A Hauptwerk Home Built Console

Introduction

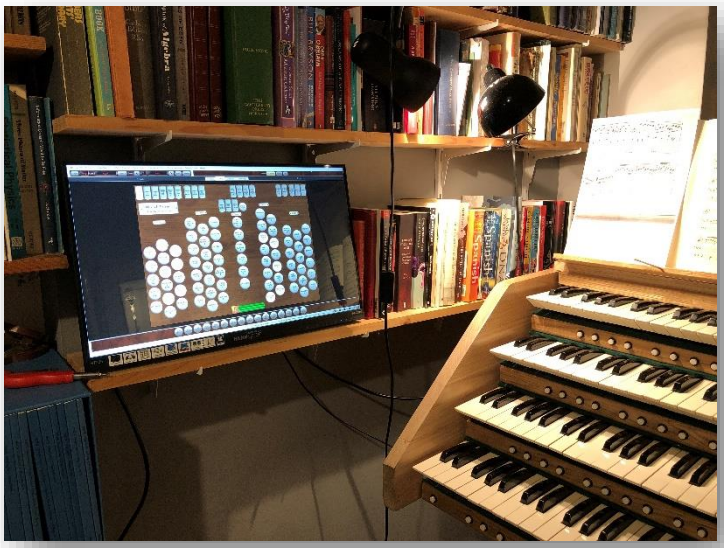
I would imagine that most readers of this newsletter will have heard of Hauptwerk, even if not fully aware of what it is and how it works, and while I know that at least some have their own Hauptwerk instruments, for others this may be something completely new. This is the story of how I built a IVP console from a combination of second hand organ components and parts and materials readily available on the internet. I'm not alone in having done this, there's a large and very mutually supportive internet community of people working on their own, some of whom clearly have the skills and tools to produce professional standard consoles. I'm not quite at that level!

For context, Hauptwerk is a computer program that uses samples of actual pipe organs to turn note on/note off information from an organ console into sound you can listen to. To use it to play organ music requires an organ console.

In theory, the main selling point of Hauptwerk is that by loading different sample sets, you can play repertoire on the type of instrument that the composer would have known.

In practice a lot of users – myself included – have been captivated by the opportunity to create something far more elaborate – and far more personal – than we could possibly have afforded to buy.

My story starts ten years ago, when the arrival of child number 2 forced me to admit finally that our lounge no longer really had space for the 3-manual digital I then owned. Ten years, much soldering, carpentry, false starts, dead ends and countless hours of work later, I am now the proud owner of a IVP/68 cathedral organ that occupies 52" x 50" of floor space. I still can't quite believe it. My practice organ in the interim was a rather nasty 20 year old Johannes, bought for £90 on the internet and



sufficiently unpleasant as to keep the candle of motivation burning throughout the project.

Glossary

Some vocab in advance for readers familiar with organs but not necessarily with Hauptwerk.

MIDI (Musical Instrument Digital Interface)

A way of connecting electronic and digital instruments. This has been around since the 1980s. It doesn't transmit sounds, instead it sends information about which notes are on and off at any particular time. It also sends information about which instruments (eg stops) those messages apply to and even about how fast a key is pressed down, although that is of debatable relevance to the organ.

MIDI Interface

A device that turns MIDI electrical signals into signals that can be sent into the computer's USB port. Cables are available that have a MIDI plug on one end and a USB on the other, but my experience (and that of many other people too) is they don't work very well, and a specialist black box is needed

Sound Card / Audio Interface

A device that turns digital electrical signals describing sound waves into analogue electrical signals that can be amplified and sent to speakers or headphones

Expression Pedals

I use this generic term for a swell pedal when the division being controlled is not necessarily the actual Swell.

Keyboards / Manuals

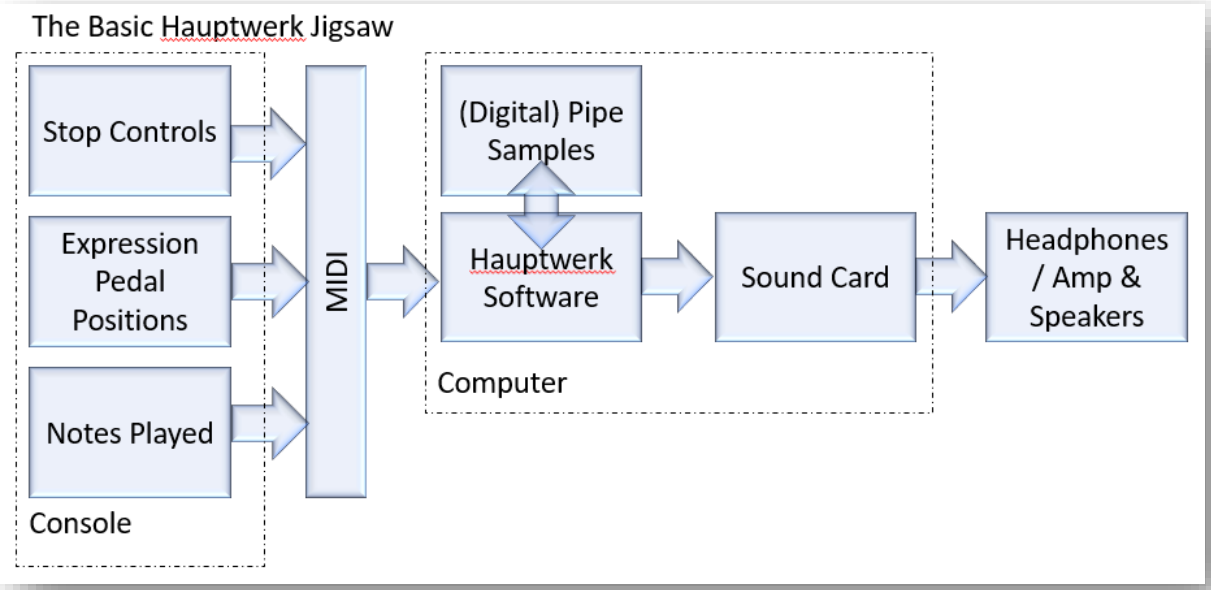
I use the term keyboard when referring specifically to the actual keys and the term manual more broadly to mean the keyboard, its supports, wiring, pistons, stops etc.

