the ABC's of REGULATORS

and their tricky valves

by Bill Exner
Illustrated by the Author

WHY REGULATORS?

In order for a pipe organ to sound right, the wind supply to its pipes must somehow be maintained at the correct pressure. This is accomplished by means of regulators, which reduce the relatively high "static" wind pressure supplied by the blower to the precise pressure required by the pipes.

A regulator is a sort of bellows, which is held closed when the blower is off by heavy springs and/or weights. When the blower is turned on, the regulator inflates to its normal working condition, at which point a valve (or system of valves) closes, shutting off the entry of any more air from the blower. The air pressure inside the regulator at this time is determined by the force provided by the springs and (or) weights. As air is drawn from the regulator, it collapses slightly. This causes the valve to open and allow the entry of just enough additional air to replace that which was used, thus maintaining the regulated pressure constant.

This article, as originally submitted, was about the several types of valves found on pipe organ regulators, their adjustment and improvement. But such a specialized technical treatise would probably be read only by organ owners suffering from valve problems, we reasoned. What's a "cone valve" to the average reader? Yet, the information was so well stated that we couldn't turn it down. Instead, we contacted the author and asked him to expand it to include a discussion of wind pressure regulators and their functions, to be followed by his words about the valves which actually do the regulating. The resulting article about these two inter-related areas of organ design are not only informative but they make interesting reading for all who are interested in the inner workings of a pipe organ. Editor (WSG)

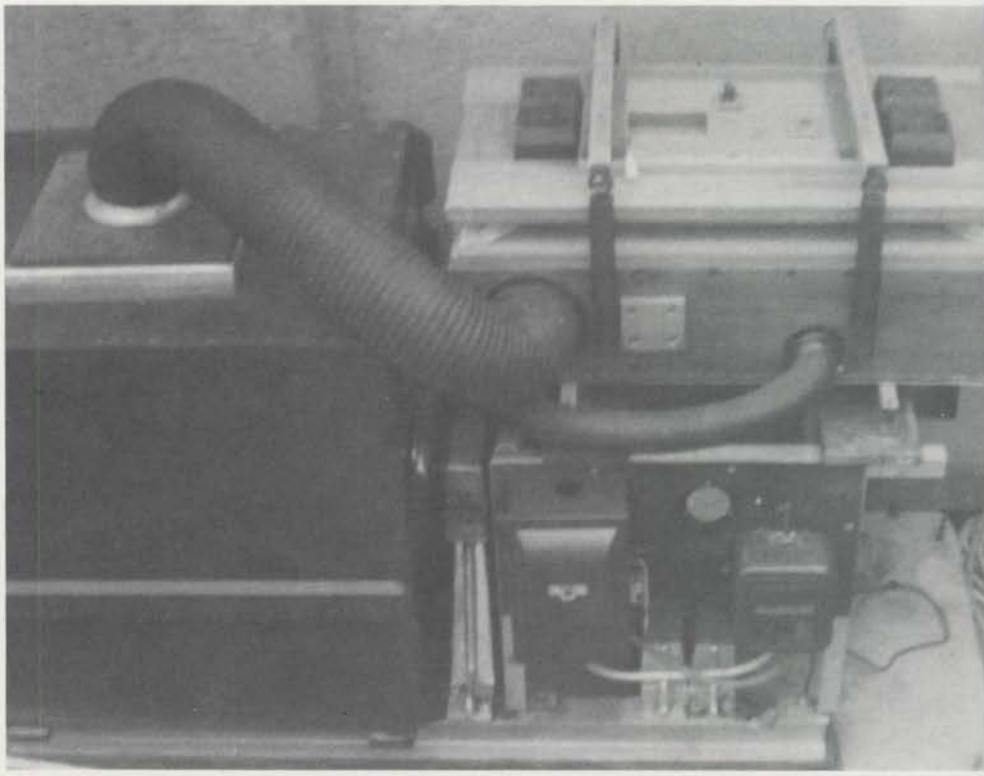


Fig. A. REGULATOR (Right), source of many problems. This small Morton regulator is being fed by a Kinetic blower (left). Valve opening and adjust nut are on top (center). The two weights and two vertical springs are factors in the regulation process. This regulator is shown deflated (blower off).

