MIDI-fication of a Bruder Fair Organ

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In April, 2008 I purchased a 52-key Bruder carousel organ from Ron Bopp. This organ plays book music. It has been and continues to be one of the more enjoyable and significant musical purchases in my collecting career. This organ came with over 1,100 meters of book music, most of which is pleasant to listen to; however, much of it is totally unfamiliar to me and most listeners. I knew almost from the beginning I was going to do something to enlarge the music inventory to include more modern music. There are several ways that a Bruder owner can enlarge his music collection. He can buy previously punched books which are quite scarce and expensive, or he can punch his own, which is quite time consuming. I have been told that it takes approximately eight hours of punching to produce 3 minutes of music. The other alternative is to modify the Bruder to enable it to play with a MIDI system,(Musical Instrument Digital Interface). The MIDI system allows music to be brought in from outside sources, modified to fit the Bruder format, installed on the computer in the MIDI system and play quite well I might add. I received the music from Bill Klinger on my home computer, transferred it to a thumb drive and then loaded it onto the computer on the Bruder. The supplies needed and the suppliers needed for the MIDI system are:

Direct Electric Valves: for the Bruder, you will need 52; however, it is suggested that 55 be bought in case some get damaged. I chose Peterson organ valves, 90 ohm, ½ inch. They retail for a little over $6.00 each. You can see these valves in their catalog on page 28 and 29 at www.petersonemp.com. Organ Supply Industries also makes a similar valve.

Driver Board: I recommend the j-Omega for simplicity and price. This is model MTP-8: 64 note MIDI-to-parallel converter. The price was 89 pounds and the total with shipping from England was less than $200.00. Find this at www.j-omega.co.uk. A small MIDI routine is run into the board to set it up. An interactive form on the j-omega web site provides this setup routine in a few seconds after filling out the form.

Power Supply: We used an Astron 20 amp. I bought it used from Bill Klinger for $50 plus shipping. I think he might have a couple left. You can find used ones on eBay for little more but from Bill you know they are going to work. The organ will never draw more than about four amps, thus a smaller supply could be used.

Computer Interface: This is a small device that goes between the computer and the driver board. It transfers the MIDI files to the organ. The UX16 powers off the USB port in the computer and plugs directly into the j-omega board. We suggest you use the Yamaha UX 16. It will be about $40.00 plus shipping and can be purchased from www.musiciansfriend.com. A similar device is a "MIDIman," price and operation the same as the UX16. Software upgrades for UX16 are available on the Yamaha web site.

Computer: The computer needed to run this MIDI is minimal. I acquired a used small lap top for $60.00 which has proven to be more than adequate. If you are transferring files with a portable drive, a second USB port is nice to have and is essential if the mouse needs a USB port.

Creating the valve board: (Tom Hutchinson)

This organ belongs to Tom Hutchinson and is located in Sturgeon, in central Missouri. The first step after receiving all the materials was to construct a valve board, sometimes referred to as the manifold board or toe board. This is the board onto which all of the Peterson valves are mounted. See **Figures 1, 2 & 3**. Technical advice and time for building this board was graciously given by Kenneth Kavanaugh of Columbia, Mo. I chose to make the valve board from hard maple which works

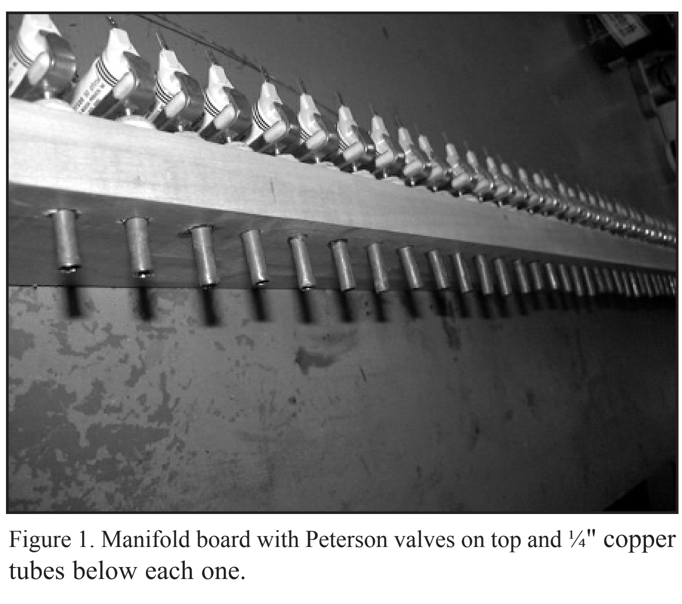

Figure 1. Manifold board with Peterson valves on top and ¼" copper tubes below each one.

fine but because of its hardness is difficult to work. I was informed by Mr. Kavanaugh that many of these valve boards in even major pipe organs are made from tulip popular. Softer woods than the maple I used will most likely require filling the holes with shellac or thinned glue to seal against any leakage between the holes.

