WEPUKO PAHNKE ENGINEERING P.O. Box 2120, 4949 URBANA ROAD REAR
SPRINGFIELD, OH 45502 USA PHONE : (937) 390-2100 FAX : (937) 390-9715 EMAIL : mail@wepuko.com

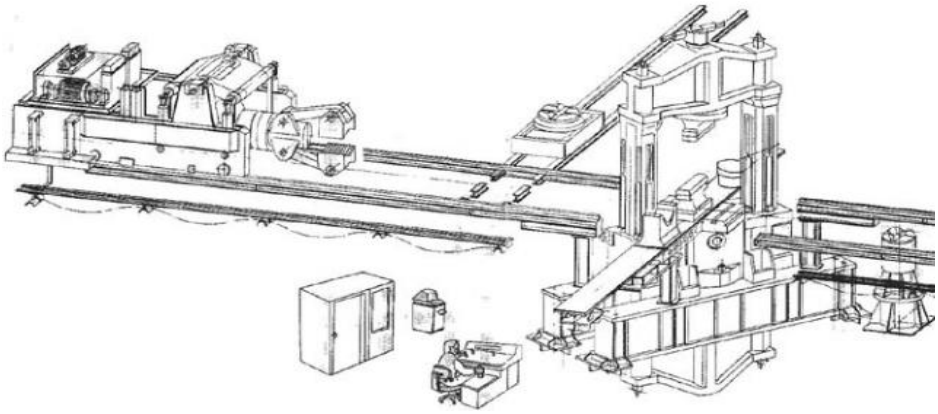
PRESS DESIGN ELEMENTS The free-forging press must be designed and built to meet a host of rigorous demands. For example:

- Adequate rigidity in design and manufacture and safety of operation to withstand very large eccentric loads, abrupt load changes, radiant heat from ingots, and other extremely unfriendly operating conditions.
- High precision forging capability to ensure improved material yield and reduced machining allowances.
- High speeds of operation to forge the work piece into the desired form within a limited allowable working temperature range and with minimum possible re-heat times.
- Reduction of labor.
- Decreased power consumption

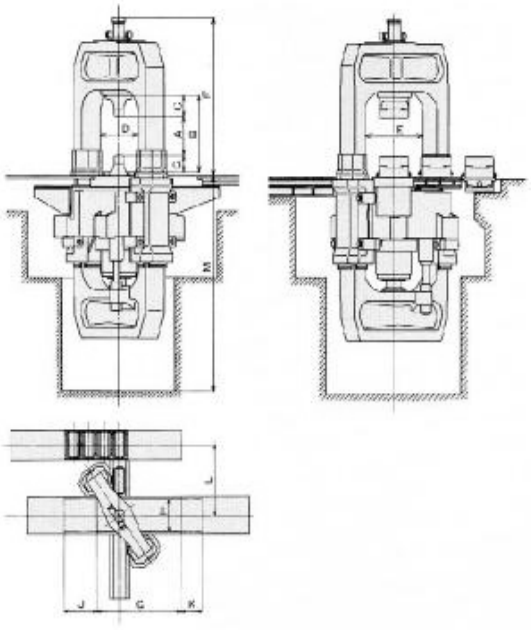
Advanced Engineering Features :

We can offer many forging press and manipulator systems, which satisfy the Press Design criteria and offer State-of-the-Art features such as:

- Sturdy and streamlined press frame construction,
- Sinusoidal cycle drive system that ensures shock-free, high-speed, and high-precision forging operation,
- Application specific computer control that makes ideal forging operation possible,
- Other user-oriented design considerations to meet a wide range of clients special requirements.



"Pull Down" type Press



The pull down type press, with its center of gravity at a low level relative to ground level, undergoes only an extremely small displacement in its center of gravity even under eccentric loading and hence remains free of vibration even during high speed operation. Its forging operation, therefore, is very stable.

Nearly all of its oil hydraulic equipment, including the cylinder, control valve, piping etc., are installed under the floor, leaving a wide open working floor area around the press and thus ensuring a high level of safety against oil leakage and fire.

With the press standing low above the floor, the forge building can also be built low with consequent savings in construction cost, not to mention the other advantage of a lower overhead traveling crane.

