St Mark's Episcopal Church, Grand Rapids

A telephone call in the autumn of 1997 led to the installation of our largest tracker organ in the United States to date. Out of a total of ninety mechanical action organs already installed in the USA since 1984, (from Hawaii in the west to New England, and from Minnesota in the north to Florida) this—our ninety first—is the sixth instrument installed in the state of Michigan.

In describing our latest opus it was interesting for me to look at the evolution, both technically and tonally, since our first US organ was installed in Arkansas in 1984. Current methodology has been developed primarily from early experiences working in America's diverse climates, and subsequently being able to monitor stability through maintenance over a long period has been a huge advantage. Consequently, (apart perhaps from mosquito nets) when installing instruments in Iceland or Norway, Germany, Korea, Japan or Australia, there is no longer a consideration of needing to apply a different approach for a diverse climate.

Since all our instruments have mechanical action, the fundamental issue is that timber has to tolerate change: actions must be able to adjust constantly and rapidly. For example, during Minnesota's springtime, temperatures can fluctuate daily between minus 40°F to plus 70°F, with relative humidity ranging from 20% to 70%. Not even the best European made keyboards were able to cope with these environmental extremes, the basic problem being the European climate, which had justified a proud tradition of air dried, rather than kiln dried timber.

This 'impediment' quickly led to 'in-house' keyboard manufacture. Timber is imported from the USA, where there are huge resources of cultivated, quality stock available. It is kilned to 10% moisture content before shipping, and further dried in the factory before being converted to keyboards. However, this alone is insufficient for the stability we demand: on arrival, key thickness timber is sliced into veneers, then turned and glued into a three laminate board. These boards are then left in stock inside our 'dry' factory for a further six months, before being used in the manufacture of keyboards. It is also desirable to adopt a similar approach for soundboard pallets, since instability in either keys or pallets can bring an otherwise fine instrument into disrepute, and building frames are also laminated from kiln dried maple. Soundboard tables, upper boards, and pipe racks are made from quality marine grade plywoods, or from laminated birch boards with 'water boil proof' adhesives.

Another important issue stems from the refinement of contemporary tin processing, coupled with the higher ambient summer temperatures in the USA. Having fewer impurities, the available alloys are much softer than the traditional product. English pinned reed stays, or just tapes, are totally inadequate for use in the USA. Reed resonators require up to four tiers of supporting stays for total security, and more for 32ft stops.

All sixteen of the reed stops for the Grand Rapids organ were made in-house. The metal resonators were manufactured from a 'home brewed', stronger than normal alloy, achieved by the addition of Antimony, Bismuth, Silver and Copper in the following proportions per 100 kilo quantity:

50kg	Tin	1kg	Bismuth
50kg	Lead	600g	Silver
3kg	Antimony	250g	Copper

These four additives were pre-melted by blowtorch, before adding to the normal lead and tin percentages. The result is akin to pewter – but we still took the precaution of four levels of supporting stays!

The construction and support of facade pipes sometimes demands a non-traditional approach in order to reduce the weight on the pipe tips. In various situations this has been accomplished by fitting compression springs at the stays, or by counterbalancing individual facade pipes. In the latter instance cables are attached to internal collars at the pipe top, which then run over pulleys to weights inside the organ. For Grand Rapids, the inside of the feet are lined with copper from the very tip, up to a position above the mouth cut-up.
St Mark's Church, Grand Rapids, is a cruciform building with two large transepts, making it almost as wide as it is long. The

▲ *Four levels of stays*

previous 1910 Austin Organ was situated in two chambers on either side of the chancel, each with openings into the chancel and respective transept. The detached Austin console was sited on the south side of the chancel, facing across the choir stalls.

In planning the new instrument we proposed that a new case be sited in the south transept, backing onto the existing chamber in order to accommodate the large pedal pipes and swell box. The blowing equipment would be in the cellar space under the organ chamber, with the intake through floor grilles in the base of the new case to aid tuning stability. The organist would be seated at a low, detached, French style terraced console in the middle of the transept, and the tracker action was straight-forward and well within our experience, having an initial horizontal run of some 12ft (3.6m). As part of the overall plan, the church choir would be moved from their traditional chancel stalls to a position in front of the new organ case, facing the organist.

