STAMTEC®
METAL STAMPING & FORMING EQUIPMENT

WHITE PAPER

GUIDE TO LINK MOTION MECHANICAL PRESSES

Modified drives which change the motion of the slide

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Link Motion Mechanical Presses

Traditional Mechanical Presses Overview

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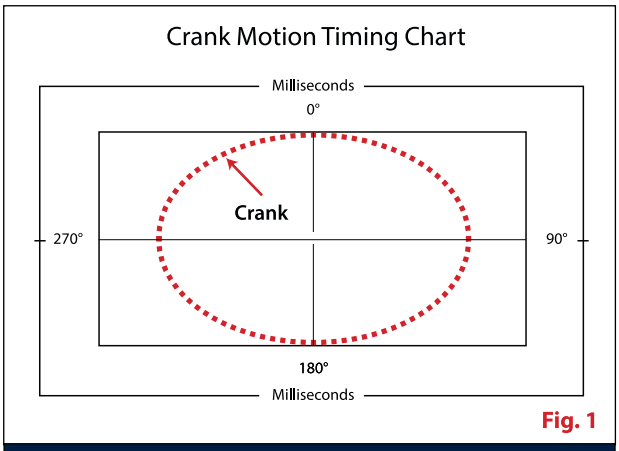
Mechanical presses achieve the highest production speeds, when running relatively flat parts with simple, shallow forming requirements, that typically can be processed from coil stock through a progressive or transfer die.

Characteristics of a traditional mechanical press include:

- Fixed stroke length, although variable-stroke length presses are available from some manufacturers.
- Variable slide velocity (SPM), but slide velocity within a single cycle of the press is fixed.
- Working energy depends on flywheel mass and speed.
- Full press tonnage capacity (rating point) only near bottom dead center (BDC) of stroke.
- Simplicity of setup and operation.
- Typically the highest stroking speeds.
- High accuracy and repeatability.
- Special slide motions, such as link-motion, are available.

Mechanical presses, often equipped with a crankshaft or eccentric gear drives, produce a symmetrical slide velocity between the top and bottom of the press stroke (**Fig. 1**). This system has part production limitations due to the excessive slide velocity through the working portion of the press stroke.



Symmetrical slide velocity between the top and both halves of the press stroke

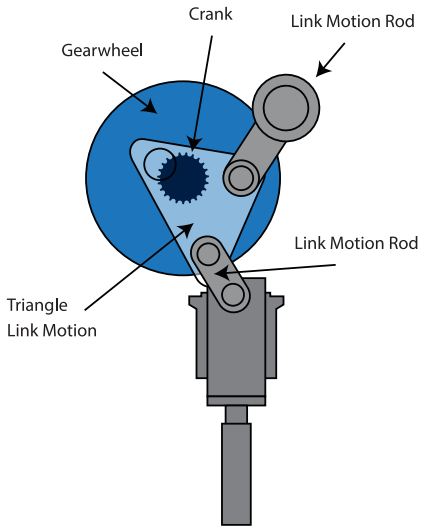
To improve and expand part production capabilities, Stamtec offers multiple modified drive options, including draw link, progressive die link, vertical link, and knuckle-joint motions, which change the motion of the slide.

Modified drives have proven effective and can significantly improve common stamping operations.