IVP/68 (etc)

A way of summarising the size of an organ. The number of manuals is given first in Roman numbers, the P indicates there is a pedalboard and the Arabic number is the number of speaking stops.

About Hauptwerk

Hauptwerk is computer software that takes incoming MIDI signals, looks up the required sounds in a digital sample library and sends those digital samples to your computer's Audio Interface (Sound Card).



This is shown in the diagram above.

- The MIDI signals come from a standard Organ Console.
- Hauptwerk runs on standard home computers (PC or Mac, although you need a relatively high amount of RAM - 16GB minimum - to run large instruments).
- The Sample library also sits on the computer. Several firms record and sell organ sample sets, although Hauptwerk comes with the IIP/30 Brindley and Foster instrument of St Anne's Moseley and there are some stunning completely free sample sets available online.
- As shown above, a computer's built in Sound Card will work, but much better performance is available from an external plug in box (which will probably be called an Audio Interface although it does the same job).
- Decent Headphones will plug straight into the Sound Card or Audio Interface, or the sound can be routed via to a complex of multiple channels of amplification and surround sound speakers.

One benefit of having a system built of multiple, independent, and (for everything except the console itself) commodity items is that a simple system can be created (relatively) inexpensively and then upgraded piece by piece.

Project

The full twists and turns of a long journey will have to wait for the movie - I'm going to outline my original design goals and concept, as they survived the journey, and then describe what I built over the last two years after restarting the project almost from scratch at Easter 2018 (but having acquired a few skills, tools and ideas about how to achieve it along the way).

Design

My goal was to build

- A 3-manual console, with
- 61 note manual and 32 note pedal compasses
- standard console dimensions but occupying the smallest possible amount of floor space
- simulated tracker touch
- plenty of console aids
- Choir and Swell under expression.

I suspect the reasons for most of those design goals will be self-evident to anyone likely to read this article! The only one that needs further comment is the physical size of the console. Many small digitals I've played, especially those aimed at the home market, compromise a bit on size – they may have a G compass pedalboard but the pedals might be just a bit shorter and the black notes just not quite far enough back under the manual overhangs for complete comfort. This also creates problems adjusting to playing other instruments. So, whilst minimizing the overall floor space occupied, the actual playing dimensions would be those of a full-size standard console.

Sources and Approximate Costs of Parts

The internet in general and ebay in particular are great sources for components. These are the items that made it into the final build – at least six other manuals, one pedalboard, several expression pedals and two benches came and went over the years.

Item	Source	Approx. Cost
Manuals	Reconditioned ex Compton keyboards – ebay	£400
Pedalboard & Bench	Old electronic, but of pipe organ spec and build quality – ebay	£250
Expression Pedals	One from the above, two others from other ebay sales.	£50
Toe Pistons	2nd hand from an organbuilder, initially via ebay	£100
Midi Electronics	Hwce-max bundle from Midi Boutique (bought new).	£500
Hauptwerk	Dhmidi-organs.eu (New)	£500
Midi Interface	M-Audio MIDISPORT 2x2 (New)	£50
Audio Interface	Behringer UCA202 (New)	£20
Magnets	first4magnets.com (New)	£200
Allen Bolts	GWR Fasteners (New)	£25

That totals about £2k and doesn't include a computer (I use my work laptop). But after adding in wood, screws, solder, wire and glue and a few power tools it's still cost less than £3k. I paid £6k in 1996 for a second hand IIIP/40 Gem Praeludium which I thought then (and still think) was good value for money.

MIDI

The very first decision to be taken was how to convert key presses into MIDI signals. The options are:

1. Most existing digital consoles have a MIDI output. Buy a secondhand console (£80-£2500 on ebay) and a £5 MIDI lead and use it to drive the Hauptwerk software, bypassing the console's own sound generation.
2. Buy MIDI keyboards. These start at £30 in toyshops and run up to £2000+ per keyboard for organ-spec models with wood core keys and tracker touch.
3. "MIDIfy" (a bit of a Hauptwerk word, that) existing keyboards, using either homemade or dedicated off the shelf electronics boards.

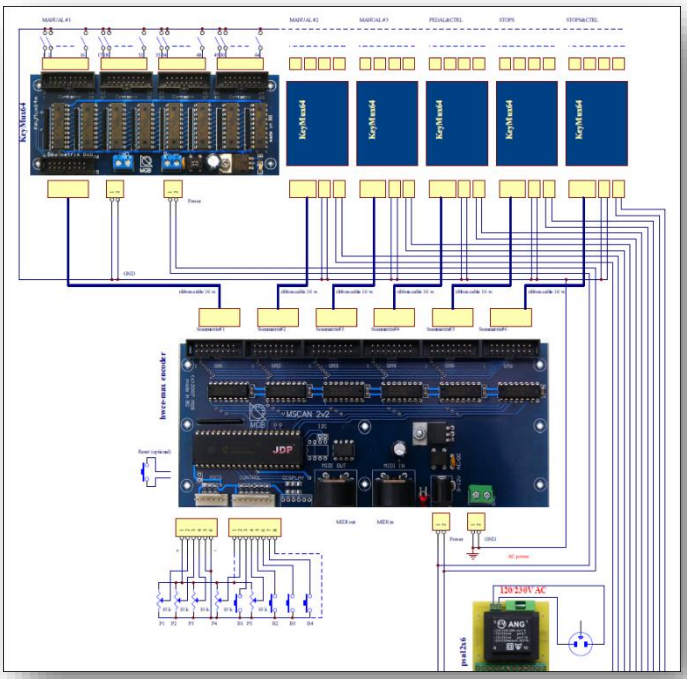
I always intended to use Option 3. I wanted to build a console, so Option 1 was out (and anyway most cheap secondhand consoles are only 2 manuals) and Option 2 was far too expensive.