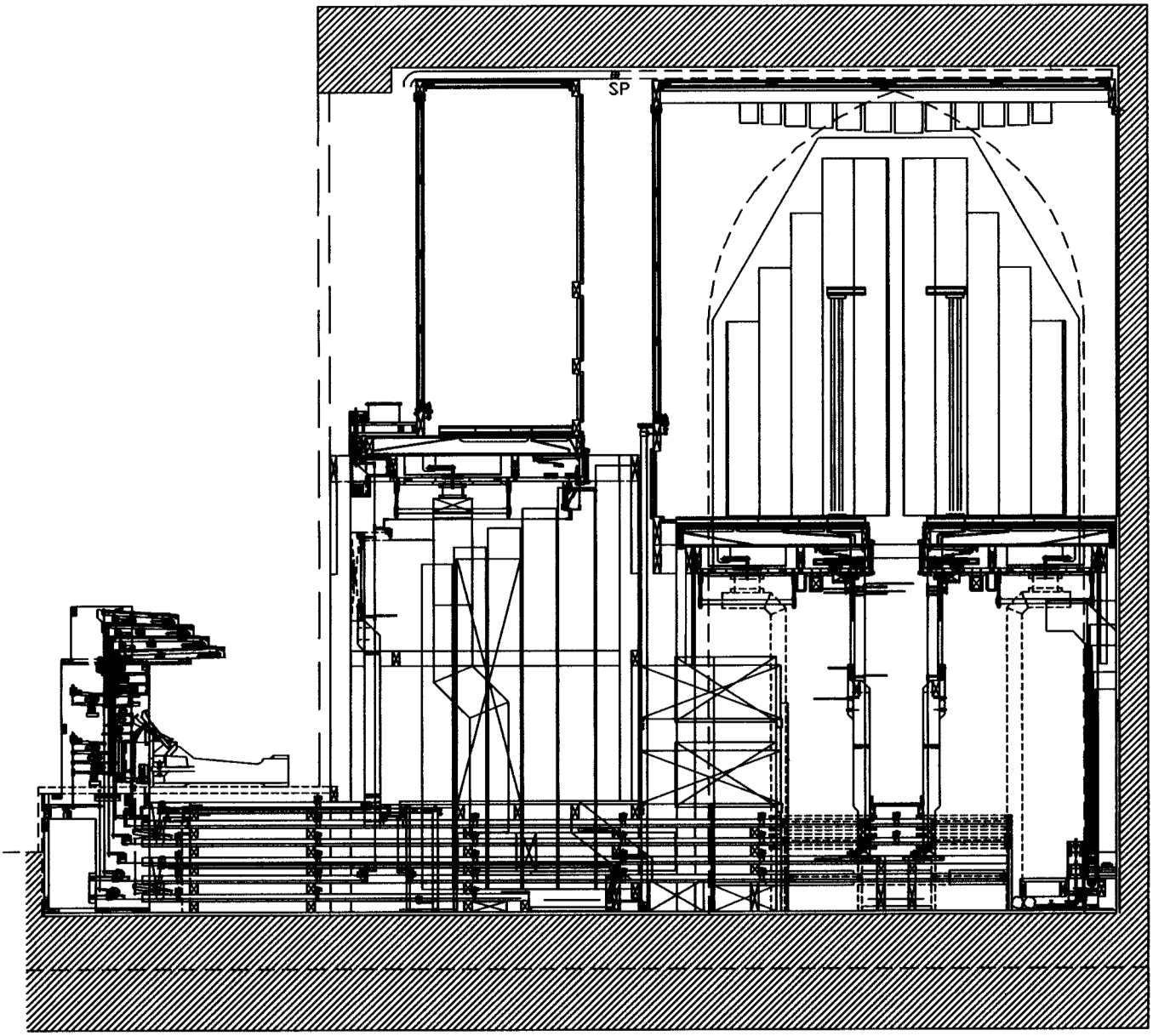
After finalising this proposal with the organ committee, an artist's impression was commissioned showing the reordered music arrangements and proposed organ case design; final presentations were then made to the committee and the congregation. Attention turned to the contractual matters, and a draft contract was presented for signing. Some time then elapsed before an email was received headed "Are You Sitting Down?" Its message was clear: the console was now to be sited in the chancel in the place where the Austin console sat; the choir would retain their present position in the chancel stalls, and the main case alone would remain sited in the south transept, adjacent to the organ chamber as originally planned. These were significant changes, to which we had to give very serious consideration.

