Woodworking on a Grand Scale

Pipe-organ builders combine 500-year-old designs with modern materials

by Aimé Fraser

Shavings litter the floor, and the tang of resin fills the air. A Bach fugue pours from distant speakers, but the real music in the shop is the sound of sharp plane blades on clear, quarter-sawn fir. Robert Lange and Dominick Parker, organ builders at Paul Fritts & Co. in Tacoma, Wash., are smoothing panels that will become part of the crown on the first level of a large organ case. Wide, lacy shavings curl from their wooden planes. They are two months into an almost two-year-long job.

Fifteen feet to their right, under the peak of the four-story roof, stands the foundation and lower framework of a 54-stop Baroque-style organ (see the photo on p. 85). They're building the case the same way organ cases were built 500 years ago—solid-wood frame-and-panel construction with mortise-and-tenon joints, splined miters and decorative dovetails.

By the time the case is done, Parker figures they will have cut and fitted more than 300 mortises and tenons. There will be more than 25 sets of dovetails for the corners of the three levels of crowns, dozens of splined miters for the pipe towers and miles of molding. That doesn't even take into account the woodworking required to build and fit the panels into the mortised-and-tenoned frames. Before the panels go in, Parker and Lange will install the keyboards and wind-distribution system, as well as the thousands of tiny parts that connect the two. "Organ building is pretty straightforward woodworking," says Parker. "It's just that there's so much of it."

Organs built twice: in the shop and on-site

A year and a half from now, when this organ is finished, its highest point will just fit under a beam 35 ft. off the shop floor. It will weigh more than 19,000 lbs. and contain more than 3,800 pipes. Most of this colossal instrument will be made of wood. The case is made of fir, the duct work is poplar and the keyboards are basswood and ebony. The pedals are made of maple and oak, one-third of the pipes are oak and the wind chests are redwood,

Photos: John Fitlow

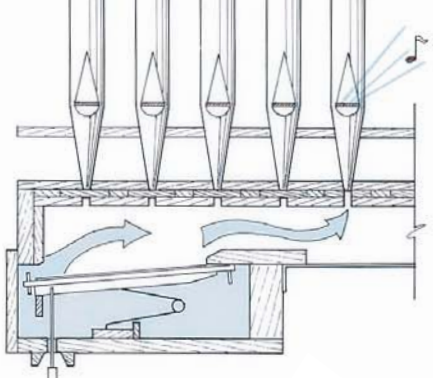
Organs are built and tested in the shop, *disassembled, shipped and reassembled on-site. The scene above is the Edythe Bates Old Recital Hall at Rice University in Houston, Texas, just after the C.B. Fisk Co. organ arrived. It took about six weeks to get the organ in playable condition and another 42 weeks to tune all the pipes properly (right).*

poplar and oak. A few months from now, when Parker and Lange finish the case, they'll also build the inner workings of the instrument the old way. The keys will open valves to deliver wind to the pipes some 30 ft. away through a complicated series of levers, springs, bell cranks and push rods; most of these small parts are made from sugar pine, maple and cherry. Virtually every piece of this instrument, from the tiny maple bell cranks to the huge lead-alloy pipes, will be built in this shop by six men. When the work is done, they'll completely disassemble the instrument and pack it for transport. When the pieces reach their destination, the builders will spend weeks rebuilding the instrument (see the photos at left), but in the greater scheme of things, it's nothing. These fine organs are built with more than 300 years of music-making in mind.

In at least a dozen small shops scattered across the United States, talented woodworkers devote themselves to the art of building organs with mechanical, or tracker, actions. These shops combine 500-year-old Northern European designs with modern tools and materials to create some of the world's finest pipe organs. Universities, churches, symphony orchestras and even private individuals from all over the world are lining up to buy these organs. They happily sign contracts for instruments that cost $750,000 or more, knowing full well five or more years may pass between signing and installation.

Old ways don't work

These builders travel extensively to learn the secrets of the great old instruments and their warm, sweet sound. But methods that worked for centuries in Europe don't work in the United States. Builders trained in classical European organ



***Two years, one organ**—This 54-stop, 3,900-pipe organ is under construction at Paul Fritts & Co. in Tacoma Wash. When finished, the organ will go to Pacific Lutheran University, also in Tacoma.*

Press a key; hear a note

In a tracker organ, the connection between the key and the valve that gives voice to the pipe is purely mechanical. Pressing the key actuates a series of levers, springs and push rods that can span more than 30 ft. The design is basically unchanged since medieval times, but today's tracker organs use modern materials, making them easier to play and maintain.

Many organists prefer the direct feedback of tracker action to electrical or pneumatic action; they say it allows subtle musical expression.

shops say seasonal wood movement is three times greater in the United States than in northern Europe. "We study the woodworking in the old instruments," one builder says, "but we can only use it as a guide."

A perfect example of the difficulties in transferring classical organ building to the United States can be found in the wind chest, a complicated box that distributes wind to the pipes. In most modern organs, the wind is supplied by a high-volume electric turbine. The low pressure (only about 0.1 psi) is maintained by expanding wood and leather boxes weighted with lead. From there, the wind is channeled to the wind chests through ducts, called wind trunks. The wind chests (six or seven in a 50-stop organ) are located throughout the case to spread both the weight of the pipes and the sound they produce.

