

Section IV: Background

Brief tour of a pipe organ

If you are unfamiliar with pipe organs and their terminology this section should give you a background sufficient to find your way around Hauptwerk.



A pipe organ has one or more keyboards, termed *manuals*, and usually a *pedalboard*, which is effectively another keyboard played by the feet. The *console* is the part of the organ with which the organist interacts, containing the keyboards and controls used to play the organ.

Different tones are produced by engaging sets of pipes, each with a particular tonal quality. Such a set of pipes is termed a *rank*, and usually has one pipe for each key on the keyboard or pedalboard. The rank is engaged and disengaged with a switch on the console called a *stop*. The stop switches on the console are usually physically either *draw-knobs* (push-off, pull-on) or *tabs*.

Each rank is usually attached to only one manual or the pedals. A manual (or the pedals) together with the set of stops (and hence ranks and pipes) that are attached to it is termed a *division*. Each division has a name and a particular overall tonal character. Of course, organs from different countries have different names for the divisions and traditions have led to differences in their tonal structure.

On an English pipe organ, there are usually between two and four manuals and a pedalboard:

The *Pedal* division is used to play the bass parts and has the deepest sounds.

The *Great* (bottom manual or second manual from the bottom) division has the main and loudest organ sounds (the *diapason chorus* or *principal chorus*).

The *Swell* (second or third manual from the bottom) division has more orchestral and imitative sounds, such as oboes, clarinets and varieties of string-like sounds. Its tone is usually controlled by a *swell pedal*, which operates shutters on a box that encloses its pipes, allowing the sound volume and brightness to be increased or decreased.

The fourth division usually found is the *Choir*, with its manual positioned below the Great manual. It contains softer, plainer stops for accompanying singers.

If there is a fifth division, it is usually the *Solo*, positioned as the top manual and containing louder, prominent, solo stops.

The Choir and Solo divisions are sometimes enclosed in separate swell boxes operated by independent swell pedals.

The stops are designed to complement each other both in terms of timbre, volume, and the pitch at which they sound. The pitch of many stops is used to reinforce the harmonic content of other stops, when used in combination with them. The numbers on stops indicate their pitch in feet. The number indicates the length of the lowest C pipe in the stop, hence the lowest C pipe on an *Open Diapason 8* stop is 8 feet in length. 8' stops are the 'normal' (*fundamental*) pitch of the manuals. A 4' stop will sound exactly one octave higher than an 8' stop, hence engaging a 4' stop reinforces the second (octave) harmonic of the 8' tone. A 2' stop will reinforce the fourth harmonic, two octaves above the pitch of the 8' stop. The lowest stops usually found are 32', in the pedal divisions of very large pipe organs. Sounds below a 32' C are not audible to the human ear. The highest stops are commonly found are $1\frac{1}{3}'$, again bordering on the human hearing range at the top of the manual.

Some stops have fractional lengths, such as the *Quint $2\frac{2}{3}'$* . These are termed *mutations* and enforce harmonics that are not octaves of the 8' fundamental tone. For example, playing a C note on a $2\frac{2}{3}'$ stop will sound a note approximately equal in pitch to playing a G note an octave and a half above the C on an 8' stop, reinforcing the third harmonic. A $1\frac{3}{5}'$ stop will play two octaves and a major third above an 8' stop. These stops would not normally be played without their non-fractional counterparts, since they would effectively transpose the music played.

Most organs have one or more *mixture* stops. These have more than one pipe per key (and thus several ranks), and the number of pipes per key is indicated in the stop name; a *Mixture IV* has four pipes per key, for example. The intervals that separate the pipes comprising the mixture (the *mixture composition*) vary, and they often vary across the compass of the manual. Most frequently, they contain a 2' stop and various mutations (of the fundamental 8' tone) built around it. They are used to add a shrill sheen to the sound, and again are almost never used as solo stops.

The name of a stop (rank) also indicates its tonal qualities. There are four main tonal groups:

Diapasons or *Principals* are of pure 'organ tone' and are rich in harmonics, with a full-bodied sound. These form the main *diapason chorus* on the Great, the backbone of the organ. Secondary, softer diapason choruses are often found on other manuals. They appear under various names - *Diapason*, *Principal*, *Octave*, *Fifteenth*, *Prestant*, *Montre*, and are usually also used for the mutations and mixtures.