The valve (or valves) must be designed to control very precisely the small amount of air required by a single small pipe, and also to handle the blast required for a big chord on full organ.

Having gone to all this trouble to provide rock-steady wind, the theatre organ builder now messes everything up by adding a tremulant. The tremulant is a contraption which "shakes" the regulated wind pressure by intermittently releasing puffs of air from the regulator. Thus, in a theatre organ, the regulator must be husky enough to provide steady wind under all conditions of demand, yet not so unshakeable as to prevent the tremulant from doing its job. This requirement is met by the proper proportioning of springs-versus-weights, and by the design and adjustment of the valve system.

In the early days of theatre organs, the wise men at Wurlitzer found that the conflicting demands of steady wind versus good trem action could best be met through the use of a triple valve regulator. A cross-sectional view of a typical Wurlitzer regulator is shown in Figure 1. The photo (Fig. 2) shows the actual valve assembly from such a regulator. Referring to the sketch, wind from the blower enters the lower chamber, and passes by way of the three regulating valves to the upper chamber. As it does so, the build-up of pressure in the upper chamber forces the regulator top upward, against the downward force of the springs and weights (not shown in the sketch). When the top of the regulator reaches the position shown, the valves close (as shown), shutting off the flow of air to the upper chamber.

If a small amount of wind is drawn from the regulator, the top drops very slightly, causing the cone valve (A) to open just enough to make up the loss. If somewhat more wind is used, the top drops further until it reaches the push rod which controls the small flapper valve (B), which then opens and supplies more wind to the upper chamber. Similarly, if a really heavy demand is made on the wind supply, the regulator top drops further yet, engaging the large flapper valve (C) push rod and opening the large flapper until the demand is met. Not shown in either the sketch or the photo is a safety valve which protects the regulator in the event something should go wrong with the operation of the three valves.

The relative lengths of the push rods, which control the valve opening sequence, are adjustable. On Wurlitzer regulators, adjusting nuts are provided at the top of the threaded cone valve rod, and the effective lengths of the flapper valve rods are adjusted by adding or removing felt spacers at the ends of the rods. Small access panels are provided so this can be done without major disassembly of the regulator.

The adjustment of the push rods has a great deal to do with the kind of tremolo which will be produced. Like everything else about tremolos, it is far from an exact science, and depends

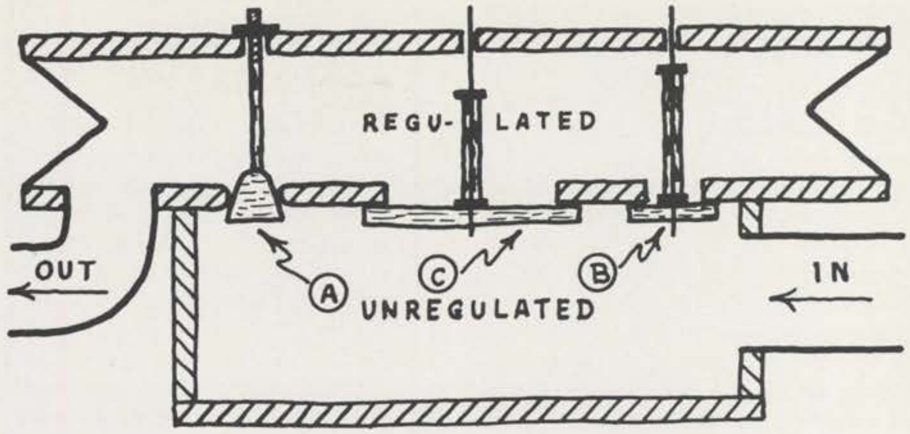


Fig. 1. WURLITZER THREE-VALVE REGULATOR. Note the small cone valve (A), small flapper valve (B) and large flapper valve (C). This cutaway view shows the regulator with all valves closed, its normal condition when the blower is running but no wind is being used.

mostly on some combination of "cut and try", experience, luck, and black magic. In general, it seems to be true that for a really sexy Tibia trem the small flapper valve (as well as the cone valve) should open on each trem cycle.