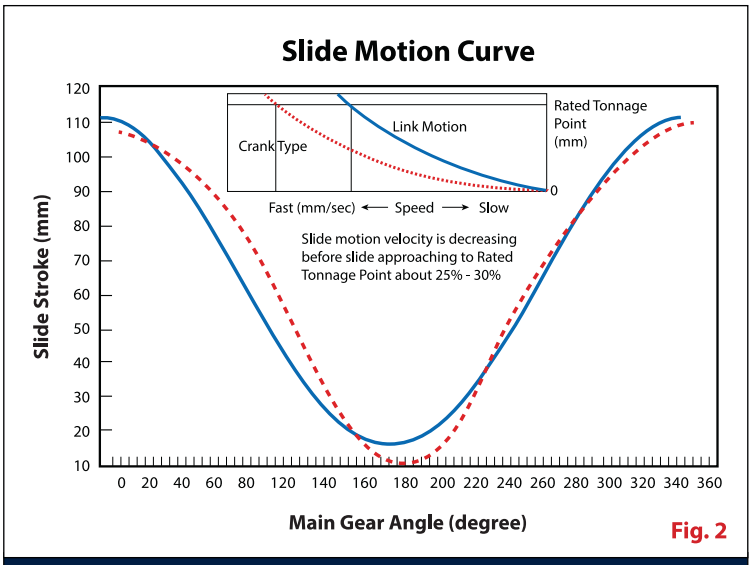
Link Motion Drives

Link motion drives are designed to stamp parts that require deeper or more complex forming and in addition, can increase productivity 20% to 40%.

With a link motion drive, the slide velocity decreases by up to 40% during the working portion of the stroke (**Fig, 2**).



Link motion drive design



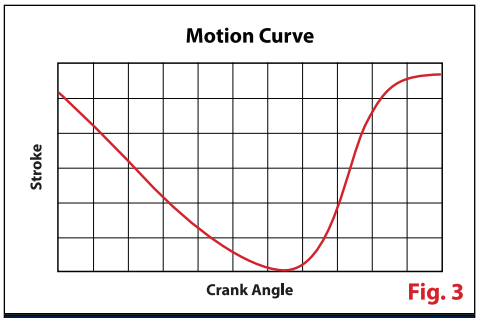
Decreased slide velocity during the working portion of the stroke

Material flow in the non-working portion of the stroke increases by an offsetting amount to maintain high production rates. The results are better quality parts produced at higher production speeds. In addition, the slower speed of the working stroke reduces die impact, punch penetration, snap-through, noise and vibration, increasing machine and die life.

Types of Link Motion Mechanical Presses

Draw Link Type: Draw link motion drives are most commonly used when performing deep drawing operations. The reduced slide velocity through the working portion of the press stroke, allows metal to be stretched and formed without tearing. This reduction provides a more constant slide velocity (**Fig. 3**) during the drawing operation, improving part quality and reduced side wall thinning.

While draw link motion is ideal for deep drawing operations, the small amount of time the slide is near the bottom of the stroke, limits the performance in other operations, including blanking, coining, forming or progressive die.



Constant slide velocity during the drawing operation

Progressive Die Type: Also known as drag or slider, this motion is specifically designed to enhance progressive die operation performance. Progressive die link motion reduces slide velocity through the working portion of the press stroke by 20% to 40%.

Applying pressure, increases metal plasticity and forming capabilities. This is enhanced the longer pressure is applied to the metal.

Benefits of this plasticity include:

- Less spring back during forming operations
- Achieving desired shapes without re-striking during coining operations
- Less material cracking during pierce and extrude operations
- Higher SPM during in-die tapping operations
- Very high SPM during shallow draws

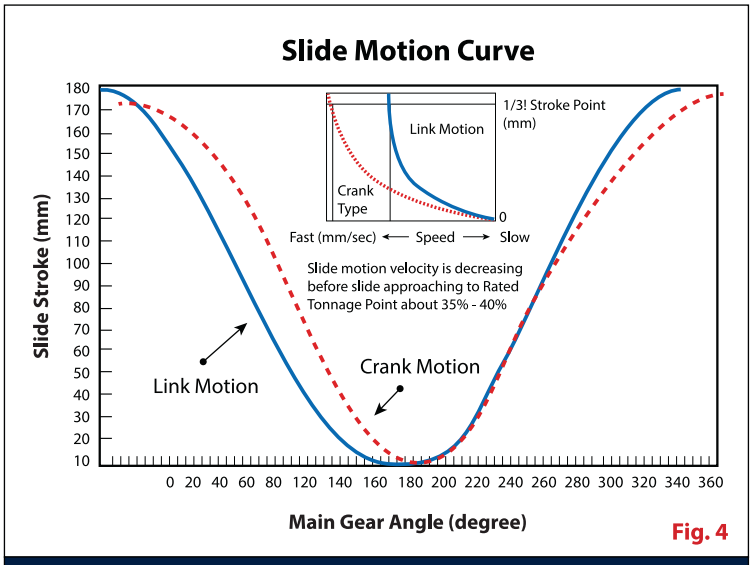


Fig. 4

Reduced slide velocity of a progressive die-link motion

Lost time created by the slide velocity reduction in the lower portion of the press stroke is regained by increasing velocity through the upper portion of the stroke (**Fig. 4**). With progressive die link motion, strokes per minute are not sacrificed, and operating speeds can be increased by 25% or more.