Figure 2. Manifold board from above showing the Peterson valves and the copper ground wire connecting each one together.

This board is 52 ½" long by 3 ½" front to back and 1" thick. It was left ¼" shorter than the inside dimensions of the Bruder to facilitate ease of getting it in and out. Small support blocks were screwed onto the inside of the Bruder at each end to support the valve board. There isn't much leeway on the inside as to where the valve board must be placed. It is a compromise between the items it must clear and be in a position where it can be worked on. Placing it too low and it would run into the organ crank shaft at the right end and too high it would interfere with the Driver board on the left end. One of the more time consuming parts of making this valve board was determining valve placement on the board. I strongly suggest that you do all your marking on the board with pencil. It sands out easily whereas ballpoint pen is very difficult to remove from the wood. Planning the proper spacing for the valves is important for function and looks. Remember you have 52 valves which have to fit into 50.5 inches; note 1" on each end of the valve board is taken up by the support blocks. Each valve has a ½" foot print. I initially tried to determine the valve placement using inches but that did not work because inches don't allow for precision that the metric system does. I ended up converting all my measurements into metric and then dividing the length by the number of valves which thus gave me the space that was available for each valve. I marked with a pencil the center where each valve should seat. Once the spacing has been laid out you are ready to drill your holes. Since the Peterson valves I used have a ½ inch foot or pad, a ¼ inch hole will work fine. I drew a pencil line 3/4 inch back from the front of the board, the complete length of the board. This line intersected with the valve spacing lines in the previous step which thus gave the point where the hole should be drilled. Drill the holes all the way thru and make sure no residual debris is left in the holes. Next obtain a reel of ¼" OD copper tubing and cut 52, 1 ½" pieces. I cut them into pieces using a band saw for speed. The rough ends were then cleaned up using a motorized wire brush. I cleaned out the lumen on each end of the copper tube with a small round file. These small tubes must be clean as they will be the conduit for the pressure that activates the Peterson valve.

It needs to be pointed out that the ID of the copper tube is still larger than the holes in the key frame. I dipped one end of each copper tube into Titebond III glue and inserted it about ½" into the hole on the bottom side of the valve board. Once all copper tubes have been inserted into the board you are ready to set the Peterson valves. (An alternate material for the tubes would be ¼" brass tubing from a hobby store.) Peterson makes a valve setting guide to assist in positioning the valves. I had borrowed one and found it awkward to use. I developed a technique which I found to be easier and more accurate. I located a washer that was the exact diameter of the foot of the valve, ½", with a ¼" hole. Using a large Phillips screw driver as a centering device I positioned the washer over the hole and inserted the tapered point of the screwdriver into the drilled hole. This caused the washer to be exactly centered on the hole. I then drew with a pencil around the washer. This gave an exact position of where the foot of the Peterson valve had to be. Peterson suggests using #6, ¾ inch slotted hex washer head sheet metal screws but I used a 5/8" because that's what the hardware store had. It is much more economical to buy a box of 100. It is important to follow the instructions carefully as the valves must have the proper amount of lift to function. Before screwing down the Peterson valves it is important to sand to a smooth flat surface. I sanded thru 400 grit paper which on the hard maple gave a glass smooth surface. You will need a proper size nut driver as a lot of force is needed to make the prongs of the valve dig into the wood. If the wood you use is softer than the hard maple I used it will be fairly easy to make the little prongs on the back end of the valve dig into the wood to stabilize the valve and make the frame sit flat against the valve board. Next I soldered a continuous piece of wire to the back contact of the valve. This becomes the common ground for all of the valves. It is not necessary to use diodes on the Peterson valves since the MIDI driver board does this function.

Figure 3. Another view of the manifold board from above—the copper wire on the left will be connected to the MIDI circuit board.

