# OUR DEVELOPMENTS TOWARDS A NEW SYMPHONIC ORGAN

**by Jan L. van den Heuvel**

**SCALES**

The scales of the pipework should be related in such way that all harmonics of each stop fuse into the fundamental. The first nine harmonics of an eight foot stop are 8', 4', 2 2/3', 2', 1 3/5', 1 1/3', 1 1/7', 1', 8/9'. At 16' and 32' pitches the harmonics are respectively one and two octaves lower. Every tone has sixteen audibly discernable harmonics which vary accourding to the generating sound source - the upper harmonics of a Gambe are more prominent than those of a broad flute. In a large symphonic organ the harmonics are usually re-inforced in the specification. This is specially true for flue stops. Accourding to their manual placement, the foundation stops are quite strongly voiced with the fundamental pitch especially important in the upper range. Should the organist wish to add some harmonic support, a string stop (Gambe, Violoncelle or Salicional) should be added. These stops should be heavily endowed with upper harmonics. With a string stop, it is possible to colour all other stops of the same pitch separately or together with extra harmonics. It is only after the addition of one of these stops that other flue stops can be added to the registration.
In the St. Eustache organ in Paris we have built the harmonics as independent flutes on the Positif and Solo divisions from 8', on the Grand-Choeur from 16', and on the Pedal from 32'.

**The harmonic flutes** (Flûte Harmonique, Flûte Traversière, Flûte Octaviante and Octavin) have their own characteristics. By a correctly cut and positioned hole, the fundamental tone is inaudible. Thus a 16' pipe length gives an 8' fundamental tone but the harmonic structure of a 16' pipe.

This is quite noticeable at the beginning of the tone speech. It is preferable to incorporate larger scaling for these pipes as it considerably heightens this characteristic. To ensure blend, it is necessary to construct the 4' proportionately smaller than the 8' and the 2' similarly smaller than the 4'. The harmonic flutes give a lot of sound-fullness. On the Grand-Orgue division of St. Eustache we built a very wide scaled Grosse Flûte 8', with wide mouths, low cut-ups and pipe bodies on normal length. From $c^2$ this stop becomes two ranks; the second rank is a very wide scaled Flûte Harmonique 8'. The sound of the smaller, wide scaled pipes and the speaking of the harmonique is filled up by the sound of the normallength pipes. On the Solo division of St. Eustache we situated harmonique flutes 8', 4', 2 2/3', 2', 1 3/5', 1'. Using these stops in several combinations will give a very fascinationg result and can be even more effective if coupled to the other divisions.

**The compound stops** should be clear and united in sound. The mixtures give extra harmonics on each manual. The Cornet is only succesful if the five ranks sound as one tone. The pipes of the principals, mixtures and strings are slotted to encourage upper harmonics. Open flutes, harmonic flutes, mutations, Cornet and Carillon are cut to length - without slots or slides - to encourage the fundamental. The stopped flutes have quite large chimneys, starting at the 2' pipe. If there is more than one mixture, there should be a considerable difference in pitch levels and in scaling. The mixtures on the Grand-Orgue division at St. Eustache have a range on C from 2 2/3' up to 1/2' and on $f^2$ from 21 1/3' up to 1 1/3'. The C-notes diameter of the 2' pipe bodies respectively are 47mm and 44mm. The Plein-Jeu on the Grand-Choeur is from 2' pitch and ranges at $c\#^3$ from 16' up to 1 1/3'. The diameter of the C-note pipe body of the 2' here is 62mm. The two mixtures of the Positif division have on C a range from 2' up to 1/4' and on $c^3$ from 8' up to 1 1/3'. The diameter of the Fourniture C note pipe body is 45mm (2'). At St. Eustache, on the Positif and Grand Orgue divisions, the principals and mixtures have tuning rolls from top of the body; on the other divisions the have slots. In the Victorial Hall organ at Geneva and the Duke's Hall organ in London all principals and mixtures are slotted; these organs are more traditional in the style of Cavaillé-Coll.

