THE ACOUSTICAL CONSULTANT

MUSIC AND HEARING

by R.J. Weisenberger

In all of my previous articles I have discussed methods by which pipes could be built to maintain a relatively uniform sound pressure level throughout each register of a rank, while maintaining a stable tonal quality. I have also discussed methods by which dissimilar scales of pipes can achieve similar sound pressure levels, so that the larger scales will not dominate an ensemble. All of this makes good technical sense, but does it make good musical sense? The answer is an emphatic Yes!

A pipe organ that is voiced weak in the upper octaves will have a mushy sound lacking in detail; this problem is further multiplied when such an organ is installed in chambers with the swell shades located much above the windchest level. Even a well-designed chamber will favor propagation of the lower frequencies over that of the higher frequencies and their harmonics.

This property of the chamber and swell shades in itself is not undesirable, as the ear is generally more sensitive to the middle and upper frequencies than to low frequencies, especially at lower volume levels. It becomes a problem only when the ear itself would tend to hear the lower frequencies as being louder than the middle and upper frequencies. All too often I have found this to be the case, especially in smaller installations.

As early as 1933, acousticians Fletcher and Munsen published a report on their studies, made on a multitude of subjects, concerning the sensitivity of hearing over a wide range of frequencies and sound pressure levels. The result of their findings, verified time and time again, show that at low sound pressure levels (40-70 dB) much more energy is required at the lowest bass frequencies to sound equally loud. For a 30 Hz tone to sound as loud as a 40 dB tone at 1000 Hz, the 30 Hz tone would have to be increased to 80 dB! Closed swell shades will naturally tend to pass far more low frequencies than high frequencies, so this condition will be fulfilled.

In baroque organs with exposed pipework, it was often necessary to voice the upper octaves more softly to obtain good balance with the lower octaves, particularly in the softer ranks. If this approach is carried into voicing the more powerful ranks, the organ will become bass heavy, as we shall soon see.

For a 30 Hz tone to sound as loud as a 70 dB tone at 1000 Hz, still by no means a loud sound, the 30 Hz tone would only have to be increased to 86 dB, already a much more modest increase. A bass boost as great as this can be achieved by mounting the largest pipes near a corner of the chamber, and this is assuming that in a free field situation there would be equal acoustical power output from both the 16' pipe and the 6'' pipe. For a 30 Hz tone to sound as loud as an 80 dB tone at 1000 Hz, a moderate sound level, the 30 Hz tone would require only a 10 dB increase to 90 dB.

Between levels of 90 to 110 dB the ear hears all frequencies between 30 and 2000 Hz of the same intensity as being equally loud and well balanced, and very little if any compensation is needed. By building the majority of the organ, or the most powerful ranks at 16' and 8' pitch, this condition would be fulfilled.

Peak levels as high as 110 dB from a large symphony orchestra can be found at a distance of about 30 feet, and likewise from a large theatre pipe organ of present design. There were a few organs built that can achieve such sound levels at even greater distances, although most organs can only throw such levels about 10 feet.

At levels in excess of 110 dB, the ear no longer hears such a range of frequencies as balanced, and there is also a tendency to perceive pitches near middle C as being falsely flattened. Also, at these levels hearing damage can occur with relatively brief exposure. Such levels *do* exist in most theatre pipe organ chambers, and those assigned to tuning the organ should not expect to hear the same tonal balance as heard in the auditorium, but a much brighter, more piercing sound, with upper levels approaching the threshold of pain. If it sounds nice and sweet in the chamber at full organ, it will invariably sound dull and muffled in the auditorium, especially if the auditorium is of any appreciable size.

Of course, any pipe design can be made to vary considerably in both tonal character and volume by simply re-regulating the operating pressure (or the toe holes) from the optimum efficiency point; too little pressure for a given design will give a softer, mellower sound, while too much pressure will overblow the pipe into the next octave.

All references I have made to operating pressures and acoustical outputs in previous articles refer to the upper *stable* operating limit of each design. This does not mean that the voicer has no other option than to voice such designs only at these pressures, but if he so chooses they will perform as indicated.

There will be a giant leap in the organ building profession when more people understand the physics of why a given level of performance can or cannot be achieved in a given pipe design.

So much for tonal balance within a rank. Why would it be desirable to balance ranks in volume with each other? Even in an organ that is well balanced tonally, there may be a gross imbalance among the various ranks themselves. In a large organ we can expect some ranks to be far more powerful than others for sheer contrast, but in an organ with fewer ranks, large dynamic gaps are undesirable.

There are cases where a Tibia or Diapason can dominate an ensemble, leaving the more delicate flutes and strings barely audible by contrast. This does not have to be the case. Within the pressure ranges used in most theatre organs, flutes and strings can be designed which will hold their own with any Tibia or Diapason of the same pressure rating.

Who said that the foundational stops must necessarily dominate all other flue ranks? This idea probably

came about because it has long been accepted that larger-scaled pipes are more powerful than pipes of smaller scale, because of the failure of too many organ builders to experiment enough with mouth cut-ups. However, no one has ever seemed to question why a small-scaled Posthorn can achieve similar levels to a large-scaled Tuba of the same pressure rating.