To Midify a keyboard involves two things:

1. Create on/off electrical signals when the keys are pressed.
2. Turn those signals into MIDI signals to the organ.

The first is a straightforward matter of putting wiring and some kind of switch on each key and I was confident of being able to do that. The second requires knowledge of electronics well beyond me, but there are companies who make exactly what you need here, so I bought a kit.

The one I bought, from Midi-Boutique in Bulgaria, has a motherboard (centre) which connects via a MIDI cable to a USB port on the computer and six daughterboards (one shown in photo top left and five other identical ones represented by blue blocks).



Each daughterboard has 64 inputs, each one usable as a key or a piston or a stop knob, for a total of 6 x 64 = 384 different circuits.

The wiring uses 16-wire ribbon cable and special connectors that simply clip onto the ribbon.

The bottom left of the picture has connections for 4 more push switches (I didn't use these) and 5 slider controls for use with expression pedals, of which I used 3.

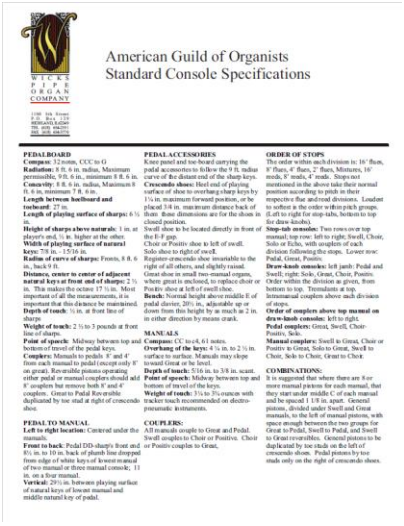
It might look complicated, but it's actually a small number of things repeated many times.

This was where the project became a four manual! For about €100 more than the 258-circuit version, this kit has enough circuits for four 61 note manuals and a 32 note pedalboard with 108 left over for stop controls or pistons. It was too tempting to resist!

Console Dimensions

Romsey Organ Works website has a page (http://www.organworks.co.uk/news/console-dimensions/) showing 3 separate sources of data about 'standard console sizes', which saved me the effort of touring our local churches with a tape measure. These are shown below. The first is a 3

page pdf which was at one time on the Wicks company website. The second is stated to have been drawn by Clive Sidney in 2003 and the third to be labelled Hill Norman and Beard and looks to me like a sketch one of John Norman's books. These diagrams and dimensions, although not totally consistent with each other were the basis of my console.



American Guild of Organists
Standard Console Specifications

PEDALBOARD
Compass: 32 notes, CCC to G
Radiation: 8 ft. 6 in. radius, Maximum permissible, 9 ft. 6 in., minimum 8 ft. 6 in.
Concavity: 8 ft. 6 in. radius, Maximum 8 ft. 6 in, minimum 7 ft. 8 in.
Length between footboard and touchpoint: 27 in.
Length of playing surface of sharps: 6 ½ in.
Height of sharps above naturals: 1 in. at player's end, ½ in. higher at the other.
Width of playing surface of natural keys: 7/8 in. - 15/16 in.
Radius of curve of sharps: Fronts, 8 ft. 6 in., back 9 ft.
Distance, center to center of adjacent natural keys at front end of sharps: 2 ½ in. This makes the octave 17 ½ in. Most important of all the measurements, it is important that this distance be maintained.
Depth of touch: ½ in. at front line of sharps
Weight of touch: 2 ½ to 3 pounds at front line of sharps.
Point of speech: Midway between top and bottom of travel of the pedal keys.
Couplers: Manuals to pedals: 8' and 4' from each manual to pedal (except only 8' on great). Reversible pistons operating either pedal or manual couplers should add 8' coupler but remove both 8' and 4' coupler. Great to Pedal Reversible duplicated by toe stud at right of crescendo shoe.

PEDAL TO MANUAL
Left to right location: Centered under the manuals.
Front to back: Pedal DD♯ sharp's front end 8½ in. to 10 in. back of plumb line dropped from edge of white keys of lowest manual of two manual or three manual console, 11 in. on a four manual.
Vertical: 29½ in. between playing surface of natural keys of lowest manual and middle natural key of pedal.

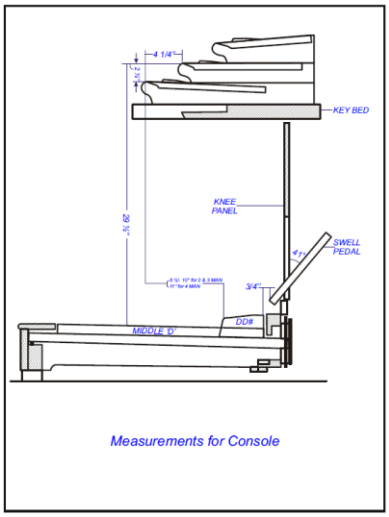
PEDAL ACCESSORIES
Knee panel and toe board carrying the pedal accessories to follow the 9 ft. radius curve of the distant end of the sharp keys.
Crescendo shoe: Heel end of playing surface of shoe to overhang sharp keys by 1¼ in. maximum forward position, or be placed 3/4 in. minimum distance back of them those dimensions are for the shoes in closed position.
Swell shoe to be located directly in front of the E-F gap.
Choir or Positiv shoe to left of swell.
Solo shoe to right of swell.
Register-crescendo shoe invariable to the right of all others, and slightly raised.
Great shoe in small two-manual organs, where great is enclosed, to replace choir or Positiv shoe at left of swell shoe.
Bench: Normal height above middle E of pedal clavier, 20½ in., adjustable up or down from this height by as much as 2 in. in either direction by means crank.

MANUALS
Compass: CC to c4, 61 notes.
Overhang of the keys: 4 ¼ in. to 2 ½ in. surface to surface. Manuals may slope toward Great or be level.
Depth of touch: 5/16 in. to 3/8 in. scant.
Point of speech: Midway between top and bottom of travel of the keys.
Weight of touch: 3¼ to 3¾ ounces with tracker touch recommended on electro-pneumatic instruments.