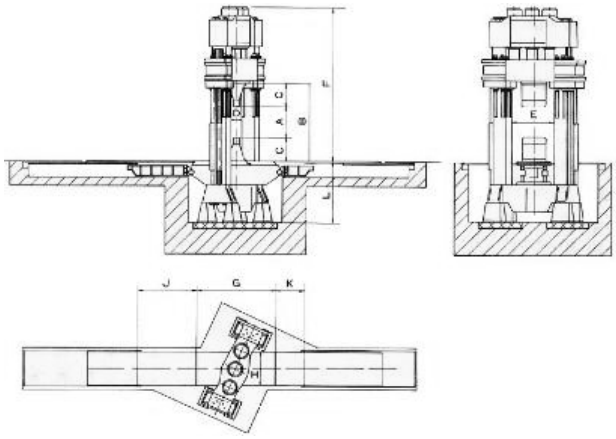
Push Down" type Press

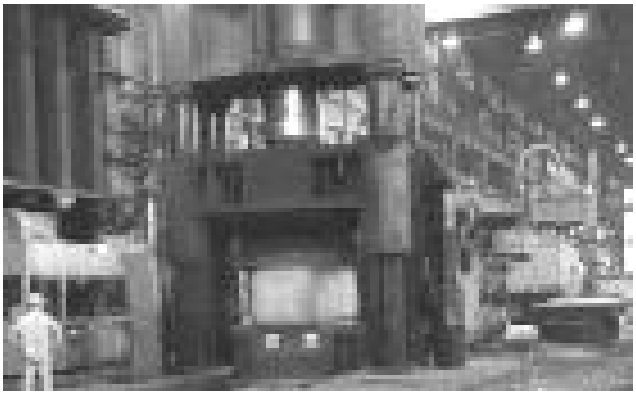
This forging press employs the same 2 column design as the pull down type press.

The 2 column design makes it easy to ensure the equal and uniform distribution of load between he two columns. The rectangular column sections are advantageous in withstanding eccentric load. The press's two columns are arranged so as to ensure the optimum angle relative to the manipulator and operator position.

Compared to the pull down type, the push down press has a smaller foundation depth and is therefore more economical in terms of construction cost.

Also, with its moving parts being smaller in weight, the press offers good response characteristic. In terms of press style, the push down type can be said to find universal applications.

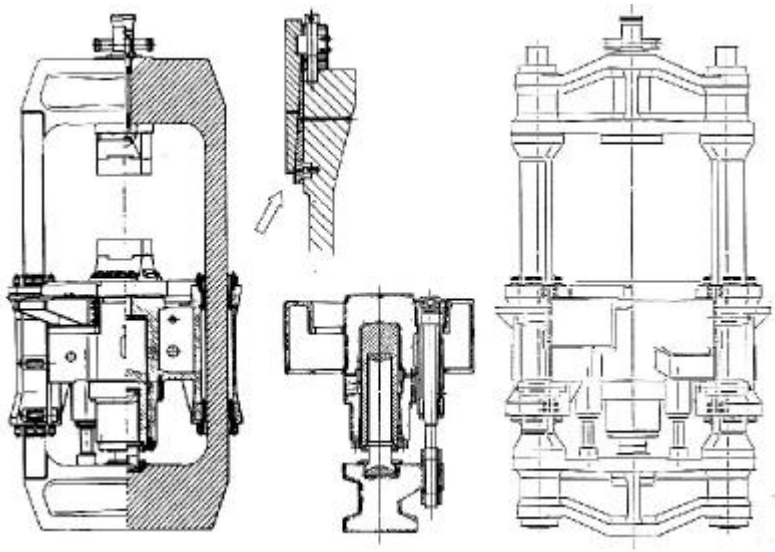




PRESS STRUCTURAL DESIGN FEATURES

Press Frame

The forging press frame can be subjected to intermittent and heavy eccentric loads and is thus exposed to the most rigorous working conditions. It is therefore the most important member of the press fabrication and requires detailed design considerations to achieve maximum reliability and durability.



1. Mono-frame Construction (for smaller presses)

The press frame is a cast steel mono-block construction shaped like a chain link. It has high structural rigidity at the transition between the upper and lower crosshead beams and the column. This gives an ideal frame profile with minimum stress concentrations.

