Air Counterbalances: A Matter of Pressure

By Peter Campbell

The pneumatic system of a forging press is often overlooked. Current PLC systems are set up with lubrication monitoring for pressure or broken line faults. Tonnage monitoring is another area that is often tied in with a PLC control system and will shut the press down when an overload occurs. The air system, however, is usually set once and forgotten.

It's Simple Yet Critical

Air pressure can run many components and add-on devices, but for this article we'll focus on air counterbalances. The air counterbalance(s) perform a simple yet critical function: to counterbalance the weight of the ram, pitman, wrist pin and upper bolster/ die. It consists of one, two, or more air counterbalance cylinders attached to the frame and the ram; a pressure control regulator; an airline filter/lubricator; a check valve; a surge tank; and manual bleed off valve (LOX Valve).

What is that Sound?

In order to run, a mechanical press needs clearances between the bushings and mating parts for proper lubrication and operation. What happens when a press is operated without air counterbalances? Pulled by gravity, the components would sit at the bottom of the mating bushings. In this case, when the ram comes down and the part is forged, the clearances would quickly get pushed to the top of the bushings. A notable "clunking" sound is made from clearances being taken up in the component parts. When the counterbalance pressure is on and set properly, the components are held up at the top of the clearance already in the "impact" position. At impact there will be one sound rather than the clunking of the parts coming together at the bottom. Appropriate pressure eliminates the shock load, as excess clearances are taken up at impact.

Avoiding Accelerated Wear

It's important to understand the accelerated wear that shock load or hammering on the bushings does to the press. As the wear grows and clearances increase, you will start to see cracks in the bushings. You may also see the edges of the bushings mushroom out in the load area. Insufficient air pressure will cause the main gear to work harder because the air counterbalance is not assisting it in picking up the load. Think of two kids on a teeter-totter. If the two participants are not of similar weight, the bigger kid may need his dad's help to pick up his end when in the down position. This is the extra work that a gear does to pick up the ram assembly and upper die. Now, imagine hearing the phrase "again" and repeating this action over and over. The strain on a gear is similar. Picking up extra weight over and over causes accelerated gear tooth wear.

Image: Worn main gear teeth

Without the air counterbalance assisting, the clutch will work harder to pick up the weight of the ram assembly and die. Overworking the clutch causes accelerated clutch plate wear and clutch hub and housing tooth wear. In turn, the brake will have more weight to stop at the top of the stroke. This will cause accelerated wear on the brake linings/ pads and hub. The motor will also be called on to work harder, picking up more weight without assistance.

Image: Worn clutch housing teeth

Finding Balance in the Counterbalance

So, it seems the more air pressure the better, right? As General George Patton said, "pressure makes diamonds." What's true for diamonds is not true for mechanical presses. Too much air pressure also causes accelerated wear. Excessive pressure causes the counterbalances to hold the ram assembly and die in the upper position. Consequently, the drive train is working against the air counterbalances when pushing the ram assembly down. Let's return to our teeter-totter analogy. Take the smaller of the two kids. To avoid getting stuck in the air, he'll need help from dad to push his side down to keep the teeter-totter moving. Likewise, gear teeth will wear on the drive side as it pushes down against the counterbalances; and on the back side as it slows the ram on the return cycle while the counterbalances try to pull it up quicker.

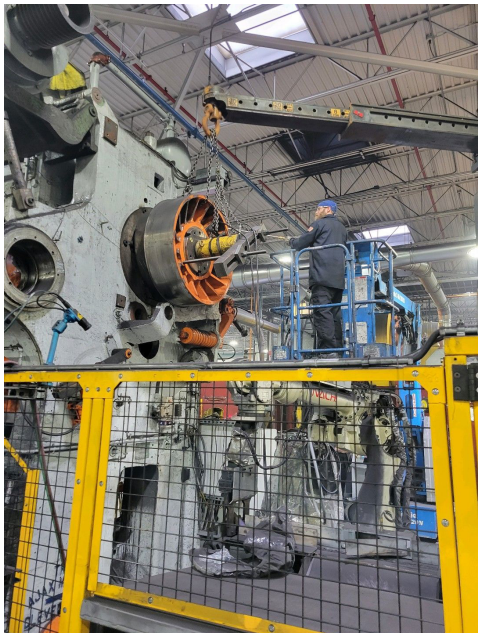

Image: Brake removal

Avoiding the Domino Effect

Again, we see the domino effect. The clutch mechanism will also be working against the air counterbalance as it drives the ram down. This causes accelerated wear on the plates, the hub and housing ID spline teeth. Additionally, this causes the motor to work harder driving the system against the heavy pressure from the counterbalances. Consequently, the brake works harder to stop the system as it nears the top dead center. This "over counterbalancing" may cause your flywheel to slow down. Since speed is one of the factors in producing energy, your available energy will decrease. Without enough flywheel energy to push through, the press could get stuck at the bottom of the stroke. Ultimately, excess air pressure will cause accelerated wear on your press as much as under counterbalancing.

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