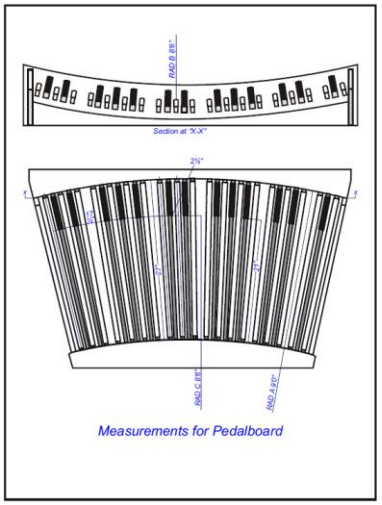
COUPLERS:
All manuals couple to Great and Pedal.
Swell couples to Choir or Positive. Choir or Positiv couples to Great.

ORDER OF STOPS
This order within each division is: 16' flues, 8' flues, 4' flues, 2' flues, Mixtures, 16' reeds, 8' reeds, 4' reeds. Stops not mentioned in the above take their normal position according to pitch in their respective flue and reed divisions. Loudest to softest is the order within pitch groups. (Left to right for stop-tabs, bottom to top for draw-knobs).
Stop-tab console: Two rows over top manual, top row: left to right, Swell, Choir, Solo or Echo, with couplers of each division following the stops. Lower row: Pedal, Great, Positiv.
Draw-knob consoles: left jamb: Pedal and Swell; right: Solo, Great, Choir, Positiv. Order within the division as given, from bottom to top. Tremulants at top. Intramanual couplers above each division of stops.
Order of couplers above top manual on draw-knob consoles: left to right.
Pedal couplers: Great, Swell, Choir-Positiv, Solo
Manual couplers: Swell to Great, Choir or Positiv to Great, Solo to Great, Swell to Choir, Solo to Choir, Great to Choir.

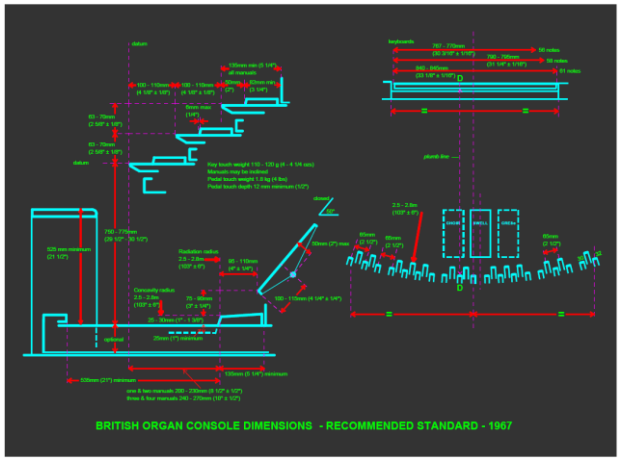
COMBINATIONS:
It is suggested that where there are 8 or more manual pistons for each manual, that they start under middle C of each manual and be spaced 1 1/8 in. apart. General pistons, divided under Swell and Great manuals, to the left of manual pistons, with space enough between the two groups for Great to Pedal, Swell to Pedal, and Swell to Great reversibles. General pistons to be duplicated by toe studs on the left of crescendo shoe. Pedal pistons by toe studs only on the right of crescendo shoe.

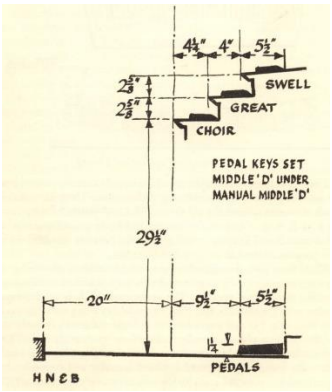


Measurements for Console



Measurements for Pedalboard





Building Frame

Many Hauptwerk consoles omit stop knobs and jambs, since relabelling them for each organ would be tedious. Hauptwerk displays the organ's stop jambs on the computer screen and you click on a stop (or tap it on a touchscreen) to hand register.

The determinant of the minimum width of a normal console is the need to straddle the wide end of the pedalboard. I decided to keep the chassis width tight to the width of the keyboards and to prevent it toppling forward by extending the base underneath the pedalboard.

In the top picture at right, the green area shows the extra space that would have been required for standard stop jambs. Many Hauptwerk consoles have a flat table and mount the keyboard stack on this and that would have been a better option, as the design is inevitably not completely rigid although I do quite like the present look of it. It would also have increased the bulk to the red area.

The frame construction is 3mm angle iron, and the manuals are cantilevered as shown here.

The angle iron holes are at 1" centres, which set the vertical separation of the keyboards to exactly 3". This is ¼" more than the maximum Sidney specification and makes thumbing down a bit of a stretch, but 2" would have been too small to have accommodated pistons and I wasn't inclined to start drilling fresh holes into the angle iron.

This approach was very convenient during the build: each manual can be removed simply by undoing the bolt on each of the rear uprights and sliding it forwards. This meant I could keep checking that the entire assembly would fit together. I didn't do drawn designs – I don't have the skills – and, lacking any prior experience, I just kept trying different arrangements and components until I got something that worked.

In the final build, the timber uprights were replaced with more angle iron for greater rigidity and the Choir has triangular bracing underneath. There are also timber blocks (3rd picture, orange arrow) to take the weight of the manuals above and maintain the correct vertical separations. Adding casework (veneered chipboard for the lower area, solid oak for the key cheeks) greatly increased the rigidity, as I had expected it would. Overall though, this aspect of the design is not as successful as I

was hoping and a (fairly straightforward) conversion to a more conventional layout is being planned. This will also reduce the front-to-back distance by about 8”.

Layout of main circuit boards. These are located at the rear of the Choir manual, as this where most of the spare space in the console is.

Visible are:

[1] Motherboard
    a. Connection to Manual Piston Daughterboard [3]
    b. Connection to Pedal Daughterboard [2]
    c. – e. Sockets for connections to So/Sw/Gt Daughterboards
    f. Connection to Choir daughterboard
    g. Connections to Expression Pedals (white cable and white terminal plug)
[2] Pedal daughterboard – 4 cables at rear are 2 x 16 notes and 2 x 16 pistons
[3] Manual Piston daughterboard. The occupied slot is connection to Choir pistons and the empty 3 are for the other manuals
[4] Mains power supply
[5] MIDI interface – the white lead is a standard USB cable to the PC. Black lead (coiled, with red tape) is the MIDI cable to motherboard
[6] Power supplies for Great, Swell and Solo
[7] Speakers – these are for testing purposes only, the sound is not great!