The principle challenge was to design a horizontal action from the reversed console and round to the main case, in which three departments would be stacked vertically: Small Pedal at the bottom, Great Organ at impost level, Positive above the Great. In this situation, even the horizontal part of the tracker run from console to organ case would now be some 30ft (9.1m), having turned 90° in the organ chamber toward the transept. The longest tracker run to the Positive would be 48ft (14.6 metres) having turned 90° vertically into the transept case and finally 90° horizontally to the Positive horizontal wooden roller boards. Respectively, the Great action run would now be 35 feet (10.7m); the Swell 24 feet (7.3m) and the Solo organ a mere 16ft (4.9m). The action runs to the small and large Pedal soundboards would be particularly contorted, due to their divided positions at opposite ends of the organ footprint.

The heavily carpeted floor in the nave exacerbated our concerns over the potential weight of the tracker touch, and the consequent need to employ heavier pressures for the organ to be able to do its job. Wind pressures are not usually finalized until the on-site voicing is begun, when the voicer sets the pressures that are necessary to achieve the desired result. The pressures as finally set are:

Great	3¾"	(95mm)
Swell	3¾"	(95mm)
Positive	3"	(75mm)
Solo	3⅞"	(100mm)
Tuba	15"	(380mm)
Large Pedal	5½"	(140mm)
Small Pedal	3¾"	(95mm)

After careful consideration of all the engineering implications of the revised arrangements, the challenge was accepted, based on the introduction of 2mm diameter carbon fibre rod for making the trackers. The contract was duly signed.
Other than a recently completed new two manual organ in a similar situation in Minnesota, where 2mm fibre glass rod had been used for long horizontal tracker runs, all previous experience had led us to favour traditional wood tracker material. Before finalising the Grand Rapids technical design, we therefore first cut our teeth using carbon fibre on a smaller instrument, also destined for the USA.



▲ *Section showing horizontal tracker runs*

The design concept for Grand Rapids was as follows:

Although the stop actions would be electric, in order to accommodate the normal capture system and sequencer functions, the objective was to rid the organ of as much mechanical noise as possible. Pushing General Cancel from full organ had to be quiet, if not silent! Solid State Organ Systems provided a superb solution, after persevering with at least two software upgrades to meet the criteria.

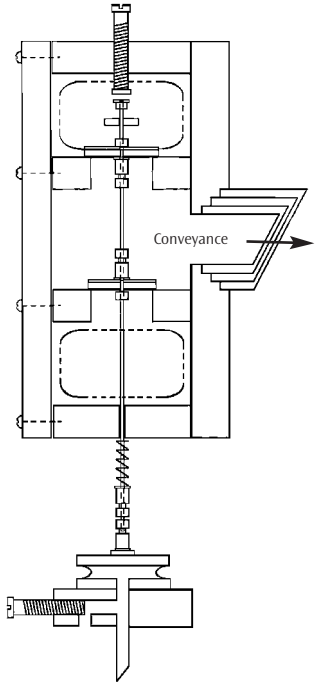
To maintain the total integrity of the organ, (with the exception of 16ft and 8ft facade pipes, the Swell Bourdon 16ft bottom octave and the balanced pressure valves for the Tuba chest), there would be no other 'off note' chests or 'unrelated actions'. Off notes would either be conveyed directly from an auxiliary bar (a dedicated wind bar and pallet for tenor and bass octaves on specified soundboards) or tubed from the upper board to a recently developed 'balanced valve' which responds synchronously with the opening of the main soundboard pallet. Wind hungry basses would sit directly on the soundboard, supplied from the auxiliary bar. This would not only provide visual integrity within the organ, but would place pipes in the perfect relationship with the rest of the stop. Even the larger of the two pedal soundboards (32ft and 16ft stops) is a slider chest, using a variation of the balanced double pallet valve.

Depending on the requirements, the soundboards have either two or three pallets per note in the bottom and tenor octaves, and throughout the organ there are no action assists (balanciers). The one compromise is the use of an auxiliary bar. The pallet for this is opened by a pneumatic motor, the exhaust valve of which is connected to the reverse side of the key action rollerboard, which pushes up in contrary motion to the other two or three pallet pulldowns on the same note.

Mechanical coupling is fitted for all of the couplers, together with the option for electrically assisted intermanual coupling.

