Regulator Design

As the regulator design was evolving it was necessary to build test fixtures that could cycle the reg and give information that was needed as to what was actually happening during the regulator cycle. Without the regulator checker it would be very difficult to determine what setting the reg was at or if there were any detrimental effects going on.

The decision to use a particular valving system was based on several factors. I have always believed that simple is better than complicated. The more moving parts and seals there are, the more there is to go wrong. Also simplicity in manufacturing has to play a significant role. If it takes a long time to fiddle with the unit to get it working it would probably be too finicky for trouble free operation over a long period of time. Also ease of repair and seal replacement was considered. It is only a matter of time or number of shots before the o-ring seals start to wear and leak.

The design I use only has two dynamic seals, which actually see wear from the moving valve. This limited the wear to these two points. The next consideration in limiting the wear was the travel that the valve moved from shot to shot. The other designs which I studied used coil springs to offset the air pressure. This had two drawbacks. 1) The coil spring had a lot of travel from empty to full setting, as much as .250". Also inherent to coil springs is that they impart a twisting motion as they are compressed and relaxed. This meant that the seals would see the valve rotating as it moved through its travel during each cycle. These were areas that I saw needed improving if I was to produce a more reliable regulator. I decided to use Bellville washers as my spring source. These are cupped washers made of spring steel. They were very strong and have an extremely long service life. They also do not twist during operation and the overall travel from empty to full was only .050". This was about 1/5 the travel of the other design. Which should equate to 5 X the Seal life. I also reduced the diameter of the seals required so that there was less surface area exposed to the moving valve. Here again this equates to less wear and a longer life. This was the easier potion of the development..

Now came the hard part: the main seal which shuts off the flow of air to the regulated side of the valve. This is the most critical part of the regulator. There are a lot of detrimental effects which stem from this area. The biggest

of these is “Creep”. Creep is the condition that occurs when the regulator does not stop the flow of air completely after the valve has shut. This allows the regulator pressure to continually climb over time. Some may climb a little, or it may climb to whatever the reservoir is filled to. It just depends on how well it seals the valve.
A lot of testing was accomplished here until I came up with the material I use today. One thing is for sure; I now know a lot of materials which don’t work!

The next stage was to decide on the body of the regulator. Because I had reduced the size during the seal phase, I could now incorporate a larger secondary chamber into the design, which is required for higher energy levels of the US market. The trick was not to make it so big that it ate up valuable high-pressure air volume that would reduce the number of shots per fill, and still give enough volume at the regulated pressure to get the velocity required.

The next phase of the development was the incorporation of the regulator into different guns. Precharge airguns come in all shapes and sizes. The reservoirs are usually one of two sizes. 1 inch OD or 1 ¼” OD. So this meant two distinctively different reg body sizes. Except for one thing -- different gun manufacturers use different wall thickness tubing. This meant the reg bodies had to be able to be adjusted to changes in designs as they unfolded over time. For this reason I make the regulators in two oversized body styles and custom fit them to the particular gun they will be fit to. This insures the best fit possible. But it also means I have to do the installation. With a few exceptions the regulators, which I produce, are not for the “do it yourselfer”. This also allows me to keep a tighter control on the quality of the reg and the installation.

As time has gone by gun makers have changed their designs to include external regulators. Typically, the user can install these. The first reg of this type that I produced was the regulator for the RN-10 from Air Arms. My goal here was to make a direct, screw in replacement, for the unit supplied at that time by Air Arms. Other manufacturers have also followed suit and are also using this same type of design technique. From my stand point this make my job of producing regulators for the ever-increasing variety of gun a bit more difficult. Unless there are sufficient numbers of people wanting these regs, each has to be hand made from scratch.