**The reeds** are another story altogether. French reeds are extremely rich in upper harmonics. In the Récit the tonges of the trumpets are wide in contrast with the depth of the shallots which contributes to the expressive nature of this section. At St. Eustache the Contre-Trombone 32' has full length resonators of wood, the Contre-Bombarde 32' also has full length resonators, but these are made from metal. The Contre-Trombone has small scaling. The advantage of two 32' reeds is that the 32' sound becomes more powerful and more round. For the Trompette en chamade 8' we developed a special construction to approach the sound of the musical instrument, the trumpet. After many experiments we decided to make this stop I-III ranks. The first choir we made from C with normal length resonators; the second choir, from $f^1$, we made with double length resonators; and the third choir, from $a\#^1$, we made with 2x double length resonators. Besides this, we built a Trompeteria en chamade II ranks with the following composition: C = 8' and 4'; $c^1$ = 16' and 4'; $c^2$ = 32' and 16'.

All chamades are playing on an increasing windpressure which ranges from 105mm up to 167mm; this also gives an extraordinary result.

Our preference is for metal with a **high tin content** for principals. strings and most of the reeds. A 40% tin content is sufficient for stopped flutes. Larger pipes of the flutes are made from mahogany.

All pipe work in a symphonic organ should be **strongly voiced**. This is true in Cavaillé-Coll organs. Many feel that a symphonic organ should exude a sweet sound, supplying gentle sound to the ears. This stems from confusing a symphonic organ with the romantic, weak sounds typical of instruments built at the end of the 19th and beginning of this century. We voice the flue

stops with a minimum of nicking and regulated straight cut up. In general scales become wider towards the treble. The result is that all organ music, including Bach and other baroque composers, can be played on this type of organ, in contrast to many late romantic organs.

**WINDSUPPLY**

Our wind chest are made in the traditional manner, of oak and mahogany, designed to withstand extremes of humidity. The sliders are self-sprung and are fashioned from two layers whereby the holes are joined with leather collars. Spiral tension-springs are placed between the two layers. This system insures that the air passages between the grid and the toeboards remains closed: the result is a virtual absence of untuned pipe work because of leaks. It is an extremely metriculous procedure, but in our opinion the most responsible one. In large instruments we prefer to stand the pipes for each keyboard on more than one chest - to prevent larger ranks from robbing wind from the treble and reeds.

Additionally, it is possible to include **different wind pressures** per wind chest. larger pipes need less wind pressure than correspondingly smaller pipes from the same stop. In listening to an orchestra one notices that upper tones convey more expression than lower tones - while this is exactly the opposite for an organ with equal wind pressure.

When playing a trumpet, less wind is necessary for playing the lower tones than for higher ones. This indicates why, on larger organs, we prefer to employ a system of increasing pressure. A pressure of about 105mm for basses for instance, might be increased to 110mm in the middle range, and again to 120mm in the treble. This is especially beneficial to the reeds and harmonic flutes. I would also recommend a similar division of wind pressures for organs in concert halls. It is my opinion that most of these organs possess too little power of sound to **adequately perform with**, and **in relation to**, a modern symphony orchestra.

Our prederence extends to **traditional folding bellows**; we find that these bellows insure a responsive wind supply as long as a they have sufficient surface space. An organ should sound as a wind instrument, and naturally the wind system should exert stimulation upon the sound. Therefor we do not use wind regulators into the soundboards. In a large instrument the reservoirs may be fed by several independent blowers. Each reservoir is mounted as close as possible to the department it serves and trucking is made of mahogany.

## ACTION

Our **key action** is of traditional type, using squares and levers of hardwood, trackers of cedar, and iron rollers with brass arms. Tinned brass centres turn in red cloth bushings. All wires are of phosphor-bronze. We do not use aluminium as its life expectancy is suspect. We aim for 100 years working life without large repair bills. The key action is not self-regulating, constant depth of touch being maintained by using a rigid steel builing frame.

Where necessary in large organs the key action includes Barker-lever machines. Our extensive studies in this fiels lead us to believe that the last type used by Cavaillé-Coll (as at St. Ouen, Rouen) is the best.
Couplers remain mechanical and are situated behind the Barker-levers. I have conducted test which show it to be possible to adjust the speed of the machines so there is no difference between the attack of a mechanical tracker. The key-touch remains responsive and "mechanical" in feel, even when the full organ is used, allowing the performer to concentrate on the music. Large mechanical action organs of the symphonic type cannot be built without Barker-lever machines. The many large pipes use a great deal of wind, requiring equally large pallets. Higher wind-pressures make them more difficult to open.