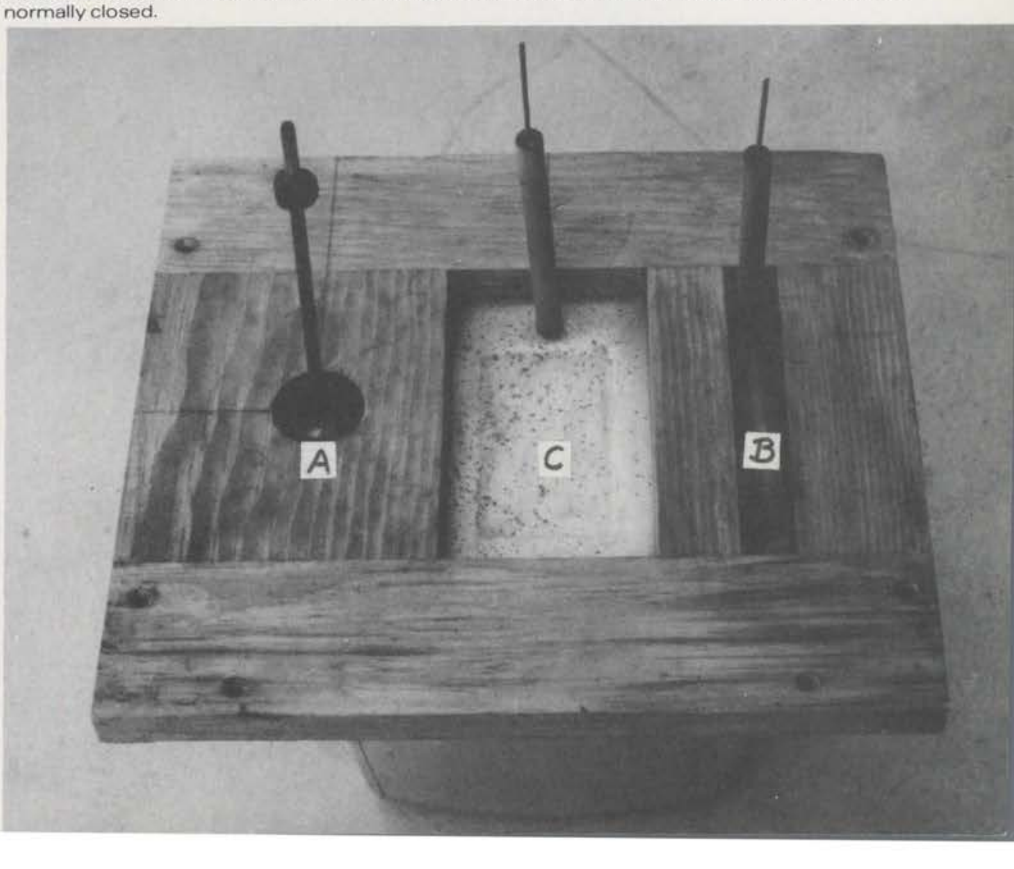
But is the triple valve the only answer for a well-regulated but trem'd wind supply? Is there any hope for an organ whose regulators have only one valve? Please continue.

THE THREE-IN-ONE VALVE

In one of the later Kimball theatre organ catalogs there is a picture of the valve assembly from inside a Kimball regulator, and it looks very much like the familiar Wurlitzer triple-valve system. The prose accompanying this picture emphasizes the superiority of three-valve regulators for theatre organs, making it abundantly clear that nobody but an idiot would try to trem a single valve regulator. On this point nobody should question Kimball's right to speak, because for many years previously they had done exactly that!