The table right gives details of the result obtained from the longest action run – the Positive. The reference "Hold Down Weight" represents the weight at the key after breaking the pluck:

The use of carbon fibre exceeded all expectations: the mechanical action throughout the organ is extremely responsive. Apart from cost (around £1 per metre, depending



on quantity), the only downside to using carbon fibre is the need to terminate each tracker with standard wooden ends, which need to be glued with epoxy resin. One must not use collets grub-screwed to the carbon fibre as would be normally found in console couplers, as these cause it to shear through the strands and break off quite easily. Titanium wire was therefore used for the mechanical couplers in the console chassis, which stands some 6ft tall. The chassis, and preassembled action frame which holds five layers of horizontal trackers, was cut into the Chancel floor. The console encases the top section of the chassis.

Both horizontal and vertical tracker registers are made from Teflon, and the horizontal tracker suspension system uses red thread for hangers, attached to rubber grommets on the carbon fibre, and suspended on drilled hardwood rails at one-metre intervals. Wooden wedges of 3mm dowel are inserted in the suspension rails and were glued after the trackers had been finally levelled on site.

Controlled from a single swell pedal, the swell box has two sets of shutters – one facing the chancel arch and having mechanical action, the other facing the transept and controlled by a stageless synchronised swell engine. The transept shutters can be disengaged or engaged by a reversible thumb piston with warning light, an arrangement that has proved very useful for accompanying the Choir. The Solo shutters also face directly through the chancel arch.

Although parts of the organ had been played during the voicing and finishing process, the organ was fully taken into use on Easter Sunday 2005, followed two weeks later with the Dedication and first dedicatory recital, given by David Hurd.

Over the following two weeks there were three more concerts, each event being planned to show off the organ in its different roles. The first was music for organ and orchestra, the final event in the Grand Rapids Bach festival. Organ concerti by Bach and Handel involved three local organists, and the conductor for the occasion was Karl Hochreither, conductor of the Berlin Bach Choir. The second event was a Festive Evensong featuring English cathedral music, with Dr Gerre Hancock conducting the St Mark's Community Evensong

Positive Manual

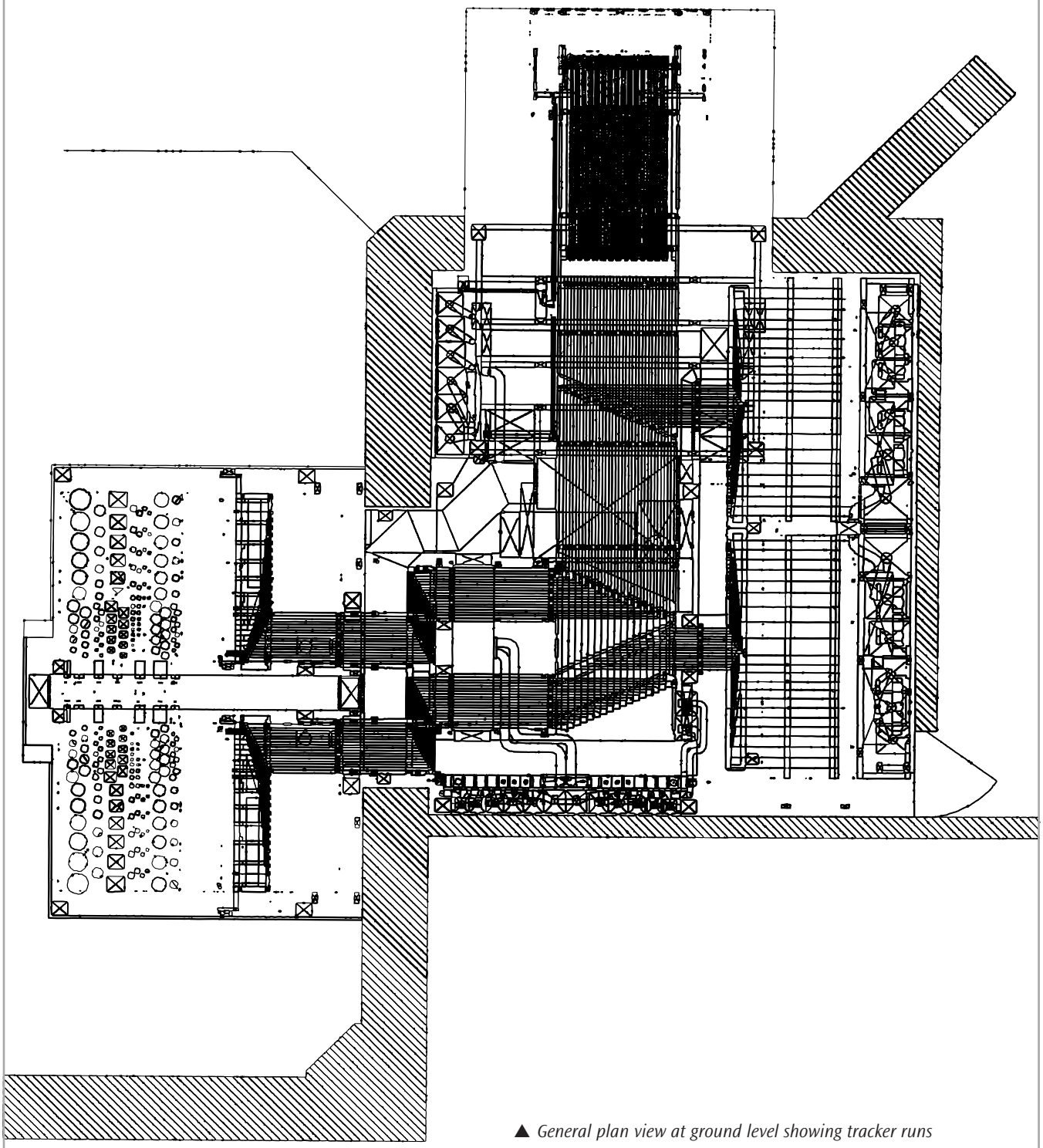
NOTE	ONE STOP	ALL STOPS	HOLD DOWN WEIGHT
C 1	4.50oz. (125g)	8.25oz. (235g)	3.00oz. (85g)
C13	4.50oz. (125g)	6.50oz. (185g)	3.00oz. (85g)
C 25	4.50oz. (125g)	5.25oz. (150g)	2.75oz. (78g)