Manuals

Keys

The keyboards are two pairs of (I think) ex-Compton manuals. They are wood cored and had been well cleaned and were in excellent condition. I dismantled them completely, then mounted the front and rear pin rails to the thin plywood bases that was using. I replaced all the felt with ordinary green polyester based felt bought from ebay arts and crafts sellers.

The front guide pins are slightly oviform in plan view and it was easy to inadvertently rotate these a small amount in the sockets: when that happens the key sticks.

The keys are not remotely interchangeable – it is critically important not to mix up the keys between sets, or even between octaves within a set – they don't fit. Although the keys have their order number stamped into them, this is not very clear, and I would have saved a lot of time by doing earlier what I eventually did, and writing the numbers on in marker pen.

(Left) All four manuals without keys, showing the arrangement of front and rear pin rails on their plywood bases. The bases are simply to retain the correct alignment between the two pin rails – the weight is taken at each end of the rails by the horizontal portion of the angle iron.

The small black objects at the very front of the keys are the reed switches which are activated by the key movement. The picture at left was taken before the wiring had been added – the reed switches are simply glued in place. The upper picture shows both the common wire just visible – as a strip of copper wire running the whole width right next to the green felt to which every switch is wired. It also shows the individual wires which are separated at this end of the ribbon, one to a switch which carry the signal back to each manual's daughterboard.

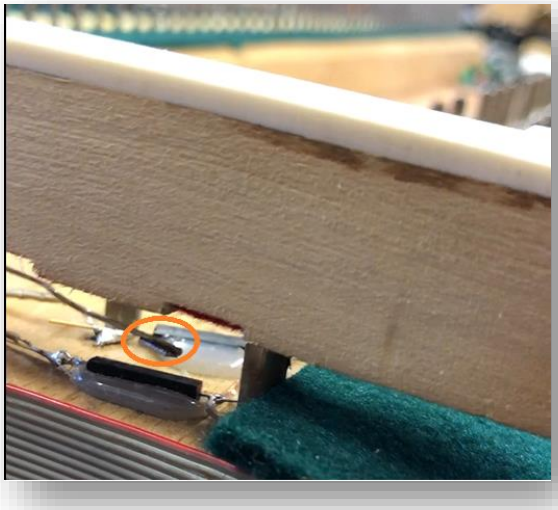
Key Actuation

Reed switches are magnetically activated and, although commonly used for pedalboards in digital and pipe organs, they have a bad reputation for manual action. The reason for this is that the position of the magnet that activates the switch is not the same as the one that deactivates it. You might need to bring a particular magnet to within 4mm of the switch to start the note sounding, but then it might stay on until the magnet is 8mm away. The vertical key travel is only about 10-12mm in total, so there is some risk that the position of the magnet that will get it close enough to the switch to activate it when the key is down will not get it far enough away to deactivate it when the key is up, leading to ciphering. Furthermore, pipes in tracker action organs start to speak when the key is

only a couple of mm into its travel, and I wanted to replicate this, which further reduces the available margin for error.

However, reed switches are very cheap technology (a few pence each) and with 244 keys to action I wanted to use them rather than wiper wires (which corrode) or any of the other contactless options (Hall Effect sensors or LDRs) that are available, but which would have been more like £1-£2 per key. My solution was to get a *very* small (5mm x 2mm x 0.5mm), weak, magnet *very* close to the reed switch, and so far it has been very successful – once the exact correct adjustment is made to the position of the magnet I've had no ciphers at all.

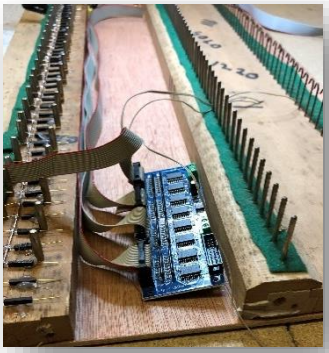
This is shown below. The orange oval shows the magnet, glued to an unwound paperclip and arranged to 'float' beneath the key. The magnet must be practically touching the reed switch to activate it. The paperclip arrangement means that the magnet reaches the switch when reaches approximately the halfway point of its downward motion and the springiness of the paperclip (they are made from springy metal) then absorbs the remaining motion of the key while holding the magnet against the reed switch. As the key is released the reverse occurs and the magnet lifts off the switch when the key reaches its halfway point.



Because the magnet is very weak, it activates the switch at distances of around 1mm and deactivates it at around 3mm. However, the magnet's total descent is about 6mm, so when the key is up, it is twice the distance of the switch off point, enough of a margin for error to prevent problems.

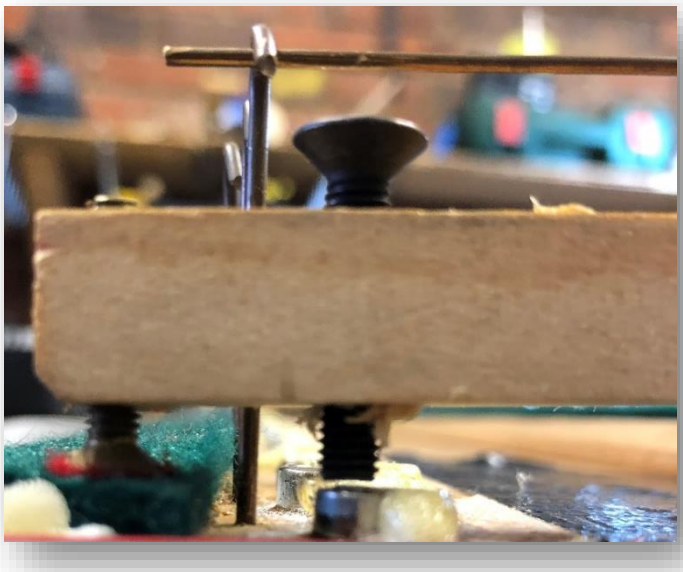
The role of the paperclip and the fact that the magnet 'floats' is critical in this – it means that the magnet gets close enough to the switch early enough in the key press and leaves it late enough in the release to mean that the on/off happens at the expected points in the key travel, while allowing for a final resting position far enough away relative to the switch off point to avoid ciphers.