These rectangular columns have a better rigidity than conventional circular columns and the column guide surfaces are flat, resulting in very low guide block pressures.
The cast steel frame is designed to have a low working stress and hence minimum deformation under load. This ensures a high level of forging precision. The casting employed is completely solid and thus has a high heat capacity and hence low local thermal stress even when exposed to the high radiant heat experienced during forging.

2. Pre-stressed Frame Construction (for larger presses)

This type of frame employs a pre-stressed frame construction and is useful where large, heavy objects cannot be transported.
The pre-stressed press frame consists of two upper and lower crosshead beams with two right and left uprights, usually with a "C" cross section. These are all securely held together with high tensile pre-stressed steel tie rods.
The tie rod pre-tension is designed to be about twice the normal maximum working load to prevent the structural joints from opening under exposure to eccentric load.
The pre-stressed press frame is also normally made of cast steel and designed to keep the working stress to a similarly low level as the mono-frame design and, by employing the simplest possible frame profile, ensures freedom from deformation under loading as well as from thermal stress.

- Column Guide Designed to Absorb Eccentric Load

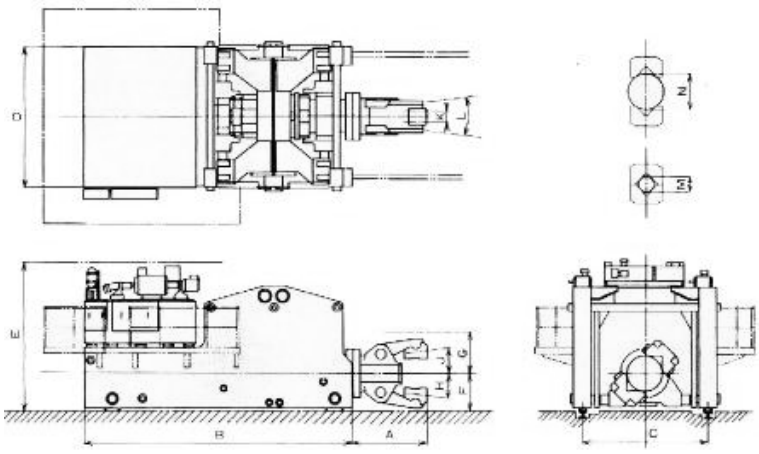
The right and left columns of the press frame slide upwards and downwards in their vertically extended guide sleeves, which are provided on both sides of the press bed. Guide blocks, which are at four places at the upper, lower, right and left sections of each guide sleeve are designed to be capable of completely stopping the entire eccentric load acting on the press frame. The upper and lower guide blocks are spaced vertically to minimize the load applied at each point. As the column is rectangular in cross section, its surface and the corresponding guide block sliding surface have low bearing pressure, and thus wear due to sliding friction is minimized.

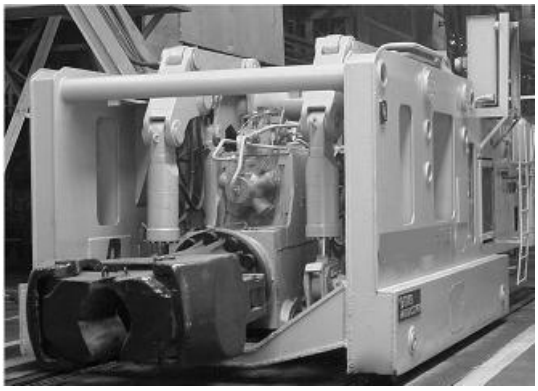
- Main Cylinder Highly Resistant to Eccentric Load