Vertical Link Type: Vertical link motion can more than double how long the punch is engaged with the material (**Fig. 5**). Vertical link motion is common in coil fed forming operations where pressure is applied by the press.

Like progressive die, vertical link motion enhances press performance by operating at a significantly reduced slide velocity.

The increased slow down in slide velocity provided by vertical link motion, increases the flow of material and improves the production of net shape parts where secondary machining operations have been eliminated.

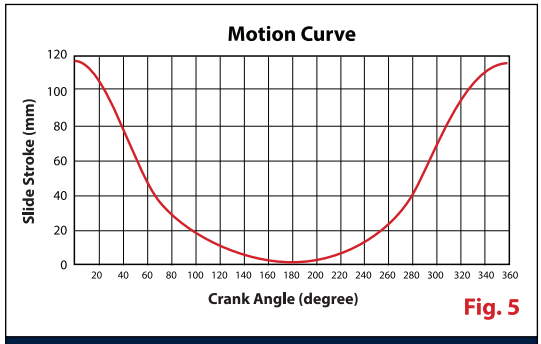
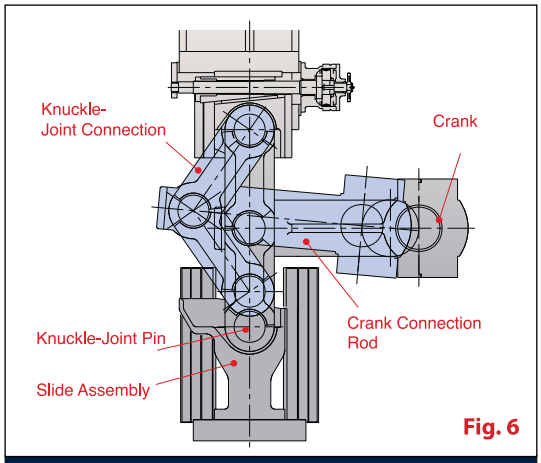


Fig. 5

Increased time the punch is engaged with the material

Knuckle-Joint Type: Knuckle-joint motion is a modified slide motion, specifically designed for near net-shape forming where a very high degree of metal flow is required. The knuckle-joint drive (Fig. 6) not only slows down the slide through the working portion of the stroke, but actually produces a significant dwell at the bottom of the stroke.



Knuckle-Joint Drive System

The benefits of knuckle-joint motion technology include:

- High rigidity - minimum deflection
- Long BDC dwelling time
- Designed for thicker materials and NET-shape blanking and coining
- Prolonged tooling life
- Improved quality, precision, and stability of produced parts
- Capable for wider stamping applications
- Reduced noise and vibration

Additional Benefits

Link motion drives can improve die life by reducing shock and vibration. The reduced slide velocity in the working portion of the press stroke allows progressive die and vertical link motions to reduce shock and vibration by 30 percent to 70 percent during blanking operations. This reduces both press and auxiliary equipment noise levels and wear.

Shock and vibration are highest while the punch is engaged with the material and lower die section. The reduced shock and vibration also reduces maintenance costs for issues related to guards shaking loose, press wiring connection failures, and press frame stress cracks.

The lower working velocities also create savings in lubrication.

Press Feeding and Transfer Systems

Feed timing is traditionally based on the degrees of crankshaft rotation. However, with link-motion presses, the slide velocity is increased through the upper portion of the press stroke, leaving less time to complete the cycle.