Wiring arrangements. (Left) (viewed from the treble end) the ribbon cables have been cut to approximate length and to join the reed switches in groups of 16 to this manual's Daughterboard, located in the void beneath the keys. One ribbon wire then runs from this to the Motherboard. (Right) after all the wires have been cut to exact size and soldered, one onto each of the 244 reed switches.



Tracker Touch

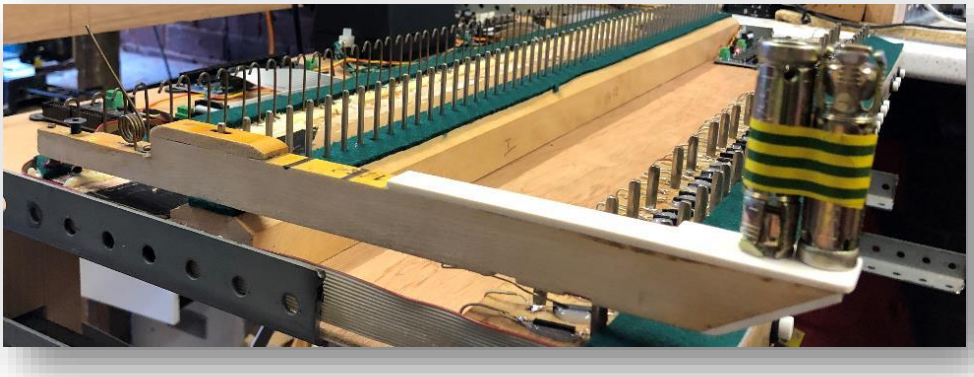
The other thing I wanted to add to the keyboards was simulated tracker touch, sometimes referred to as pluck. I expect most readers will be aware that on a pipe organ with tracker action, it is quite a bit harder to start the key moving down than to keep it going. This is because the air pressure in the windchest initially opposes the pallets opening, but as soon as the pallet is slightly ajar the pressure equalises on both sides of it and this resistance disappears. The "feel" of such an action is unique to the organ and gives a very different, and much more rewarding experience than simply pushing against the constant force of a spring. There are several ways of simulating this experience. My solution involved – again – small magnets, but this time very strong ones.



The picture shows the key tail, the far end from the player. Above the key is the brass spring that brings the key back up, and at the left hand side of the picture is the adjustment screw (resting on green felt) that sets the exact height that the key sits at when not pressed.

My addition is the black bolt made of high tensile steel and the magnet positioned directly below it. The magnetic pull is very strong at short range but falls off within a couple of mm as the bolt moves upwards. That the effect, as with a tracker action, is that a hard press is required initially, but then only a smaller one once the key starts moving. To avoid clattering noises, the bolt does not actually touch the magnet at any point: the magnet was chosen to be strong enough for this task without needing to touch the bolt, and the exact air gap can be adjusted to give exactly the right resistance.

This picture shows how this adjustment was done. At the key tail, the brass spring has been unhooked from its retainer and is sticking up in air. The two pieces metal of taped together weigh 75g and their downwards force is balanced only by the magnet. The black bolt is adjusted until the slightest additional touch on the key is enough to start it moving and then it falls freely down.



Pedalboard

This came from a donor organ, and the main tasks were to clean it and add wiring, reed switches and magnets. Due to the greater travel distance of a pedal, the magnet adjustments did not need to be so precise and the arrangement adopted is shown here. This is the end on view of the 5 highest pedals looking from the organ towards the player. The magnets are glued to bolts which can be turned to provide some adjustment and the reed switches glued to the panel at the bottom. The bottom panel is thin plywood, curved to follow the pedal sweep.

Superglue, Gorilla Glue and staples were important to this construction effort!

Cleaning was a matter of carefully dismantling, washing, sanding, varnishing and reassembling. Reassembly was the hardest part, because the curves all fit together perfectly when in place but getting them there is a different matter. Also, while pushing one pedal down against its spring is easy, doing 32 simultaneously to get the front top panel back is a lot of work!

A white key before sanding – note the surface wear.

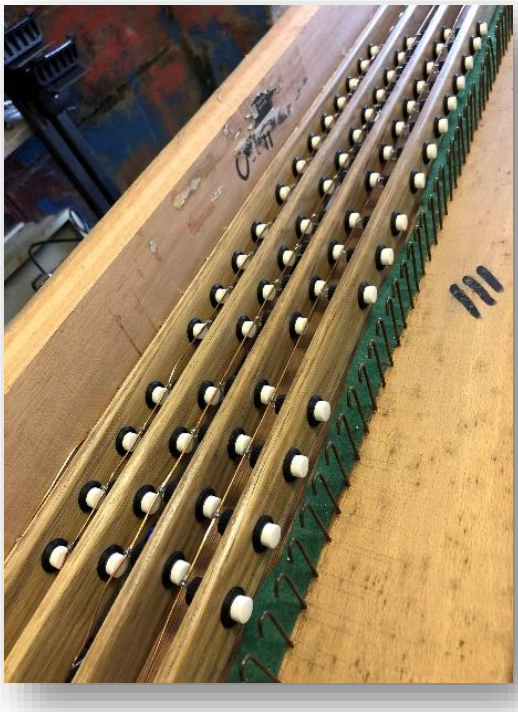
Before and after cleaning.