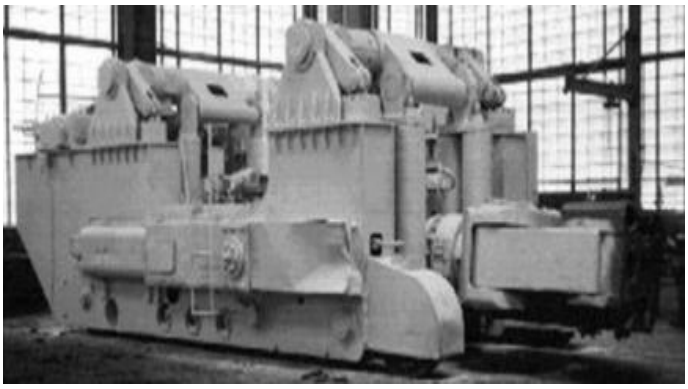
The major structural design feature of the main cylinder is that the main ram moving in the main cylinder is not directly connected to the press frame, but instead, the forging pressure exerted by the hollow main ram is transmitted to the press frame by way of a self aligning connecting rod contained in the ram. This connecting rod has spherical surfaces at its upper and lower ends enabling free oscillating motion. The press column guides are provided with a sufficient clearance to absorb thermal expansion between the frame and base. When subjected to eccentric load, therefore, the frame becomes inclined by the column guide clearance and correspondingly so does the connecting rod. With the main cylinder and main ram designed and built as mentioned above, however, only a small amount of the horizontal component of pressure stroke is exerted on the ram, as a side force. Even under severe working conditions involving the many eccentric press force strokes, the packing and bush remain free of undue strain and suffer only minimal wear.

FORGING MANIPULATORS

As the forging press is upgraded in speed and operational precision, a forging manipulator becomes necessary which can faithfully follow the press motions in speed and precision for the whole press installation to be successful. Wepuko Pahnke's forging manipulators incorporate many design features to fully meet this requirement, including the following:







- A vertical recoil system which compensates for the downward movement of the manipulator peel shaft during forging.
- A horizontal damping/recoil system, which feeds the ingot into the forging press on a complete follow up principle during high speed forging operation.
- An automatic rotary correction system, which prevents distortion of the billet/forging.
- Individual pumps for different parts of the system to enable particular manipulating motions to be performed accurately.
- Twin manipulator operation integrated with the press
- One man control of the press manipulator integrated operations.

WPE's forging manipulators are designed with many more functional advantages. Used in combination with high speed forging presses, the manipulator has greatly contributed to achieving high product quality and productivity much to the satisfaction of our customers.

AUXILIARY EQUIPMENT

We are constantly looking to automate our forging press and manipulator systems for higher productivity and greater labor savings.

Consequently, not only the press and manipulator have to be capable of high speed operation, but also the auxiliary equipment around the press. These components have to have excellent design and function to effectively serve the press and manipulator in a total and well balanced manner.

Our many years of experience as a forging press manufacturer enable us to be able to offer a range of auxiliary equipment :

- Elevator Type Turntable - Located between the forging press and manipulator, this turntable is used for turning the ingot as well as for assisting the manipulator in re-gripping the ingot. The turntable is kept at or below floor level during the forging operation.
- Ingot Car - The ingot car is used to transport the ingot to the manipulator and has a rotating top

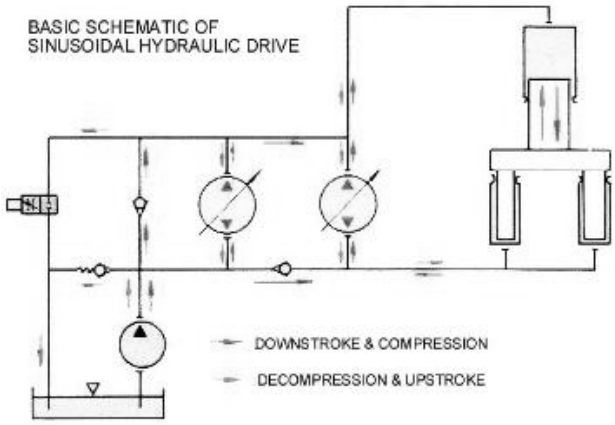
section.

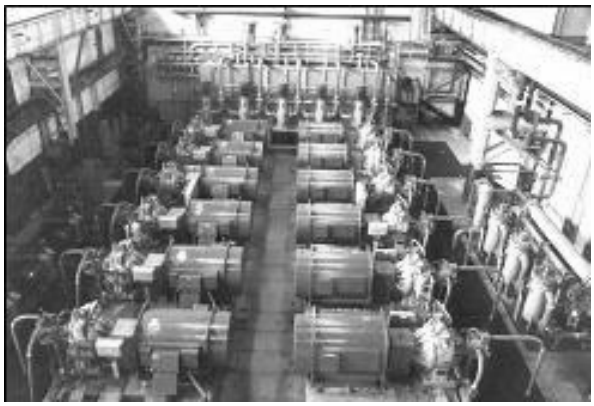
- Automatic Die Change System WPE's forging press systems can incorporate a table shifting device, a bottom die shifting device, die magazine and top die rotating device to shorten the setup time as well as to ensure work safety. All of these die exchange devices can be placed in and out of automatic operation directly from the control desk, and also their operations can be programmed into the computer controlled forging process.