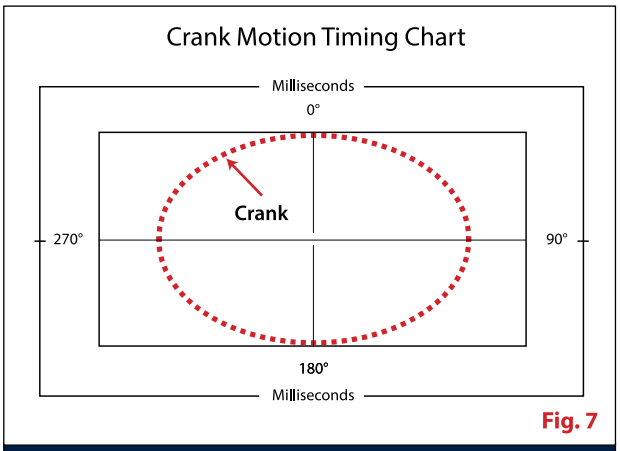


Fig. 7

Timing chart for a standard crank motion press operating at 60 strokes per minute

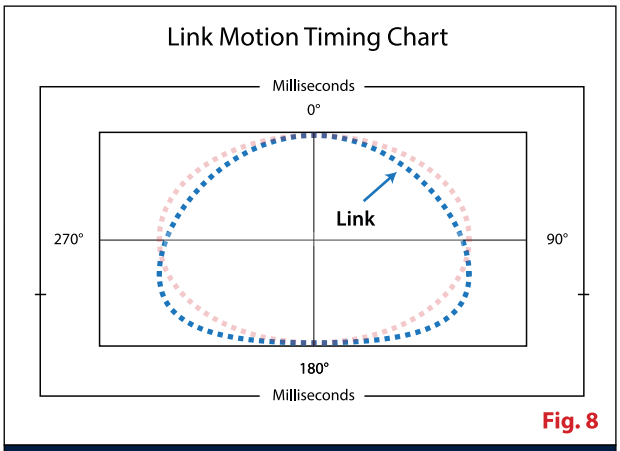


Fig. 8

Timing chart for a typical link motion, drive operating at 60 strokes per minute

Crank motion drives (**Fig. 7**), produce a symmetrical slide velocity between the top and bottom of the press stroke. The same amount of time is required for the crank to rotate between the top half, and bottom half.

With link motion drives (**Fig. 8**), the slide velocity is reduced through the working portion of the press stroke, meaning more time is used. In order to maintain SPM, slide velocity is increased through the top portion of the press stroke.

With link motion drives, there is significantly less time available to feed material through the die. Unlike using degrees of crankshaft rotation, link motion presses use milliseconds to complete the feeding cycle.

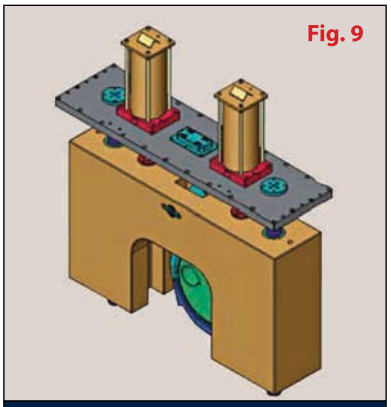
Mechanical presses with integrated feeding systems driven from a power take-off on the crankshaft, will see higher acceleration with link motion. Press speed may need to be reduced. Servo driven feeder with no mechanical tie to the crankshaft, will require no press speed reduction.

TLN2-300 Series
3-in-1 Servo Straightener with Uncoiler

Dynamic Balancing

On the upstroke (press lifting) and downstroke (pushing toward the floor), inertia forces are created that can impact press stability and performance. To reduce these inertia forces on presses with link motion drives, dynamic balancing blocks can be applied (**Fig 9**).

Dynamic Balancing Blocks can greatly reduce high-speed slide inertia forces. This helps the press maintain bottom-of-stroke repeatability, and run at higher speeds with less vibration. The effect is greater part accuracy, and reduced press and die wear.