Figure 4. Bruder valve chest showing lead tubing cut to insert plastic Tees. Right-most Tees were inserted directly into the chest.

Connecting the valves to the existing tubing: (Bob Stout)

This text picks up on the MIDI-fication of the Bruder following the creation of the valve board. This Bruder has ¼" lead tubes connecting the key frame to the valve chest, which is why we used ¼" copper fittings on the Peterson valve board. See **Figure 1**. It was determined that teeing into the lead was the simplest approach, using ¼" plastic tees from Player Piano Company (PPCo) in Wichita, KS, and ¼" ID rubber tubing from the same source. We ordered 55 tees and 100 feet of tubing to make sure we had enough. The old PPCo catalog showed the tees as having smooth legs, but the ones we received had barbs. I could have ordered barbed ones from other sources, but wasn't sure they would work. Apparently smooth sided ones were no longer available, so PPCo sent what they could. It turns out they worked just fine.

Figure 5. Another view of the Bruder valve chest showing some tees attached to the lead tubing.

At first I tried pulling the lead tubes from the valve chest. By wiggling and pulling I was able to get several of them released. It was then a simple matter of tapping a tee into the hole in the chest left by the lead, and coupling the tee and the lead together with a short length of rubber tubing. The leg of the tee was then connected to the corresponding copper fitting in the Peterson valve board (**Figure 4**). I used a one-to-one relationship—tee #52 to valve #52. I started with the lead tube the farthest from the tracker bar since it was the least congested. This approach of pulling the lead tubing from the chest was abandoned after two of the tubes broke off flush with the valve chest and had to be removed by screwing a large screw into the lead stub and working it out. The next (and final) approach was to cut a section of the lead out to insert the plastic tee with rubber coupling tubes (**Figure 5**).

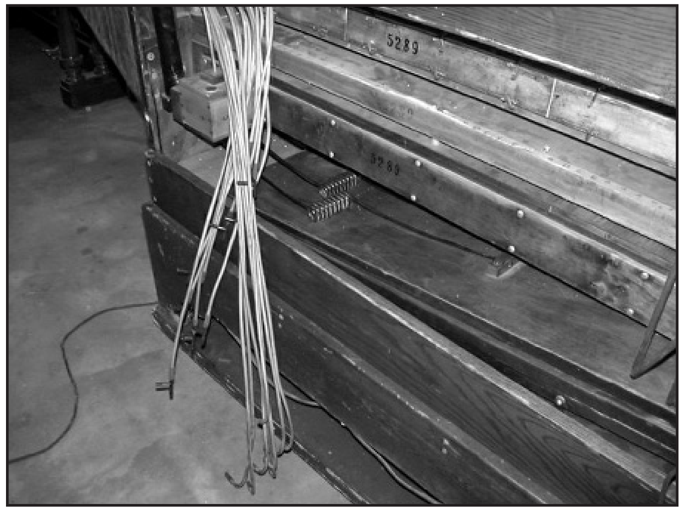

Figure 6. This view shows the longest lead tubes moved down and out of the way of the tubing closer to the key frame.

The lead is quite thick, with a side wall at least 1/16" thick. This is fortunate, because I had to move large bundles of the lead around to gain access to the sections I had to remove, and it became more congested the closer I got to the key frame (**Figure 6**). Using a hack saw was too awkward because of the tight space problems, and a miniature tubing cutter didn't have enough room to make rotations around the tube. We ended up using a commercial tool called a Foredom flex shaft with a

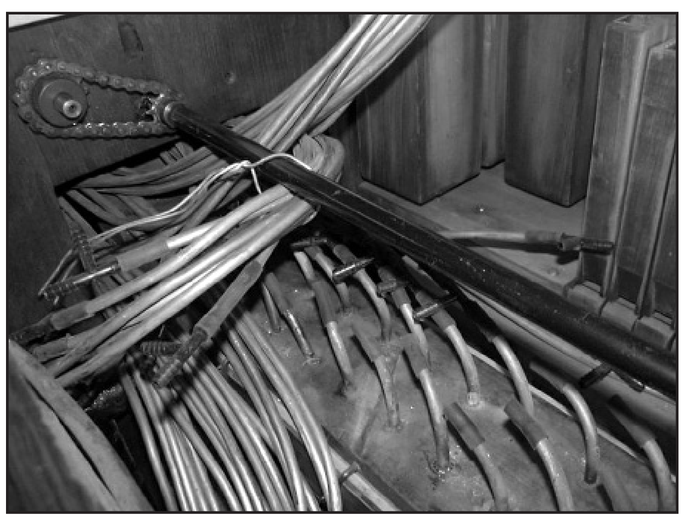

Figure 7. A closer view of the tubing closest to the key frame on the left of the Bruder.