With multiple soundboards and many couplers, each key may have to open several pallets: at St. Eustache, the C, with all couplers on, has to open even 23 pallets. Besides this number of pallets we have to count the number of pallets in the off-set chests!

In common with others, we have experimented with 'double' pallets but the results have not been satisfactory. Those who attempt to build large mechanical symphonic organs without Barkers, are guaranteed from the outset to encouter larger problems without an adequate solution. Noise can be a nuisance, even after correct adjustment of the Barker. This is caused not only to the machine itself, but result especially from the enormous force with which the connected mechanism works - particulary the coupler and wiring. If space is available, I see no reason not to place a sound absorbing chamber around the Barker machines and couplers. This chamber should only have a cog for the input and output of the tracker action to the keyboards and wind chests. If well constructed, for example with triple walls and two layers of insulating air with the rest tightly sealed, such an insulation chamber can be extremely effective (see for example at St. Eustache, Paris and Victoria Hall, Geneva).

Besides the 'normal' mechanical couplers we developed together with the American firm ICMI a coupler Soprano Solo/Grand Orgue and a coupler Alto Grand-Choeur/Grand-Orgue for the St. Eustache organ. For a symphonic organ these couplers are very important; in the plenum it enables the organist to couple the top-note (melody) from the Grand-Orgue to the horizontal reeds or to the harmonic flutes of the Solo. Like wise, the Alto coupler will send the second highest note being played on the Grand-Orgue

to the Grand-Choeur division where another contrasting Alto line can be formidably exhibited from the vast colours of this division (for example on the Tubas or Clarinette).

We have also built Sostenutos on the Positif, Récit and Solo divisions of the organ at St. Eustache. With sostenutos it is possible for the organist to sustain chords (until he reverse it) and play in the meanwhile with his hands on other manuals.

Besides this ICMI developed for us a special digital recording system which records all electrical contacts (notes, stops, swell, crescendo,etc.) of the second moveble console of the St. Eustache organ. Enabling the organists and their uniquely special improvisations and organ works to be captured for future generations. Imagine gathering a present day audience in the church, to re-live the actual artist playing his music precisly as he did even a century ago. Imagine what benefits this would have provided to hear Bach at Lüneburg, Leipzig, or hear Franck, Widor, Vierne on the magnificent Cavaillé-Coll organs. What a sheer treasure this would have provided the schools of music for organ playing with recordplayback capabilities for such recently prominent artists.

Also it enables the organist to play a second part while replaying the first recorded part. Recently ICMI developed on our request a digital recording system whereby it is possible to add other parts to former recordings; the organ can now play as an orchestra. For an instrument like St. Eustache it is possible to make compositions up to ten staves for the manuals and several staves on the pedal.

Our choice is to make mechanical **stop action** with iron tubes, onto which the arms are welded, balancers of iron, and traces of oak. In larger instruments aids to registrations are provided in the form of ventil and coupler pedals above the toe-sweep of the pedal board, as in Cavaillé-Coll organs.

For St. Eustache we have constructed an electric stop action with on each console 20 general and 3 divisional combinations, together with 32 memories, allows the organist to prepare his registrations; sequential pistions make the using of the 658 combinations per comsole easier.
The depth and speed regulation of the three trémulos (Positif, Récit and Solo) automaticly change when switching from flue to reed stops.

The organs of Katwijk aan Zee and London have traditional action, like Cavaillé-Coll organs; with ventils for the various soundboards, operating by pedals at the console. This allows the organist to determine registrations in advance, and switch groups of stops on and off as required. Coupler and tremulant pedals may be duplicated by drawstop. Drawstops are arranged in terraces, giving good overall visibility.

**Swell boxes** are of special construction. The mahogany walls and roof consist of three layers with air spaces between. The shutters, made of Abachi wood, 60mm thick, have joint which meet at three points. The effect is quite spectacular.

All our **organ cases** are crafted from a hard wood type, preferably oak or sipo mahogany, open only at the front, carvings in oak, mahogany or lime.

We do not use soft wood types such as pine as they are too sensitive to fluctuations in temperature and humidity; they are also more prone to wood worm.

## CONCLUSION

It is not our intension to recreate copies of Cavaillé-Coll organs. We regard ours as a new style developed in the tradition of the symphonic organ whereby it is possible to perform all organ music styles (from baroque up to and including 20th-century music) in a musical way without restrictions.

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