The regulators used in early Kimball theatre organs, in Weltes, and occasionally in various other makes, use a single, enormous cone valve – referred to most descriptively by organman Bill Coffman as the "churn dash valve" (Is there anybody else old enough to remember hand operated butter churns?). These regulators are

Fig. 2. TRIPLE-VALVE ASSEMBLY shown removed from a Wurlitzer regulator. Out of sight, on the under side of the assembly, are springs which hold the hinged flapper valves (B and C) normally closed.



OK for a church organ, but the problem is, if you pile enough weight on one of them to get a halfway theatrical tremolo, the regulator gets unstable and "selftrems" at random, uncontrolled.

One well known organ which is cursed with these single valve regulators is the Los Angeles Wiltern Theatre's Kimball, and being a king-size 4/37 organ it has king-size regulators. Another builder would probably have used smaller regulators and more of them, but that was not Kimball's way. The regulator which is the villain of this story is an outsize affair, 74" x 32" x 14" high, about four times the capacity of the largest standard Wurlitzer regulator. The rise of its top from collapsed position to normally open is a bit over four inches, and its "churn dash" valve is a full 10 inches in diameter. It supplies wind to the Open Diapason, Gemshorn, and Concert Flute, including their 8' offsets, as well as to five ranks of reeds.

This monster has always been a problem. Through the years maintenance crews have done battle with it, always reaching an unhappy compromise wherein the regulator was right on the ragged edge of self-tremming, but the resulting trem still wasn't deep enough.

About the Author

Bill Exner might be described as one of the "stalwarts" of the Los Angeles Chapter, having served as Chapter Chairman and in numerous other chapter-related official and unofficial capacities. His engineering background is valuable in helping solve such technical problems as the one described here. Over the years Bill has been active in helping maintain and improve the instruments which are the LA Chapter's showcases – The LA Wiltern Kimball, The Elks Bldg. Robert Morton and the San Gabriel Civic Auditorium Wurlitzer.

Several months ago I ran out of patience with this beast and determined to see whether there wasn't some way to civilize it. I started out by asking a half-dozen of the best old-time theatre organ experts in Southern California for advice. Their answers were all the same: "Sometimes these dogs work fairly well, but when they don't all you can do is either replace them with triple-valves, or give up trying to get a good trem." They also pointed out that these regulators work best on low differential pressure (the difference in inches between the static wind and the regulated wind). This helped explain some of the headaches at the Wiltern, because this regulator puts out 10 inches of regulated wind pressure from 18-inch static wind. So the differential is a whopping 8 inches!

At one point I was discussing my troubles with Bill Coffman and Bill Field, co-owners of the famous Old Town Music Hall and its 4/22 Wurlitzer in El Segundo, Calif. Bill Coffman generously loaned me a complete Wurlitzer triple-valve assembly (Fig. 2) to try, and Bill Field took the time to demonstrate the effect of various valve settings on the resulting trem.

Field (left) and Coffman had some answers. (Stufoto)

My next thought was to install this Wurlitzer assembly in the Kimball regulator and, if it worked, make a duplicate of it. However, the more I studied the problem the less attractive this solution appeared. While I was trying to figure out how best to proceed, I kept studying Bill Coffman's triple valve and asking myself the question, "If I were to design a single valve to duplicate the action of this triple valve, what would it look like?" Gradually an idea began to take shape.

In order to try out my idea, I had to find someone with a lathe big enough to handle the 10-inch disc. Fortunately, Dick Schroder has a Shop Smith which will convert to just such a lathe, and together we went to work.

The resulting valve cone is shown in the accompanying sketch, compared to the original Kimball "churn dash" cone (Fig. 3). Note the following differences:

1. The taper of the cone is much shallower, meaning that as the valve first starts to open it will open much more gradually.