Empty frame, after sanding and varnishing and reassembled pedalboard

Thumb and Toe Pistons

Recalling that each ribbon cable has 16 wires and its connector have 16 circuits, the 108 available piston circuits were divided up as follows:

- Each manual has 19 pistons
    - 16 (one complete ribbon cable)
        - 4 Generals
        - 4 Couplers (3 + Setter Piston on the Choir)
        - 8 Divisionals
    - 3 (spares from the manual – 16 x 4 ribbons = 64 but the compass is 61 notes). These are set as:
        - Solo - Recording Controls (Standby, Start, Stop Recording)
        - Swell – Emergency Midi cancel all notes + 2 unallocated
        - Great – Piston Channel Selector x 3
        - Choir – General Cancel + 2 unallocated
- The pedalboard has 32 pistons.
    - 14 Treble
        - 11 Red (8 Divisionals, 3 couplers)
        - 3 Black (Generals)
    - 18 Bass
        - 3 Red (couplers)
        - 15 Black (Generals)



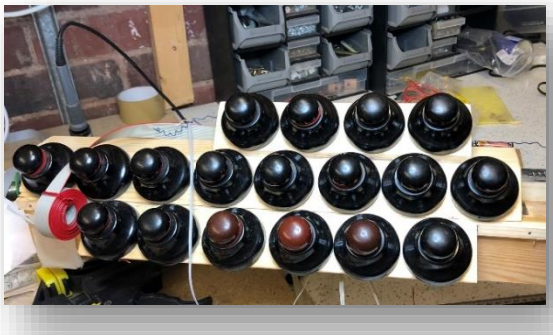
The thumb pistons are simple switches, again sourced from ebay. The piston rails are thin oak strip, sold by B&Q as edging strip, and I added a rebate to their lower rear edge for rigidity and then screwed to the underside of the manuals to avoid visible fixings. The right-hand picture shows all 4 piston rails after drilling, sanding and varnishing and with the switches mounted.

One puzzle was how to label the pistons. The tops of these are slightly convex, so using them as a base to attach a disc to would not have worked well. I considered various options such as dry transfers and permanent marker pens, but in the end, decided not to attempt it at all. The Generals

run 1 to 16 from bottom left to top right, and the Divisionals, Couplers, Setter and General Cancel are all arranged conventionally, so there isn't really any need.

The toe pistons were also sourced online, from an organbuilder who was having a clearout, and I acquired a mixture of 14 Red and 18 Black pistons. The original idea was to duplicate the 16 Generals, have 8 Divisionals and 8 other pistons and I tried (but failed) to come up with a sensible allocation as between colours and sides, given that the main constraint in where they were mounted was space.

My carpentry skills are limited to straight line cuts, and the top section of a pedalboard curves on two axes. I was a bit nervous about how it was going to fit together neatly, but I'm happy enough with the result. The middle row is a continuous beam (which is also the mount for the Expression Pedals) and then two other two sections are mounted to that on either side



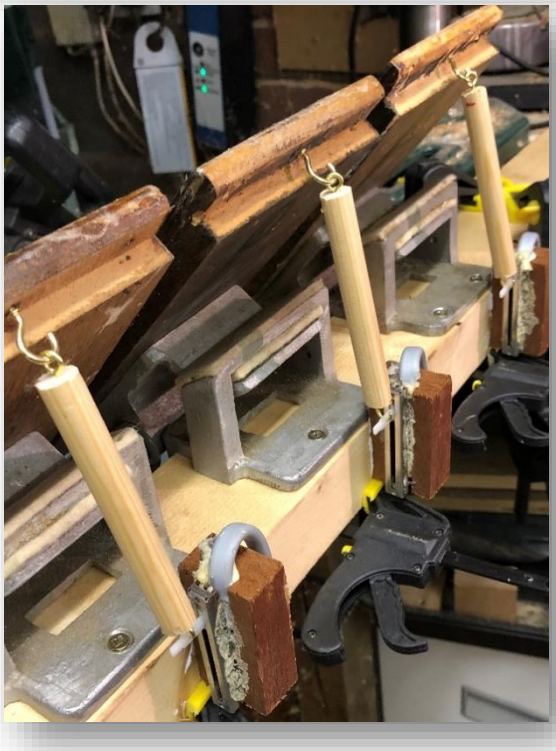
.

General views of the toe piston rails under assembly and wiring. This was the last major task of the project.

Expression Pedals

These were all sourced from donor organs, and they all started off looking like the left-hand example in the first picture. I removed the perished rubber coverings and glue, sanded and varnished the wood underneath, for a remarkable transformation.

My original plan was to make new tops, but that was unnecessary. I quite like that the wood colours don't match (the difference is less in reality than the pictures suggest)



The pedals communicate their position via a potentiometer to the MIDI motherboard. These are readily available on the internet and the motherboard documentation specified the required resistance. The hook-and-eye arrangements at each end of the dowel turn the circular arc of the pedal movement into a vertical push / pull on the potentiometer slider.

Casework

This was the very final task. I initially bought oak veneered chipboard to attach to the building frame, but didn't like the look of that, so upgraded it to solid oak – which was, to my surprise, not much different in price, but looks ever so much better. The top panel is still veneered chipboard, which I intend to upgrade, as is the lower chassis – but I plan to leave that as it is.

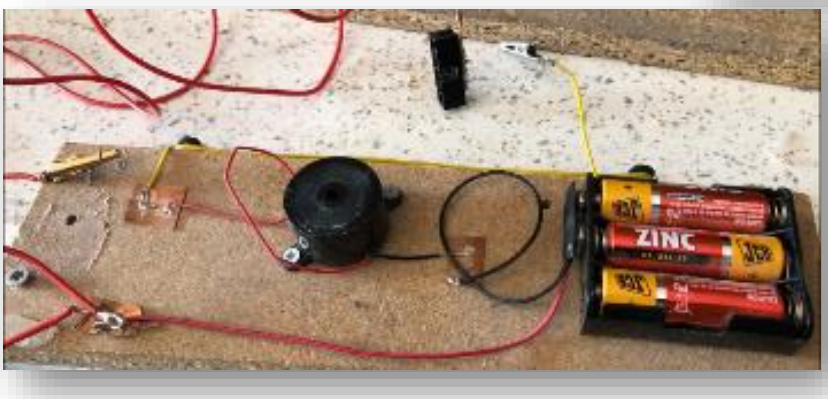
Tools

Hand tools – two battery drill/drivers and handheld circular saw (left), mains drill, jigsaw, angle grinder and sander (right).