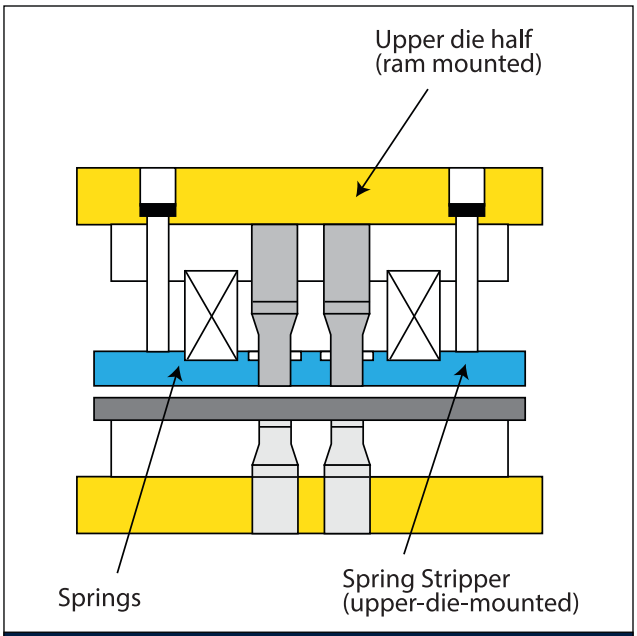


Dynamic Balancing Blocks

Spring Loaded Strippers

To maintain cycle rates, slide velocity must be increased through the upper part of the press stroke to compcompensate for the reduction in the working portion. Immediately increasing velocity after the slide passes through the bottom of the press stroke, would also increase spring-loaded stripper velocity and stripper bolt wear.

Progressive die link and vertical link motions do not increase slide velocity until the stripper has been lifted off of the material (see **Fig. 4** and **Fig. 5**). This results in decreased stripper velocity and reduced load on the stripper bolts.



Reducing kinetic energy and inertia force
with Spring Loaded Strippers

Summary

- Link motion drives decrease slide velocity by up to 40% during the working portion of the stroke
- Better quality parts produced at higher production rates
- Slower speeds can reduce die impact, punch penetration, snap-through, noise and vibration
- Increased machine and die life
- Types of link motion drives include:
  - » Die link
  - » Progressive die-link
  - » Vertical link
  - » Kunckle-joint

Link motion drives will enhance press and die performance and produce higher quality parts at higher speeds, while reducing operating and production costs.

Stamtec offers a variety of press models with available link motion drives including:

- GL1 Series (One-Point, Gap Frame)
- GL2 Series (Two-Point, Gap Frame)
- SLX Series (Two-Point, Straight-Side)
- SL1 Series (One-Point, Straight-Side)
- SL2 Series (Two-Point, Straight-Side)
- SL4 Series (Four-Point, Straight Side)
- KP Series (One-Point, Knuckle-Joint)
- KT Series (One-Point, Auto-Transferring, Knuckle-Joint)
- KW2 Series (Two-Point, Progressive Knuckle-Joint)
- KW1 Series (One-Point, Cold and Semi-Hot Forging, Knuckle-Joint)
- KL2 Series (Two-Point, Long Stroke, Modified Knuckle-Joint)
- PL1 Series (One-Point Straight Side)
- PL2 Series (Two-Point Straight Side)

PL2 Series - Two-Point, Straight Side Link-Motion Press

About Stamtec

Stamtec has been providing dependable, affordable metal stamping presses for more than 30 years in the North American market, and 70 years worldwide through our parent company Chin Fong. Our 72,000 sq. ft. sales, service, logistics, and assembly facility in Tennessee is home not only to North America's largest inventory of new presses and spare parts, but also our most important asset - our people. Our staff of engineering, sales, service, and support personnel are here to serve you in the most timely and professional manner. So, tap into the strength of Stamtec, and let us help you choose the right equipment to increase your productivity and grow your business.

For more information, contact Stamtec at 931-393-5050, email us at **stamtecpresses@stamtec.com**, or visit **www.stamtec.com**.

GAP FRAME PRESSES

1-POINT AND 2-POINT

STRAIGHT SIDE PRESSES

1-POINT, 2-POINT AND 4-POINT

SERVO PRESSES

1-POINT AND 2-POINT
GAP AND STRAIGHT SIDE

FORGING PRESSES

WARM / HOT AND COLD