2. The entire cone is much thicker, meaning that the regulator top must drop farther before the valve opens fully.

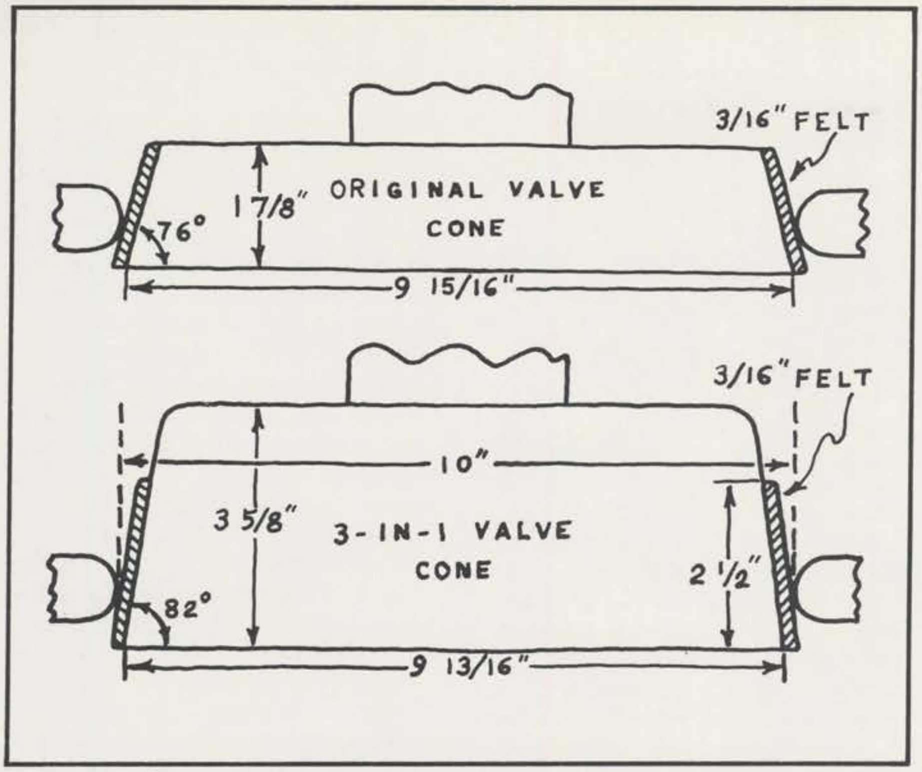
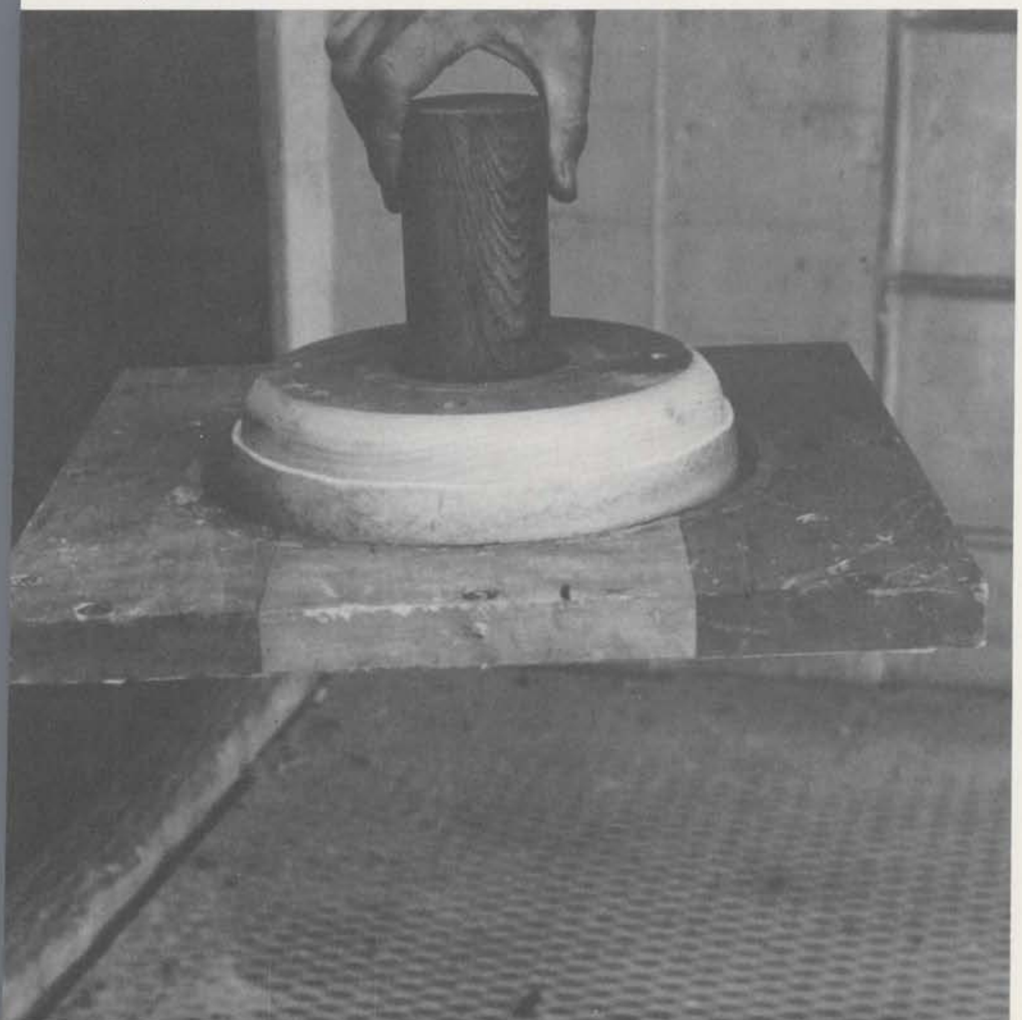