It would be nice to have flue ranks which would help bridge the gap between flues and reeds, both in tonal character and in volume. In many organs the closest match to a reed sound among the flues would be found among the strings. However, the sound of most string ranks would be barely audible, if at all, if incorporated in a reed ensemble. In other words, most string ranks become useless during loud passages.

Because it *is* possible to build loud strings of moderate scale, this dynamic imbalance no longer has to be taken as inevitable, and organists could learn to use such combinations to create new sounds. Also, having various ranks at a similar volume would tend to produce a sound in which the nuances of each rank could still be heard along with the overall sound. For dynamic contrast, and for playing in the old traditional styles, lower-pressure echo ranks of the same general tonal characteristics as the main ranks could then be added.

Tradition should never be used as a crutch or as a limiting element which would block all modern technology from entering pipe organ design. The new digital technology incorporated into many switching systems for pipe organs has already proven otherwise. Rather, tradition *should* be used as a base from which we can build.

Errata:

The formulas on page 43 of the June/July '81 issue were set incorrectly. They should appear as shown here:

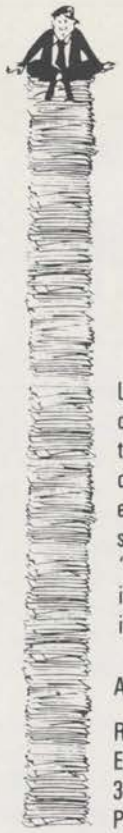
$$(A = \pi r^2)$$

$$r = \sqrt{\frac{A}{\pi}}$$

$$= \sqrt{\frac{.25}{\pi}}$$

$$= \sqrt{\frac{.25}{3.1416}}$$

$$= .282 \quad \square$$



the letters to the editors

Letters to the Editor concerning all aspects of the theatre organ hobby are encouraged. Send them to the editor concerned. Unless it's stated clearly on the letter "not for publication," the editors feel free to reproduce it, in whole or part.

Address:

Robert M. Gilbert
Editor
3448 Cowper Court
Palo Alto, Calif. 94306

Dear Sir:

With reference to the information on cinema organs in Austria in the June/July 1981 issue of THEATRE ORGAN, I would like to tell you that there are no more cinema organs in Vienna. The Scala Theatre was destroyed about 1957; the fate of the Kilgen is unknown. The Christie of the Apollo Theatre has not been playable since 1961, if it exists at all. The Welte of the Austrian film corporation, Wienfilm, was playable (at least partly) until the end of 1976. It is said that the Christie and the Welte have been destroyed. I don't know of other cinema organs in Austria.

Please let me explain the cinema organ scene of the other European German-speaking regions: In West Germany, only two cinemas are organ equipped, the Walhalla Theatre of Wiesbaden and the Metropol Theatre of Bonn, both with Welte organs in unplayable condition. The Walhalla organ is a 2/5 or 2/6. The owner of the theatre is Mr. Marc N. Levin, of St. Louis. The Oskalyd organ of the former Capitol Theatre of Heidelberg was played until 1956 by Hellmuth Kraus (now church organist in Mannheim); it was installed last year by the builder firm Walcker in the Königssaal (King's Hall) of the Heidelberg Castle. When guided through the rooms of the castle one cannot see the organ. The console (two manuals) is moved into an adjoining room and disconnected from the main cable when the organ is not played. Two pipe chambers (19 ranks, not unified) are behind four Gothic windows on a podium in the middle of one longitudinal side of the Königssaal. All shutters are closed when the organ is not used. I don't know of the plans for this organ. The future Film Museum of Frankfurt/Main has bought a Fotoplayer which will be set up. I have heard that Düsseldorf will have a film museum with a cinema organ.

It seems that only one cinema of Switzerland has a cinema organ, the Forum Cinema of Zürich. This instrument was built in 1929 by Zimmermann & Schäfer of Basel. It is now unplayable. The famous Wurlitzer organ from London's Clapham Junction Granada Theatre is in Switzerland and, I think, will be installed in Geneve.

Yours sincerely,
Wolfgang Schaa

Dear Editor:

I was very happy to see the photo and article about E. M. Cimmino, otherwise Ethel Marie Cimmino. For many years a great favorite of mine has been her song, "All Because of Spring." Many of my pupils play it. Mrs. Cimmino is doubly blessed with such great talent and a fine son like Frank.

What do the members hear about Louella Wickham, "The Sweetheart of the ATOS?" Could you give us her address again so we could remember her and her wonderful music?

Sincerely,
Esther Higgins

Dear Members of the ATOS:

Thank you for the gift from the Koenig Cancer Research Foundation to the Medical School at Northwestern University. Mr. Harry Koenig informs us that this gift was made possible by members of the American Theatre Organ Society who made donations in exchange for his organ record.

On behalf of the Northwestern community, I extend my sincere expression of gratitude for your support.

Cordially,
Robert H. Strotz
President □