▲ *Horizontal layers of action*

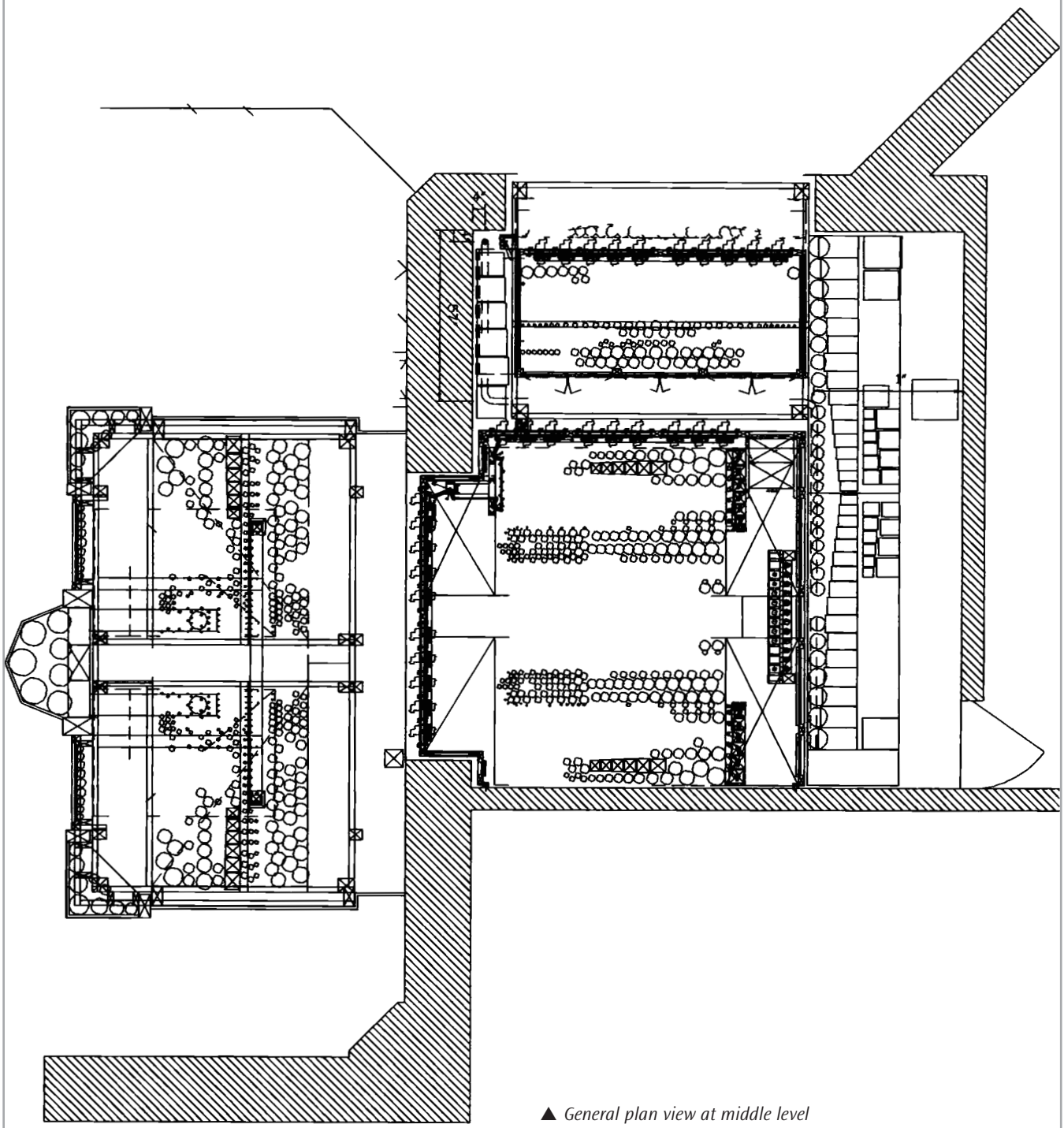
▲ *Great pipework with Positive action above*