Fig. 4. THREE-IN-ONE VALVE CONE mated with the unmodified Kimball valve seat (shown removed from regulator). This improved valve cone is a direct replacement for the original one. No other modification to the regulator is required.

Fig. 3. THREE-IN-ONE VALVE CONE compared with the original Kimball "churn dash" cone. Significant differences are discussed in the text.



3. The cone is felted only part way up. This results in a fairly sharp increase in the rate of opening as the edge of the felt reaches the valve seat. The point where this occurs can quite easily be adjusted by cutting back, or adding to, the felt.

I never really expected this creation to work on the first try. All I hoped for was some sign of promise which would provide a clue as to what to try next, and I fully expected to have to experiment with the height of the felting, and quite possibly to have to change the taper. However, when Wiltern Crew Chief Leonard Worne and I installed the new valve it worked so perfectly that the only reason we pulled it out again was to measure and photograph it for the record (Fig. 4).

The following comparison of the new valve with that of the Wurlitzer triple valve will make it clear why we call this the "three-in-one" valve:

1. As the regulator top starts to drop, the three-in-one valve starts to open quite gradually, corresponding to the opening of the small cone valve of the triple valve system.

2. As the top drops further, the three-in-one valve reaches the upper edge of the felt and starts to open more rapidly, corresponding to the opening of the small flapper valve.

3. If the top should drop even further, the three-in-one valve opens fully quite suddenly, corresponding to the opening of the large flapper valve. I am certainly not naive enough to believe that this first try at a three-in-one valve is the final answer to what one should look like. However, I am impressed by the fact that it did solve this particularly difficult problem without any need for cut-and-try "optimizing".

For a smaller regulator with less "rise" this design would have to be scaled down, and, quite possibly, the taper made even shallower. If any of you feel inspired to try it, I'll be most interested in hearing about the results.

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