corundum cutoff tool. It's like a large Mototool(tm), with a footswitch that lets you use both of your hands. Even with this tool it was a challenge to get access to the areas I needed to cut out (**Figure 7**). Also, after removing each section it was necessary to flare open the inside of the lead tube since a metal burr is created by the cutting process. I used a regular awl for this.

Figure 8. The ¼" rubber tubing is connected to the middle leg of the Tee.

Another point I should mention is that I cut this section from the horizontal portion of the lead to minimize the possibility of lead particles getting into the valve chest. Since this is a pressure model, I believe any extraneous particles would be blown out during normal operations. Because of all of the rearranging I had to do to the lead tubing in order to do the splicing of the tees, I connected the section of the tubing from the tee to the Peterson valve board last, after repositioning the lead tubes. **Figures 8 & 9.**

Figure 9. The rubber tubing is connected from the Tee to the cooper fitting on the bottom of the manifold board.

Installing the power supply was next. This supply is large and heavy, but fit nicely under the organ. It is only necessary to connect the positive and negative leads to the MIDI board. The ground connector on the power supply is not used.

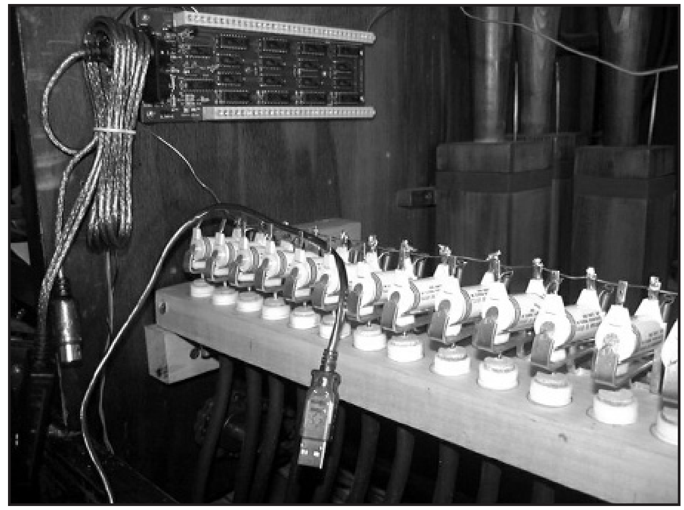

Figure 10. The MIDI circuit board is mounted on the left side of the case. The USB cable connects the Yamaha interface to the computer.

The next step was to wire the MIDI board to the Peterson valves (**Figure 10**). Tom had already soldered on the common copper wire to the ground leg of the valves, so this wire was connected to the proper connection on the MIDI board. This circuit board uses screw connectors that make it easy to connect the wires to it without soldering. For wire, I had a leftover cable of wires from an old pipe organ setup. I split open the plastic cover on the cable and pulled out the wires which were several different colors, which helped keep things in order. This wire was light-weight gauge (probably #22 or #24) and solid strand. Multi-stranded wire can be difficult to work with since you have to twist the wires into a tight bundle to feed thru the tiny hole in the Peterson valve connector. **Figures 11 & 12**

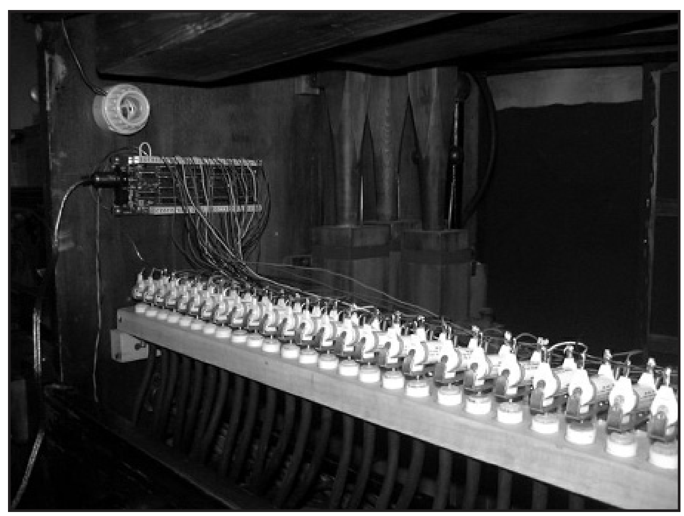

Figure 11. The MIDI circuit board is wired to the Peterson valves according to the predetermined sequence.