MODIFIED SINUSOIDAL PRESS DRIVE SYSTEM

The sinusoidal press drive system takes full advantage of the variable discharge and reversible discharge direction characteristics of the radial piston pump.
It differs from conventional press drive systems where valves are used to control the press operation and replaces it with a system in which the press operating speed and direction is controlled by changing the direction and rate of pump discharge.
The changeover between the compression downstroke and the decompression upstroke is made by the pump itself.

Simply put, a Radial Piston Pump powered Sinusoidal Hydralic Press Drive by Wepuko-Pahnke is the most energy efficient, longest lasting, lowest maintenance, most productive method of providing and controlling mechanical power to a forging press operation. It offers the lowest cost of ownership and greatest Return on Investment for any method of press drive produced anywhere by any manufacturer without exception.



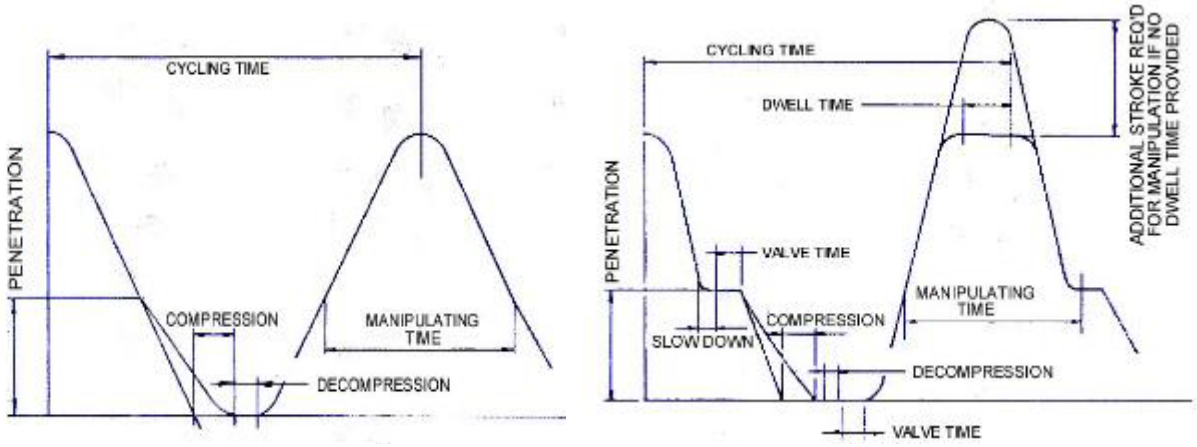


Advantages

1) The switch between the press down stroke (compression) and upstroke (decompression) is performed at the point of zero pump discharge, eliminating otherwise attendant switching shock. Consequently, vibration and pulsing of associated piping, normally experienced during hydraulic pressure shocks, is almost completely eliminated.
2) The press motion in terms of the operating curve is now simplified, making high speed forging possible.
3) The press motion and speed are directly and accurately proportional to the pump discharge rate, ensuring a high level of pump response. Also, the accuracy of position control is sharply improved (? 0.04? in terms of product accuracy).
4) Since the pump discharge is variable, employing several pumps in proper combination enables the sinusoidal operating curve to be altered or modified as desired. It therefore is feasible to obtain the correct press motion curves most suited to the customers forging operations.

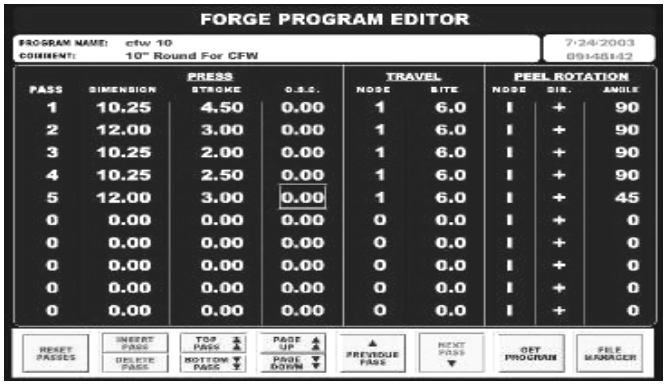
5) Energy consumption is up to 30% less than with conventional press hydraulic drive systems.