The size of a wind chest depends on the number of pipes it supplies. In a big organ, the wind chests are something on the order of 4 ft. wide by 8 ft. long by about 4 in. deep. The chest is built like a torsion box with an oak grid and thin wooden skins, called tables, glued to the top and bottom.

The old way of building a wind chest was to make it entirely of oak, including the ¼-in. tables. If it were built that way in the United States, it would crack in just weeks.

Some modern builders make wind-chest tables from high-quality plywood with many plies and no voids. A typical wind chest supplies several hundred pipes, and with so many holes in such a small area, a void in the plywood would be a problem. Air could leak between channels, causing two notes to sound when only one is intended. Plywood's dimensional stability makes it ideal for wind-chest tables. But some say plywood might affect the organ's sound; they maintain plywood has no place in the inner sanctum of an organ.

Thirty years ago, when classical organ building was new to the United States, builders studied and tested a variety of native woods to find a species stable enough to stand the tough environment of a wind chest. Some builders settled on red cedar, some on redwood and others on basswood as table material. These tables are glued up from narrow boards and attached to the grid with yellow glue.

Lately, some organ builders have started using boat-builder's epoxy and consider it to be a big improvement in wind-chest technology. Unlike yellow glue, epoxy adds no moisture to the assembly. When applied all over the undersides of the table, epoxy stabilizes the table and fills any gaps between it and the grid.

The tracker keyboard action is mechanical

Many organists favor tracker organs because the direct link between their fingers and the pipes gives them control over how the pipes begin and end their speech. The effects are subtle, but to a sensitive ear, tracker organs are profoundly expressive.

The design of the tracker action has changed very little since medieval times (see the drawing at left). It relies on three principal pieces to connect the keyboards to the valves (called pallets) in the wind chests located above, behind and off to both sides of the keyboards.

Most of the distance is spanned by trackers—3/32-in.-thick by ⅜-in.-wide strips of sugar pine, varying in length from 8 in. to 12 ft. long. Tiny maple squares take the trackers around a corner, changing the movement from up and down to in and out. As the trackers and squares leave the keyboard, they are as close to-

Photo this page: Aimé Fraser; drawing: Vince Babak

gether as the keys on the keyboard. At the wind chest, the trackers need a wider spacing to match the pipes. Parts called rollers change the spacing over the horizontal distance between the keyboards and wind chests. A big organ has some 2,000 action pieces. Keeping all these small wooden parts aligned in all seasons is not easy.

The old rollers were oak, round or hexagonal in section. For stability, the rollers were mounted on thick boards pieced together from small blocks with opposing grain. But even under the best conditions, the roller boards warped. These days, most builders mount the rollers on ¾-in. plywood boards, and many builders use metal rollers with nylon bushings. The new assemblies are smoother and quieter, and they stay in adjustment for decades.

Organists who played in the old European churches took it for granted that they'd have to spend a lot of time and energy adjusting the action and developing the finger strength to play through minor misalignments. That's no longer the case, thanks to modern materials. Today's tracker organs are much easier to play and maintain.

Today's trackers and squares look very much like the old ones. Most are made of wood, but some builders use aluminum when an instrument has more than 54 stops or will be installed in a place with climate extremes.

The trackers and squares of both materials are made with modern drilling and cutting tools, something the old builders didn't have. The precision of modern tools makes a good, tight fit between the parts of the action.

Simple tools build complex instruments

Organ builders tend to be multi-talented people. In most shops, every builder can and does work wood, and they are all expected to have other skills as well. For instance, the craftsman who spends most of his time making metal pipes might also build the wooden pipes.

The wooden pipes are basically rectangular boxes, but they're not easy to build. No two are alike. They range in size from 30-ft.-long pipes, weighing 300 lbs., to pipes smaller than a penny whistle. Pitch and tone vary with wall thickness. A high degree of woodworking skill is needed to cut and shape the wind channel through the pipe's mouth.

By the same token, the craftsman who spends most of his time doing old-fashioned woodworking on the case might help out in the metal shop on the lathe or by doing some of the preliminary pipe tuning. Many shop workers pride themselves on being able to build every single piece of an instrument. This self-sufficient attitude is obvious in the kinds of machines found in a typical shop. Organ builders don't buy specialized tools. It's all basic industrial-quality stuff; none of it is huge.

In their shops, you'll see tablesaws, bandsaws, metal lathes (used for wood and metal), chop saws, radial-arm saws, jointers, planers, grinders for sharpening and, maybe, wide-belt thickness sanders. The only thing different from scores of other woodworking shops are the multiple radial-arm drill presses occupying places of honor. Machines, though, aren't the focus of an organ shop. Hours go by without the whine of a machine disturbing the peace of handwork.

Hand tools are at the center of the organ-builders' trade. You'll see planes, chisels, scrapers, saws and knives in all sizes, but no specialized organ-building tools handed down through the ages. Most shops work in the metric system, and there are plenty of metric tapes and rules around for frequent checks against computer-generated plans. Building an organ is slow, careful work, and the simple tools reflect the fact that there are no shortcuts.

If you listen to Bach played on a modern tracker organ, you'll understand what the 19th-century French novelist Honoré de Balzac meant when he said the organ is "a pedestal on which the soul poises for a flight forth into space." While you're preparing for takeoff, pause for a moment to remember that the platform was built by skilled woodworkers, one small piece at a time. □

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Photo above: Greg Bahnsen