The MIDI "notes" on the circuit board are numbered 1-32 along one side of the board, and 33-64 along the other side. The circuit board comes with a standard MIDI layout built in, which was not going to work for our setup. Bill Klinger created a new configuration file for us that he sent as an e-mail attachment. It was simply a MIDI file that played the notes in a logical

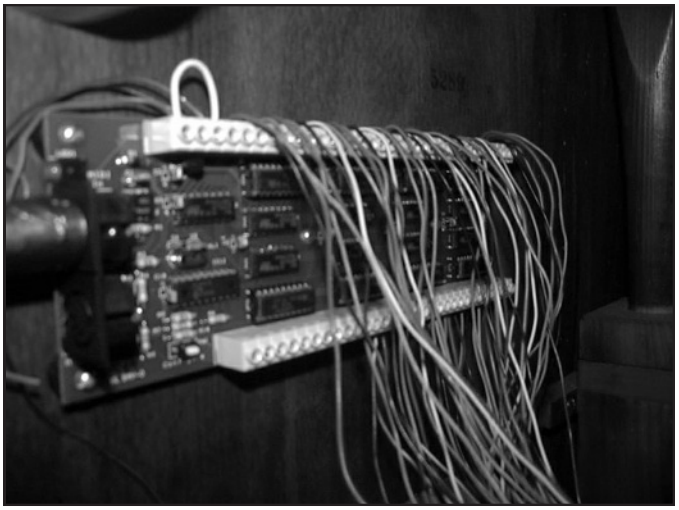

Figure 12. A closeup of the MIDI circuit board with completed wiring. The white jumber wire is necessary to power the board and described in the circuit board instructions.

order—the lowest bass notes first (in our case, 'F', 'G', etc) the percussion instruments were last. By setting the MIDI board in "configuration" mode, and playing this file as if it were a musical composition, the MIDI board was reprogrammed to our particular needs. One thing that needs to be kept in mind is that the MIDI board expects 64 notes to be played. Since we only have 52 "notes," Bill had to pad the configuration file with 12 null notes for the configuration process to complete normally. The circuit board is NOT connected to the Peterson valves on a one-to-one basis like the tees were. It is connected in the order the Bruder valves are activated, according to the tracker scale, and the corresponding note on the configuration file that Bill created. In this case, MIDI connector #1 goes to the lowest 'F' note, which is Bruder valve #50 (counting from left to right as you look at it from the back of the organ). Connector #2 goes to the lowest 'G' note, which is Bruder valve #4. Not being a band organ expert, I have no idea why the notes are laid out so haphazardly. It certainly was confusing, but after I translated the tracker scale to Bill's configuration layout, everything proceeded smoothly. I used a low wattage pencil soldering iron, and resin core solder designed for delicate circuit board work. After the soldering job was complete the wires were bundled together with twist ties to keep them neat.

This completed the MIDI conversion. All that was needed now was to turn on the power supply, connect the Yamaha MIDI interface from the computer to the MIDI board (connect the MIDI OUT cable to the MIDI IN port on the circuit board), load a music file provided by Bill Klinger into the Van Basco program and click "Play." The Peterson valves opened and closed with a satisfying little click. With the Bruder turned on, everything blazed away with a great feeling of satisfaction and a job well done. **Figure 13**

Technical Section: (Bill Klinger)

When Tom came to me about adding a MIDI system to his 52-key Bruder organ it sounded like an interesting project. Consideration was given to put the MIDI interface into the organ in such a way that it would not interfere with access for tuning or disturb the book-playing mechanism in any way. The original tubing from the key-frame to the organ was a large bundle of extruded lead tubes. It was necessary to cut into these tubes and "Tee" off to the valves that would open the ends of the tubes like the book music from the MIDI files.