(Above) Table saw – very powerful, very noisy and very dangerous. This tool still terrifies me every time I use it. The work is fed into the blade by sliding it along the guide rail.

(Right) Miter saw – length of cut limited to about 9”, but much safer than the table saw.

(Below) Homemade circuit tester – indispensable for checking soldered connections. The black circular object is a loudspeaker that beeps when the circuit is complete. The little black box on the red wire at the top accepts a ribbon connector, allowing convenient testing of the 16 wires or reed switches on a single cable.



Sound System

There isn't one (yet!). Part of me never quite believed that this was all going to work, and so I deferred the cost of amp and speakers until Phase II. At present I play through headphones only, as the little speakers built into the frame, while useful for testing, make a very poor sound.

The other reason for deferring the cost of a speaker system is that I doubt I'll get much chance to use it, in consideration of other family members.

Configuring and Using Hauptwerk and the Console

When you first load a new organ, Hauptwerk lists all the manuals, pistons, swell pedals etc on screen. You click on a manual on screen and then play the lowest and highest notes on the keyboard that you want to use for that manual. (and do the same for the pedalboard). For expression pedals, you select a pedal on screen and move the one you want to use for that up and down a couple of times. For pistons you click the one you want and then push it on the console, and the same feature is available for stop knobs, although I don't have any. From this, Hauptwerk knows which MIDI signal corresponds to which key or control. For a console of this size, that was a little time consuming, but it was very simple to do.

Most Hauptwerk menu items can be assigned to pistons, so I have the recording features (arm/start recording/stop recording) associated to the rightmost three pistons on the top manual, making it very quick and easy at least to record something even if the playback experience seems to contain more wrong notes than I noticed while playing it. Hauptwerk has choices of recording the MIDI information, (which can even be output as a score) or the sound, in which case CD quality sound is streamed direct to the hard disk drive – no microphones needed.

All of these settings are specific to an organ, so keyboard assignments could vary between instruments – the bottom manual could be the GO and the next one up the Pos for a Cavaille-Coll. This adds huge flexibility but does mean that these basic settings must be done for each instrument. That's not a problem for me, as I really only use one instrument, the Friesach instrument in its 4 manual extended form (which is free!) – the ability to swap between them is something I might explore later, along with different temperaments.

Hauptwerk allows you to revoice every note of every stop or do bulk adjustments to stops. I will confess that the Solo Chamade is now quite a bit louder than in the downloaded version, but it's not just about decibels - I toned the English Horn down to a very gentle reed sound.

Reflections

This project was a long time in the working and there were times when it looked as though it would never finish. The time was busy with other things of course - two house moves, one Open University degree in a completely unrelated field, and a day job and a family – and I've only really had a proper workshop area for the second half of that time.

There were some big false starts, due to inexperience. The biggest challenge was the manuals – getting them all mounted and wired, along with the pistons, in such a way that there would be no sticking notes and in a form that would look at least presentable as a piece of domestic furniture was not simple. All my prior woodworking had been carpentry for the amateur stage, where the finished product only needs to last for a fortnight and where errors of measurement can be covered with masking tape and paint to look convincing from 20 feet away! This called for rather more precision of measurement and cutting, and inevitably there was a lot of reworking.

I decided I would finish the manuals assembly completely before starting any other tasks, in order to reduce the chances of ending up with a functioning 2 manual instrument that might have been a disincentive to completing the whole project! This had the desired effect but did mean that errors tended to require a lot of rework: I ended up wiring all 244 reed switches twice over and drilling at least four complete sets of piston rails. I found by experiment that the principle of getting a very weak magnet very near to a reed switch was sound, but it took a lot of trial and error to find a cheap and operationally robust and reliable way of doing that.

I hadn't done much soldering before, but there are plenty of how-to videos on the internet for that – my main regret was initially buying a cheap soldering iron that didn't get hot enough. I took advantage of Macro's closing down sale to get a more powerful one with temperature control, and that was definitely a big timesaver. I haven't had any problems with faulty wiring.

The overall execution is not perfect: the tracker touch works well overall, but on some notes the magnets are not centrally underneath their bolts, which weakens the effect. I've struggled to get the keys perfectly lined up and horizontal – this doesn't affect the playing but doesn't look so good! On the other hand, some things that I was very worried about turned out not to be problems at all: I was expecting to find that the key magnets would need their positions adjusted a lot after I started using it (and in the event there have been fewer than half a dozen problems), and that the inevitable differences in the key position at which the notes sounds would be problematic (this hasn't been the case). I was particularly worried that magnets on adjacent notes would cause the switches to sound: this hasn't happened at all, although there is one place where on pressing D and Eb and then releasing the Eb key, the Eb continues to sound. Alternating the north/south orientations of the key magnets, would probably have prevented this.

By comparison, the rest of the work was not complicated. Dismantling, cleaning and reassembling the pedalboard was done over a weekend, and the casework only took a couple of days. The expression pedal solution was a lot simpler than I thought it would be and mounting them and wiring the pedal pistons was also straightforward. (By this time, I'd had a lot of practice at soldering!) The geometry of fitting this to the curved pedalboard worried me a bit and I settled for something easy to do rather than beautiful.

Ten years is a long time – I could have served an apprenticeship as an organbuilder! – and there's an obvious question as to how much better an organist I would now be if I'd just bought a two manual and spent the time practising. But the sense of achievement I got when I finished it and the motivation to practice since then has been enormous. Would I do it again? Knowing what I do now, in terms of what to do and in what order I think it would take me less than a year (much less if this lockdown was in force) to build Version 2 that I'm not going to build. Would I have started if I'd know what was involved: yes, if I'd also known how good completing it would feel.

You're welcome to arrange a time to come and have a go – drop me a line at paul@hodgetts.eu

About the author

I'm a business software engineer with degrees in Physics, in IT and Business Administration. My next organ goal is ARCO, and before Covid intervened I intended to sit the practical this summer. I left my most recent church post, (Our Lady & St Kenelm RC Church Halesowen) at Easter 2017 to make my weekends a bit more flexible around the children's needs, but will likely find another church post at some point.