Choir and Dr Judith Hancock at the organ. The final event was a virtuoso solo recital by Judith Hancock.

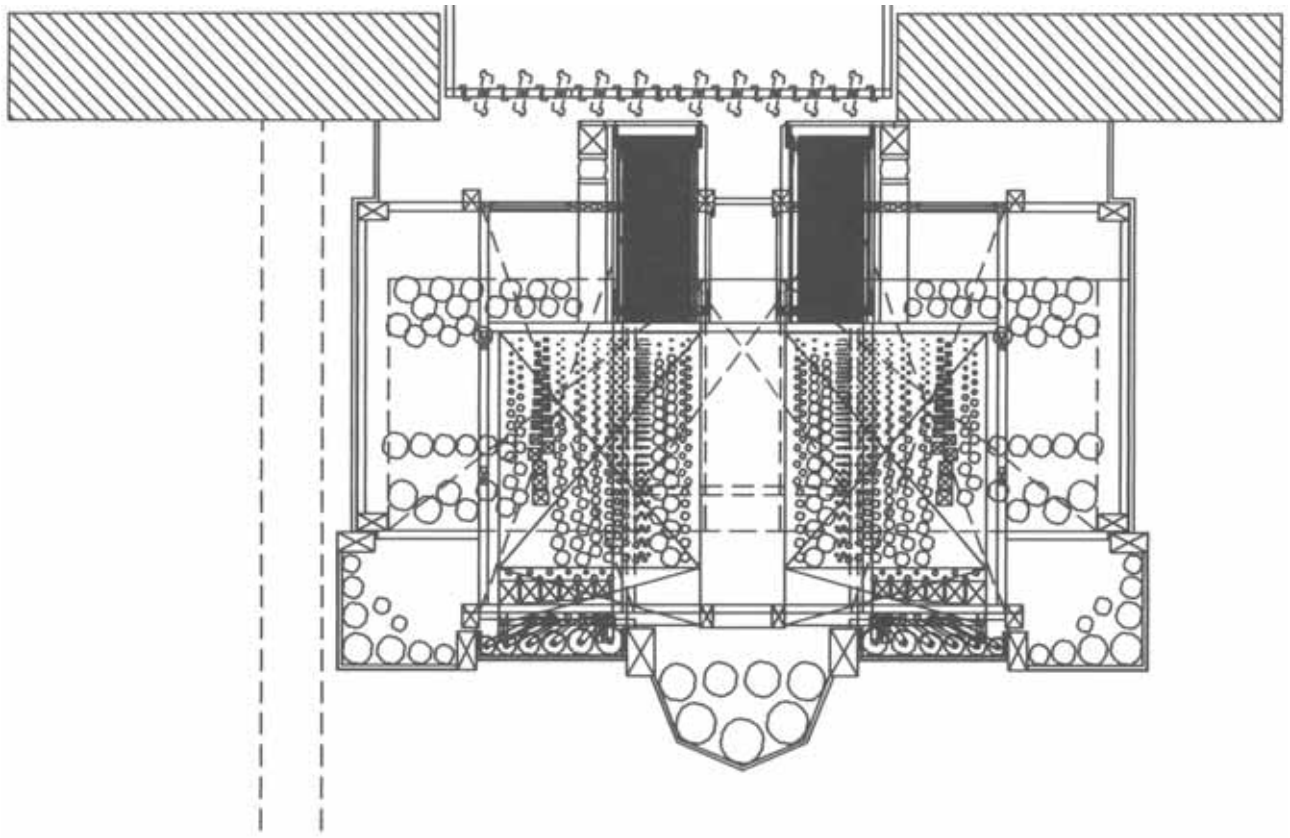
From the warm appreciation and comments that followed these inaugural concerts, we were reassured that the challenge had been met; the organ had proved able to adjust to its several roles in the musical life of the church and local community.