Sinusoidal Press Motion : **Conventional Press Motion :**



PROGRAMMED FORGING AND INNOVATIVE SOFTWARE

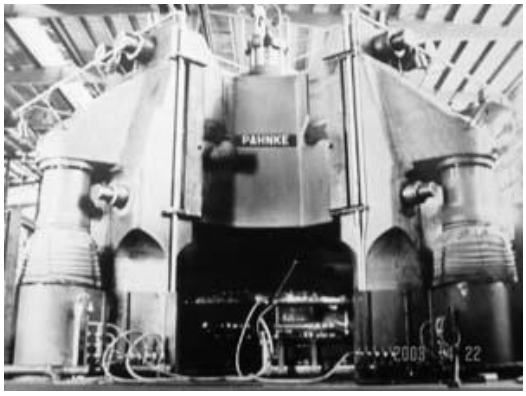
Wepuko Pahnke's programmed forging system thoroughly automates the entire forging operation, including press and manipulator control as well as automatic die change. Additionally, Wepuko Pahnke's FORGEMASTER software is a state-of-the-art, Windows compatible tool to develop pass schedules for bar forging.



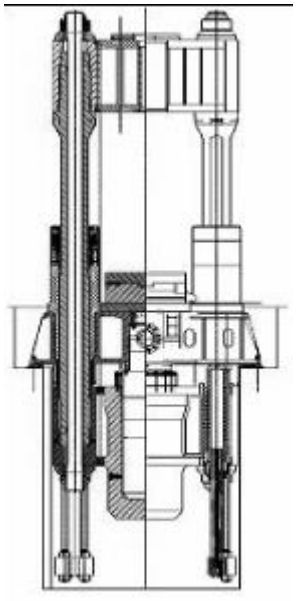
The forging programs cover not only relatively simple round or square shaft forging but other complex shaped forgings as well.

- Merely by keying in the material dimensions, material parameters, forging start temperature, and final product dimensions, the forging process and the press and manipulator operating conditions for each individual process are automatically calculated.
- The press and manipulator operating conditions calculated include the forging dimensions, press strokes, work feed rate, rotational angle, set-down length, and which dies to employ for each step of the forging process.
- The press and manipulator operating conditions calculated include the forging dimensions, press strokes, work feed rate, rotational angle, set-down length, and which dies to employ for each step of the forging process.
- The forging program developed as above is displayed graphically for the operator
- The forging program data can also be obtained for the operator to get himself acquainted with the forging process beforehand. The operating conditions employed and time required for each step of the forging process are recorded for use in production control or in improving the program for the next forging operation, reducing the forging time, etc.

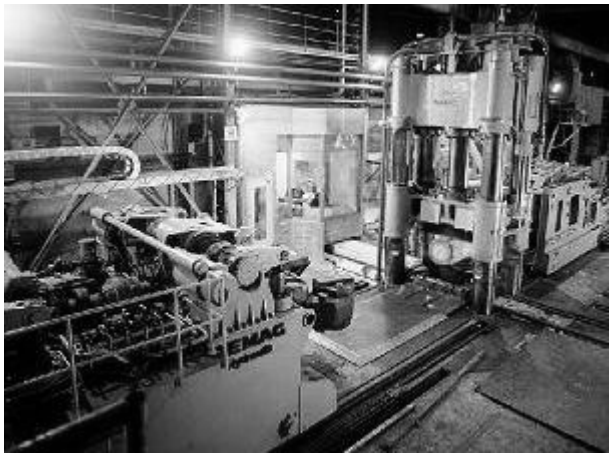
34,000 ton Closed Die hydraulic Forging Press



3000 ton Open Die Forging Press and 30 us-ton lift capacity railbound Manipulator



5000 US-ton hydraulic Open Die Forging Press(New single cylinder crosshead (was 3-cylinder crosshead))



3000 ton Open Die Forging Press 25 ton railb. Manipulator 16 ton railb. Manipulator