Flutes have less harmonic development, and are of a softer, purer sound. Some examples are the *Gedackt*, *Clear Flute*, *Harmonic Flute*, *Rohrflute*, *Hohl Flute* and *Bourdon*.

Reeds produce sound in a different way to other pipes, in that a metal *reed* vibrates mechanically against a *resonator* tube. They are very rich in harmonic content and may be very loud and brilliant. Common examples are the *Trumpet*, *Clarion*, *Trombone*, *Clarinet*, *Oboe*, *Crumhorn* and *Contra Fagotto*. They may be used as solo stops or to add vibrance and presence to a chorus of other stops.

Strings are (usually) strictly a subclass of the diapasons, but with a much narrower scale of pipe. They are harmonically rich and designed for their string-like qualities. Common examples are the *Viola*, *Gamba*, *Salicional*, *Viola di Gamba*, *Salicet*, *Geigen Principal* and *Violin Principal*. They are usually warm and soft in tone.

Some pipes are classified as *imitative*, in that they are designed to sound as close as possible to their orchestral namesakes. The *Clarinet* is one such stop.

Modern keyboards and synthesizers are almost always tuned to *equal temperament*, meaning that the musical interval between any two consecutive notes (a semitone) is constant across the whole keyboard. Although this is not musically 'perfect' (if you play a C and an E together, for example, you can hear a phasing because the harmonics are not perfectly tuned), it means that music can be transposed and progress through different keys and the tuning will sound exactly the same. It is a compromise. Alternative *temperaments* (tunings) are quite often found in organs, where the different effect of each key may be used to advantage, particularly with historical music.

A very few organ stops are deliberately tuned sharp or flat, relative to the other stops on the organ. The *Celeste* is the most common example, which is designed to produce a chorus effect when played with specific other stops, such as a *Viola di Gamba*.

The Encyclopedia of Organ Stops website (see the links page on the Hauptwerk website) is a useful reference for stop classification.

Couplers are mechanical, pneumatic or electrical devices that link manuals or divisions together. Their controls usually have the same appearance as stops, in that they are usually controlled by draw-knobs or tabs. If the *Swell To Great* coupler is engaged, then playing a note on the Great manual will play the same note on the Swell manual, enabling their sounds to be combined and borrowed from other divisions. Note the order in which the manuals are listed in the name: the division appearing first in the name plays automatically when the second is played by the organist.

Couplers may link keyboard keys physically, so that pressing a key on one manual actually causes the corresponding key on the coupled keyboard to move. However, more usually, a coupler affects only the *key action*, being the way in which the keyboard is connected to the pipes, and so no additional keys are seen to move when the coupler is engaged.

Couplers may couple at *non-unison* pitch. For example, the *Swell To Great Octave* coupler will play a note on the Swell that is one octave higher than any note pressed on the Great. Non-unison couplers may also act upon the same division as the key pressed. For example, the *Swell Octave* coupler will play a note one octave higher on the Swell for each note on the Swell that is played by the organist. In this case, the couplers are used to increase the strength of the second and upper harmonics.

The *Unison Off* coupler prevents keys played directly from sounding at all, but allows coupled keys to sound. For example if you play a middle C on the Swell with the Swell Octave and Swell Unison Off couplers engaged, the middle C will not sound, but the C above it will.

Stops do not always have pipes for all notes on the keyboard for their division, although most do. If a stop only has pipes from the second C from the bottom of a 61-note keyboard (for reasons of economy when the organ was built), it is usually shown with a *TC* or *Tenor C* legend in the specification. Occasionally, the pipes for a division extend beyond the range accessible by the keys, so that non-unison couplers continue smoothly into the top or bottom octaves.

Sometimes stops or even parts of stops are *borrowed* from ranks from other divisions. A pedal *Trumpet 8 (Gt)* stop indicates that the pipes from the Great Trumpet 8 rank actually sound when the stop is engaged, even though the stop belongs to another division. This is a fairly common economy on the part of organ builders, and is usually indicated by the 'real' division appearing in brackets.

Organs which have a small number of pipe ranks, from which many stops are *derived* (borrowed) are termed *unified* or *unit* organs, the method being *unification*. In particular, *theatre/cinema organs* are constructed on this principle, with a small number of ranks from which a great number of stops are derived at many pitches, and it is a key aspect of their sound.