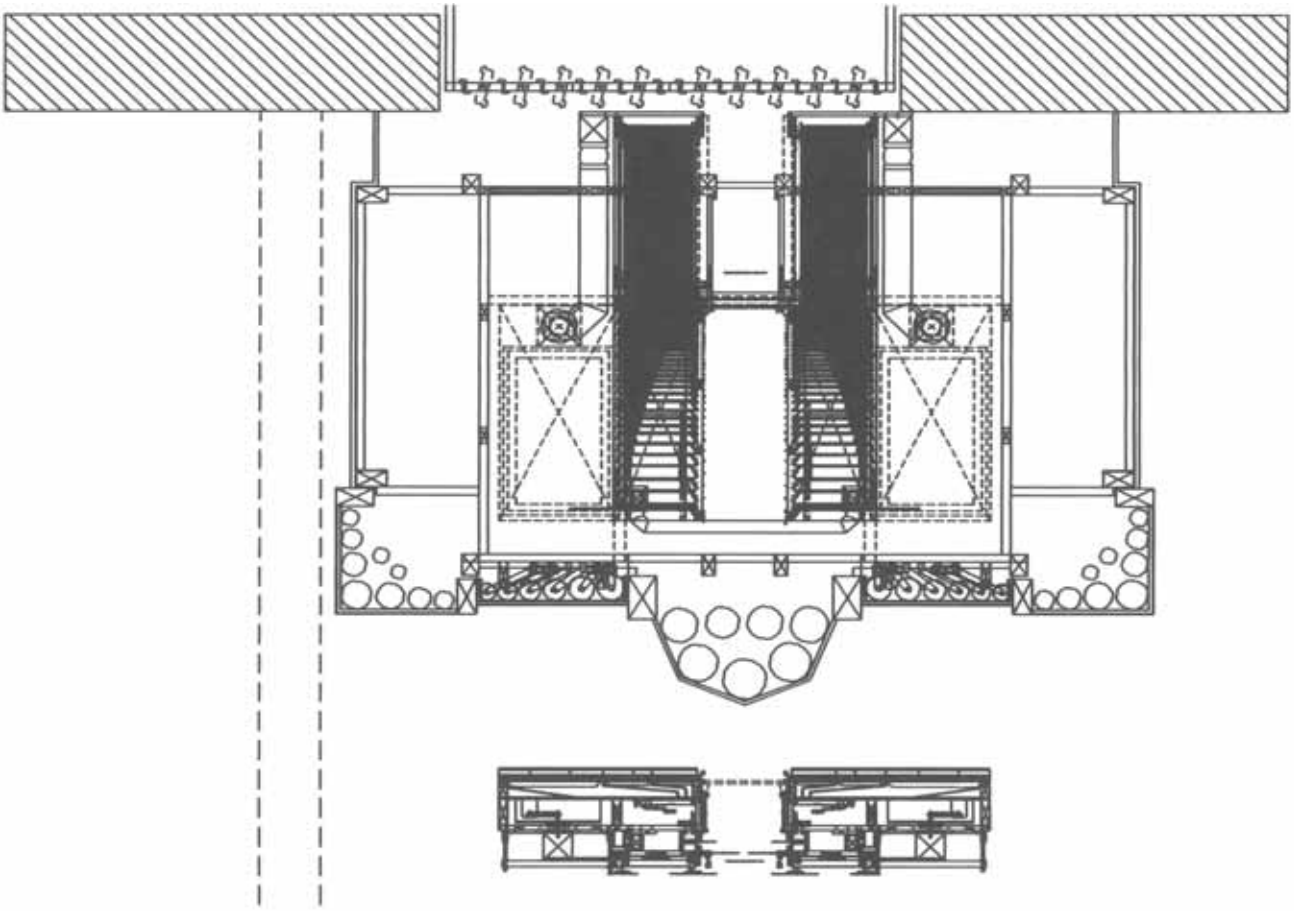
▲ *General plan view at ground level showing tracker runs*



