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Press Balancing Systems
Pneumatic Counterbalancers:

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The typical mechanical press purchaser often does not give much thought to the balancing systems included in the machine being considered. Many are not aware of systems that should be employed or the benefits they generate. Balancing systems, however, should be a major factor in the press evaluation and decision process because they can contribute much to the suitability of a press for a particular application. The balancing systems employed can also be a good indicator of both the quality of the machine and the sophistication of the engineering behind it.

Press balancing systems usually fall into one of two categories: reciprocating or rotary. This paper (Part 1) will examine reciprocating systems and point out pertinent features, functions and benefits of those systems.

SLIDE COUNTERBALANCE

The most commonly recognized balancing system is the slide counterbalance. This system is used to offset the weight of the slide and upper portion of the tool and is usually made up of one or more air cylinders that have their piston attached to the slide. Compressed air pressure is adjusted on the enclosed piston to generate an upward force that offsets the hanging weight of the slide and tool. **(Fig. 1)** Occasionally the piston and cylinder design will be replaced by a convoluted rubber bladder arrangement, but the underlying principle remains the same. Be wary of machines that have no system at all.

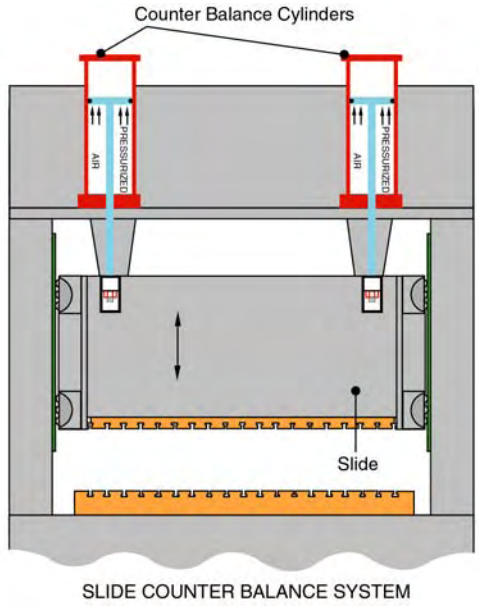

FIGURE 1

Adjustment of the air counterbalance pressure to the proper setting should be done during every setup and pressure should be occasionally monitored during operation. Some press control systems do settings automatically as part of their setup recipe management feature. There are also retrofit systems available to make this automatic feature available on existing machines that were originally purchased without it.

The primary static purpose of this system is to take slide and tool weight off the shutheight adjusting screw(s) during setup, thus making it much easier for the adjusting motor to rotate the screw(s) without overloading or stalling. Proper pressure setting also helps avoid wearing the adjusting screw(s) prematurely, since friction on the threads is reduced when

slide weight is compensated. A properly counterbalanced slide will allow the screw(s) to turn freely with an oil film above and below the thread faces. An improperly adjusted counterbalance will allow the top or bottom faces of the screw threads to squeeze out lubrication, promoting friction and wear.

On large presses, it is sometimes possible for the slide to creep downwards when the press is idle for extended periods while the counterbalance pressure is too low. Special mechanisms, like slide locks, can be sometimes employed to prevent this, but a properly adjusted counterbalance system can significantly reduce a slide's propensity to creep.