Couplers occasionally act upon only some stops in a division. For example the *Swell Reeds To Great* coupler only links the reed stops from the Swell to the Great.

Bass couplers are special in that they only couple the lowest note played. They are fairly common on smaller instruments, where the organist may not be competent in the use of the pedals, and allow the Pedal division to be played 'automatically' by the lowest note played on a manual. For Hauptwerk users without a MIDI pedalboard they are an especially useful inclusion. *Melody/Melodic couplers* are similar, but couple only the highest note played, thus emphasizing a solo melodic line.

A *ventil* is another (fairly uncommon) playing aid, which simply 'turns off' a set of ranks, usually by shutting a valve which prevents any air reaching their pipes.

A *tremulant* is a mechanical contrivance by which the air pressure supplied to the pipes is varied periodically, giving a 'tremble' to the sound. Its effect is to vary the pitch, amplitude and harmonic content of the sound of each pipe in complex ways, and with complex modulating waveforms. It is usually accomplished with a pneumatic motor venting air from the pipes' supply. It is another key aspect of the sound of a theatre/cinema organ. Tremulants are usually turned on and off by draw-knobs or tabs on the console.

Buttons on an organ are usually termed *pistons* due to the way in which they worked historically.

A *combination action* is a mechanism by which combinations of stops, couplers, tremulants and other controls can be memorized and recalled with a single piston button. These pistons are usually located below the manual and above the pedals and memorize controls for the corresponding division (*divisional combinations*), and sometimes also store combinations for all of the settings on the organ, regardless of division (*general combinations*).

A combination action may be *fixed* or *programmable/adjustable*. In Hauptwerk, all combinations can be programmed, and any current setting can usually be captured to any combination piston appropriate to the division. As do some pipe organs, Hauptwerk also has a *registration sequencer* comprising a series of programmable *combination frames*, which are general combinations that form a sequence, allowing all of the stop movements for a recital to be recorded and cycled through by pressing a single piston.

Note that some combination actions cause the associated draw-knobs or tabs to move physically when they are triggered, whereas others invisibly add to or replace the registration shown on the console, and have a 'state' (on or off), and may be grouped so that only one can be selected at any one time. The former system is more common in English organs, the latter in European organs.

The *FF, Tutti*, or *Full Organ* switch (piston, draw-knob or tab) is an example of stateful combination, which turns on the main chorus stops and couplers to give a loud, full and majestic sound conveniently, without moving the stop and coupler switches physically, and usually adding to their registration.

Some organs have *combination couplers* that couple divisional combination buttons. For example, if the *Great Pistons To Pedal* coupler is engaged, pressing a Pedal combination piston also activates the corresponding Great piston.

Sometimes *reversible pistons* are available to provide convenient short-cuts for often-used couplers (or other controls). Each time they are pressed, they toggle the state of their associated coupler. The *Swell To Great* coupler often has such a reversible piston.

A *crescendo* is another playing aid, sometimes found on larger instruments. It is operated by an expression pedal (like a swell pedal), and engages and disengages combinations of stops as it is moved. It is usually programmable, and configured so that progressively louder stops are engaged as it is moved forward, and disengaged as it is moved backwards, thus giving a convenient crescendo or diminuendo while keeping the hands free.

Theatre organs often have *second touch* on their manuals, whereby pressing a key down further than normal causes additional (usually solo) stops to sound. The stops triggered in this way can usually be selected from separate stop switches on the console.

Some organs (especially theatre organs) also have *percussion stops*, such as *carillons* (bells), acoustic pianos, glockenspiels and so forth, struck by hammers when the corresponding keys are pressed. Sometimes non-tuned percussion stops are triggered from knee levers, or whenever any key is pressed regardless of its pitch, or by other devices. Sometimes also such percussion are *reiterated*; struck repeatedly while a key or piston is held down. A theatre organ drum roll is an example.

Theatre organs also have *effects traps*, which are usually pneumatic contraptions producing special effects sounds, such as sirens, surf and bird song, turned on and off from switches on the console, and originally used for the accompaniment of silent films.

All of the above mechanisms can be modeled in Hauptwerk.

There are many books available that describe the anatomy of pipe organs in great depth and some useful Internet sites with further information.