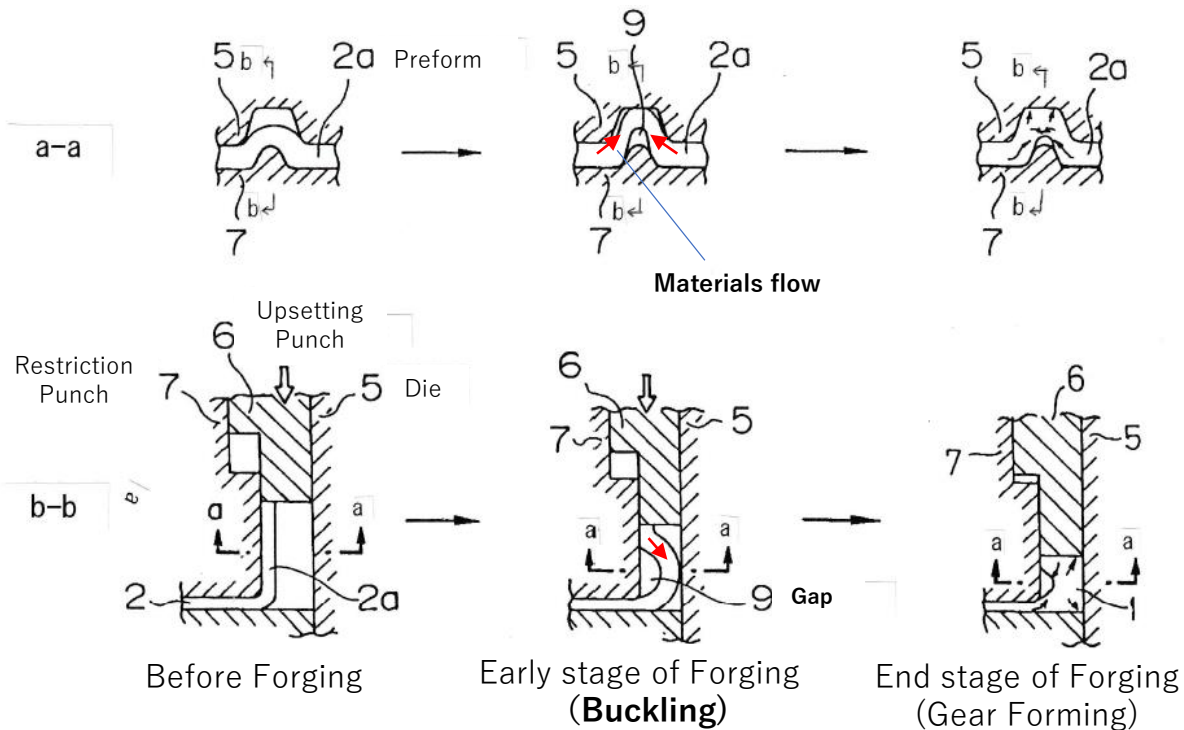




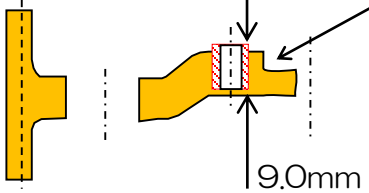
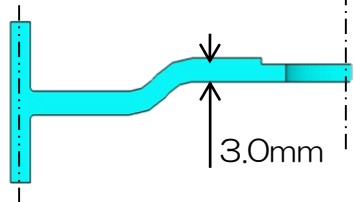


Figure : Effect of preform gear forming

3-2) Potential to expand the application region of Plate Forging



Development of Laminated Gear (Gear with minimum shear droop)	Development of Double Cup Pulley (Timing Pulley)
<p style="text-align: right; color: red;">Reduce noise : ▲10~16%</p>  <p>Laminated Ring Gear</p> <p>4.5mm × 2 sheets</p> <p>9mm (1sheet)</p> <p>Weld point</p> <p>Laminate Welding Technology (22 points simultaneous weld)</p> <p>Shearing Technology for minimum shear droop</p>  <p>Press Ring Gear (Gear with minimum shear droop)</p> <p>Normal shearing</p> <p>Shear droop</p>	<p><Conventional Method> <Development Method></p> <p>Sintering + Machining</p>  <p>Machining</p>  <p>Press (Net Shape)</p>  <p>A - A</p>  <p>B - B</p> <p>3.0mm</p> <p>9.0mm</p> <p>Double cup forming technology (Forming from a single plate)</p> <p style="color: red;">Can be thinned by double sided outer circumference structure (T-shape)</p>

4. Conclusion



1. We introduced our development examples of Plate Forging and showed that it's a processing technology that allows for complex and high precision shapes and can reduce costs.
2. For this reason, it was shown that controlling material flow is important to overcome problems such as high load for thinning and buckling for thickening.
3. As shown in the development examples of Ring Gear integrated Drive Plate, it is shown that by actively utilizing material flow in the preform gear forming, it is possible to form a thickened Gear under low loads.
4. We will also work on developing construction method that involves major changes in material flow and seek to further enlarge the application domain of Plate Forging.