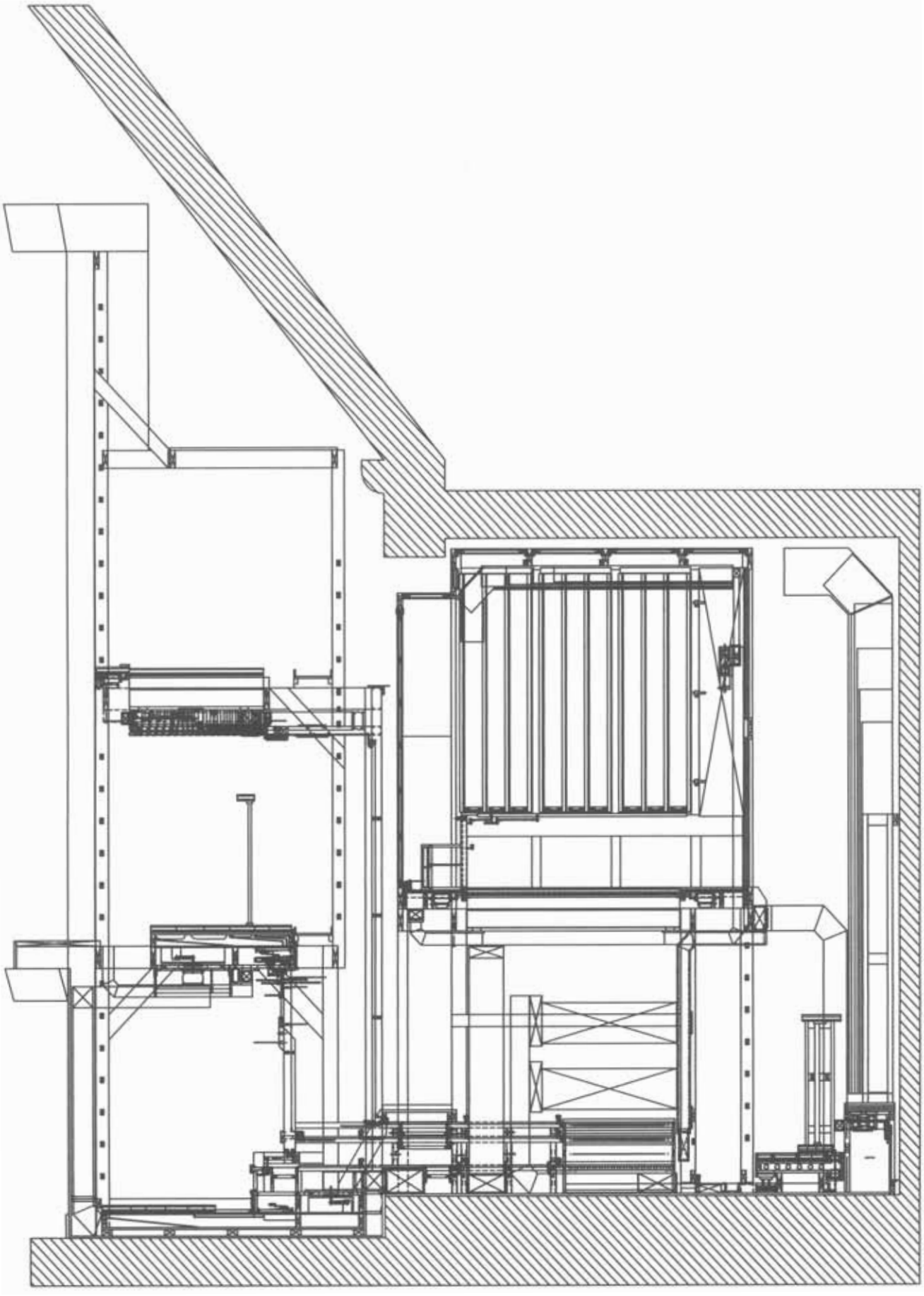
▲ *General plan view at middle level*



▲ *General plan view at top level*



▲ *General plan view from underneath the Positive sounboard*



▲ *Section through chamber and transept*