The magnet manifold board was described earlier. The valve magnets on the manifold and the MIDI board require a source of 12 volt DC power. The board also has a MIDI IN plug on it. A cable harness runs from the driver board to the manifold and contains the 52 magnet wires and a single common return. A regulated supply over five amps is sufficient to operate both the magnets and the MIDI driver board.

Tom is using a simple laptop computer as the MIDI source. Using a small computer with some of the available audio file programs like Win-amp or Von Basco allow the user to make up play lists or access any single file. There are numerous other MIDI player devices available. IttyMIDI uses a Palm Pilot and there is another unit that uses a SD memory card.

The Bruder presented a challenge because the range and musical keys in which the organ plays do not match up to music from any other builders and simple transposition does not work. Sources of music would be from other 52-key Bruder collections or possibly getting an arranger to work within the Bruder scale. I did revise a couple of Wurlitzer 125 tunes just to see how they sound. This meant using only a portion of the Bruder's range and moving one bass note so it would play a different note on the Bruder.

I knew almost from the beginning I was going to do something to enlarge the music inventory to include more modern music—T.H.

Figure 13. A back view of the completed Bruder installation.

There are a number of MIDI drivers available but we decided for simplicity to go with the j-Omega unit. One consideration was the division of the MIDI channels. The j-Omega driver is programmable and will drive 64 outputs. It is the only board that I am familiar with that will drive any note on any channel after it is setup. With this feature, the single 64-note driver was partitioned to Bass, Accompaniment and Melody on channel 1, Counter-Melody on channel 2 and percussion on channel 10. This organ has only 4 control functions, 3 of which were also assigned to channel 10. The setup of the board is done one time and is retained by the board even when the power is turned off. This is done by "playing" a short MIDI file into the board after holding down the configure switch. This MIDI file plays each note in succession one time. After that, any MIDI file with the same arrangement of notes and channels is recognized. The 12 unused notes were assigned to a non used section of channel 10. If they were to be used sometime in the future, the board can be reprogrammed from a new MIDI file.

For simplicity of editing and seeing what is playing, I assigned the Bass, Accompaniment and Melody to channel 1. Because there is a three note overlap at the top of the Accompaniment and the bottom of the Melody, I pushed the Melody up one octave. The sound playback on the computer plays one octave up but the wiring in the organ magnets puts it back to the right place when the organ is playing. I did this so all the melody playing is on one screen in Cake Walk or MIDI Orchestrator. The Counter-Melody is on channel two in its correct position which overlaps both the Accompaniment and Melody. For simplicity of editing, the Trumpet OFF was placed at the top of the staff on channel two. The normal operation is that the lower 9 counter-melody notes play both the trumpet and cello unless the Trumpet Off perforation is present. The percussion is assigned to channel 10 along with the other three controls. The controls are Soft, Loud and an un-assigned hole which may have been used for the conductors arm movement.

Now that the organ is playing from both the original cardboard books and the MIDI adapter, plans are to scan the book music into MIDI files. Many of the older books are starting to become fragile and need constant maintenance to make them playable. Tom has both a punch and new blank books. As time allows, some of the older music will be duplicated in book form.

All photos by Bob Stout.

Tom Hutchinson is a retired University of Missouri faculty member and businessman. He has been restoring and collecting mechanical musical instruments for over 25 years. He has a collection of over 5000 rolls which have a time span of over 100 years. His instrument collection can be seen and heard at, www.playerpianogallery.com.

Bob Stout rebuilt his first player (a Waltham upright with Standard action) while attending computer school in Salina Kansas. Jerome Hill, a fellow AMICA member now retired in Texas, was his computer instructor and a longtime player rebuilder. This was 1971, and the punched holes in the computer cards along with the paper piano rolls, captured Bob's imagination. After moving to Kansas City, looking for computer work he met Roy Ireland. Roy took him under his wing, teaching Bob the piano side of the business and tuning. That was 34 years ago. Jerome Hill thought he was teaching Bob to be a computer programmer—little did he know how the seed he planted would grow.

Bill Klinger is a semi-retired pipe organ technician. He has been working on theater and church pipe organs for over fifty years. He started bulding small roll-playing crank organs six years ago. He recently constructed a 1200 square foot organ shop on his property in northern Arkansas. The new shop is equipped for wood and metal working. Current projects are a reproduction Caliola and a MIDI-controlled band organ for the back of his pickup truckto be used in local prardes.