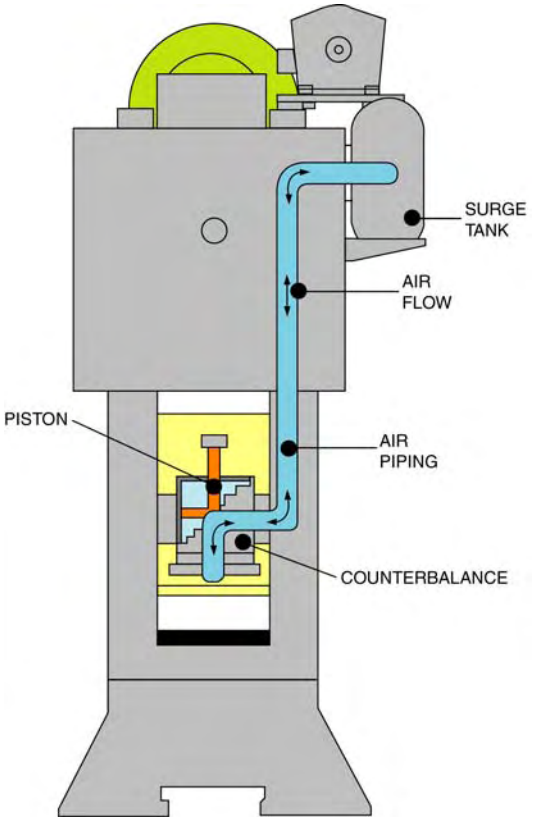

FIGURE 2

All good and premium quality general purpose presses employ slide counterbalance systems. A single-point or a two-point gap type machine may employ one or two cylinders. Most conventional straightside presses also use two cylinders and some premium machines employ four or more. When two cylinders are employed, they are usually placed between the columns on the left-to-right axis **(Fig. 2),** but they can also be placed above the front and rear of the slide **(Fig. 1)**, thus freeing the area between the columns for easier access for a feeder or transfer system.

Four-cylinder designs are not uncommon on premium grade presses and usually are arranged with two attached to both the front and rear of the slide. This design gives the best support of the slide in both the front-to-back and the left-to-right directions. It also clears the area between the columns for maximum access to feeders, transfers and for part removal.

Beyond the static purpose of balancing the slide weight during shutheight adjustment, there are dynamic considerations to be made when comparing presses. With the press is in motion, a properly adjusted counterbalance system will reduce the effective slide and tool weight that the drive system must lift after the press has gone through the bottom of the stroke. The force from the motor can go toward replacing the flywheel energy that was lost making a part rather than being wasted lifting the slide. This minimizes the overall motor load and saves energy, resulting in a lower electric bill. Additionally, a balanced slide will help reduce drive train gear wear and allow the press to operate more quietly.

Another dynamic consideration for press comparison is how displaced air is handled in the counterbalance system. During each stroke of the press, the piston in the counterbalance will try to compress the enclosed air. The counterbalance cylinder must be of sufficient capacity (volume) to accommodate the displaced air without allowing air pressure within to become excessive. For this reason, some cylinders are much longer than others. Additionally, the compressed air becomes heated and can lead to seal failure if the temperature is allowed to get too high. To avoid both these issues, many designs employ a surge tank system connected to the counterbalance to give the displaced air a place to go.

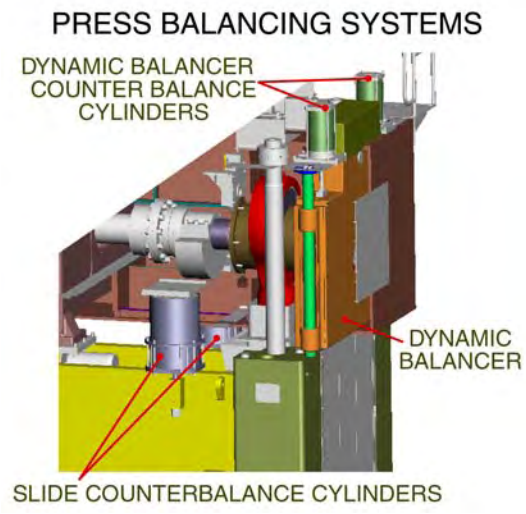

FIGURE 3

DYNAMIC BALANCER COUNTER BALANCE

Some sophisticated, premium grade presses make further use of displaced counterbalance air. These machines are the ones with dynamic balancers that have additional counterbalance cylinders attached to the balance weights. **(Fig. 3)**

Since dynamic balancers have an opposite motion to the slide, the air that is displaced by the slide balancers can be pumped back and forth between the slide and dynamic balancer counterbalance cylinders resulting in several benefits. First, the air needs less compression since it has a place to go at current pressure, resulting in low heat generation. Secondly, very little energy is lost moving air between the cylinders since the pressure change is minimized. Additionally, kinetic energy is conserved allowing more efficient use of the drive motor. Totally balanced systems such as this also generate less noise during operation.

In summary, understanding the design and function of air counterbalance systems is important to press evaluation, setup, operating and maintenance personnel. Acting on that understanding by keeping the systems properly set and maintained will generate real benefits in lower repair costs, lower power costs, and reduced downtime.