Application of servo presses to sheet metal forming

K. Mori, Toyohashi University of Technology
Flexible motion

Contents
1) Types of mechanical servo presses
2) Bending
3) Deep drawing
4) Hot stamping
5) Shearing and plate forging
6) Conclusions

Servo Presses

Mechanical servo press
AC servo motor: fast
Increase in power

Hydraulic servo press
Hydraulic pump: slow

Direct driving type press
80tonf, Komatsu Industry
Expensive

Mechanical link and toggle type press
Komatsu Industry
Conventional motor
Cheap, best seller

Crank type press
Aida Engineering, Amada
Easy maintenance

(a) Servo press (b) Conventional crank press
Contents

1) Types of mechanical servo presses
2) Bending
3) Deep drawing
4) Hot stamping
5) Shearing and plate forging
6) Conclusions

Motions of crank servo press

Amada SDE

Crank  Link  Soft
Pulsating 1  Programming  Pulsating 2
Pendulum  Coining  Iterative

Application of high strength steel sheets to automobile body panel

Reduction in car weight: high strength steel sheets

Tensile strength (MPa)

90°  9.6

Sheet

Reduction of springback in bending by bottoming

Servo motor

Ball screw

Linear scale

High strength steel sheets: large springback

K. Mori et al.

Reduction in springback by bottoming in V-bending of 980 MPa ultra high strength steel sheet

Reduction of springback by bottoming in V-bending of 980 MPa ultra high strength steel sheet

Holding

Bottoming, 0.33% reduction in thickness

Forming speed [mm/s]

Prevention of springback and twisting by re-striking

K. Mori et al.

T. Suganuma et al.
Prevention of springback by holding at bottom dead centre

440 MPa sheet

(a) Holding at bottom dead centre  (b) No holding

Sakaguchi Seisakusho

Contents

1) Types of mechanical servo presses
2) Bending
3) Deep drawing
4) Hot stamping
5) Shearing and plate forging
6) Conclusions

Improvement of deep drawability by detachment of tools from sheet

Y. Tamai et al.

Improvement of deep drawability by detachment of tools from sheet

Y. Tamai et al.

Prevention of fracture in deep drawing of step cup

Aida Engineering

Prevention of fracture in deep drawing of step cup

Aida Engineering

(a) Holding at bottom dead centre  (b) No holding
Control of forming speed in plate forging of gear drum

Prevention of seizure: decrease in temperature

H. Ando et al.

Improvement of deep drawability using servo die cushion

S. Matsuno et al.

Prevention of fracture by control of blankholder force

(a) Conventional die cushion  (b) Servo die cushion

Honda Motor

Control of blankholder force in deep drawing of automobile panel

S. Matsuno et al.

Control of blankholder force in deep drawing of automobile panel

(b) High speed servo press and die cushion control

Honda Motor

Prevention of wrinkling in deep drawing by pulsating motion

(a) No pulsating  (b) Pulsating

Iiyama

Reduction of friction in pulsating ironing

SUS 304

Increase in limiting ironing ratio

Koga et al.
Inclusion of heating process of magnesium alloy sheet in warm deep drawing

(a) Start                      (b) Heating                   (c) Deep drawing
T. Altan et al.

Warm forming of magnesium alloy laptop computer case

1 shot press for controlling ram motion

Progressive and transfer dies

Yutaka Giken

1 shot press for controlling ram motion

(a) Progressive and transfer dies
(b) One shot
(c) Start
(d) 1st drawing
(e) Punching
(f) Burring, 2nd drawing
(g) Punching, thickening

C. Murata et al.

Contents

1) Types of mechanical servo presses
2) Bending
3) Deep drawing
4) Hot stamping
5) Shearing and plate forging
6) Conclusions

Hot stamping for producing ultra high strength steel products

- Decrease in forming load
- Prevention of springback
- Increases in formability
- 1.5GPa strength

Holding at bottom dead centre
Temperature distribution in hot stamping

(a) 149 mm/s
(b) 26 mm/s

High speed stamping by servo press

K. Mori et al.

Contents

1) Types of mechanical servo presses
2) Bending
3) Deep drawing
4) Hot stamping
5) Shearing and plate forging
6) Conclusions

Reduction of noise in shearing

(a) Crank motion, 101 dB
(b) Variable motion, 75 dB

Aida Engineering

Reduction of noise in shearing

Improvement of quality of sheared edge by push-back punching

K. Junlapen et al.

Relationship between limiting expansion ratio and tensile strength of steel sheet

K. Mori et al.
Reduction in cost → To forging from cutting
Reduction in thickness of plate → Large increase in load

Plate forging

Contents

1) Types of mechanical servo presses
2) Bending
3) Deep drawing
4) Hot stamping
5) Shearing and plate forging
6) Conclusions

Advantages of servo presses

1. Free motion for development of novel forming processes
2. Local slide movement for high productivity
3. Improvement of dimensional accuracy and stability due to feedback control
4. Digital linkage with other machines
5. Easy maintenance due to simple structure

Application of servo presses

Formability
Accuracy
Productivity
Digital production
How to use the servo presses