Building a 43 note Calliope

Now if you are wondering what on earth is a "Calliope" ? (pronounced 'cal-eye-o-pea' although some American aficionados pronounce it 'calleyopey') .Calliope was the Greek Muse of eloquence and heroic poetry. How she got mixed up with a brash musical instrument is anybody's guess. In the pipe organ world Calliope was originally a steam driven organ comprising thin walled tubular brass steam whistles in a musical chromatic scale and played from a keyboard or a or a piano type roll. It was invented by Joshua C. Stoddard and first displayed in 1856. The first instrument had 15 whistles, of graduated sizes, attached in a row to the top of a small steam boiler, originally played by a cylinder with protruding pins like a barrel organ. Later, Stoddard replaced the cylinder with a keyboard, the pipe valves were operated by wires attached to the keys, in this form it was first played by his daughter (perhaps her name was Calliope ?). Because of the high pressures used, it was very loud and brash and meant to attract attention. It was usually employed by showmen running carousels or other amusements, or by circus folk during the early part of last century and in the late 1800's.

Photo 1. The Final Result

The air calliope of course uses air and not steam and it too usually was run on high pressure from a blower powered by either a petrol or electric motor . The one described here is run on lower pressure (about 3 inches water gauge) but it can be run on higher pressure (up to about 8 inches, some commercial ones used up to 28 inches or between 3/4 and 1 1/2 PSI) but more of this later.

The project started through discussion between 3 friends who have an interest in organs, and theatre organs in particular. The basis for ideas on construction was from an article written by A.K. Brill describing the construction of a 43-note air calliope and two commercial calliopes, the American Tangley and National Calliope,. Brill was an interesting character, a Jewish newspaper reporter, he established several Illinois papers and had an chequered career. Standing 5 ft 5 inches he became a lion tamer's assistant, was set upon by a mob after publishing a story about a local politician who placed boxes in front of slot machines so that children could gamble, and got fired from one paper after exposing a mayor who turned out to be a stockholder of the paper he worked for.

He was interested in circus, carnival and illusionist equipment and for years went about examining it, making measurements and drafting plans for what he had seen. He then catalogued this material and sold individual plans of various items for two to five dollars. He did this for many years and his plans were widely used. He once claimed that 40,000 people had earned a living from his plans. He did write up plans for a 28 pipe calliope run by a vacuum cleaner motor.

The idea of adopting automatic operation using modern electronic control with the music recorded on E-prom (**E**rasable **P**rogrammable **R**ead **O**nly **M**emory) was seen as a feasible option since two of the group were electronic whiz kids. They have now departed to other climes so automatic operation is on hold for the present.

Originally we were going to construct the pipes of brass and some were made of brass and copper pipe from the scrap metal yard. However, the scrap metal yard is an unreliable source, so commercially available material was investigated. Thin walled brass tube of the required dimensions is no longer available and commercially available brass proved to be prohibitively expensive so alternative material was investigated. Plastic drainage and water pipe was considered the best alternative since all material could be obtained for about $50. Other material was sourced from garbage tip recycling depots and included vacuum cleaner motors (for the blower) at $3 and electronic organ keyboards for about $5. Solenoid valves to operate the pipes are a bit more problematical, luckily, one of the members has been collecting pipe organ components and had several pipe chests containing solenoids. Otherwise, solenoid valves are likely to be quite expensive, up to $30 each! If you can't get the solenoids described later, you could try plumbing and garden irrigation suppliers or search the internet for solenoids. You might find something you can modify to suit your needs. Construction of the pipes is the most difficult part of the project and details of construction of both metal and plastic pipe will be given here. It is a distinct advantage if you have a lathe for this part of the project. A metal lathe fitted with both compound and cross slide makes the construction much easier. However construction can be done using a wood lathe but you will need to rig up some extra attachments, particularly for constructing plastic pipes. A little Aussie ingenuity would probably enable you to construct plastic pipes without a lathe. You need some sort of a spindle to hold the pipe while you cut the slots. Metal pipes (that is , brass or copper) are simpler since the pipe consists of two parts connected by soldered bridges.

The Wind Chest
You will probably need to build the wind chest before you make the pipes since you will need a source of air for setting the gap and for voicing and tuning.

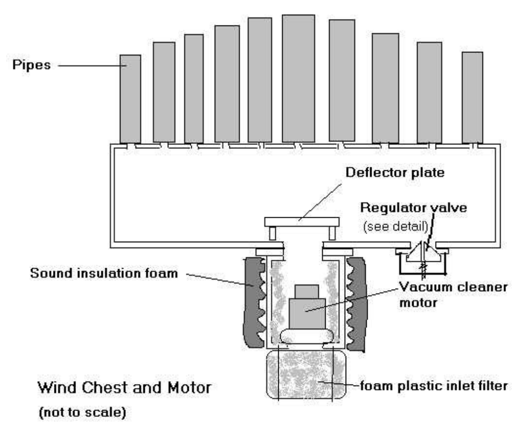


Fig 1 Wind Chest

The chest top and bottom are constructed from 12mm (1/2") fibreboard (MDF). The sides were made from 20mm (3/4 inch) solid timber, in my case 150mmX 19mm (6"X3/4")DAR pine. Dimensions to the top were 900mmX375mm (approx 3ft by 1ft 3ins.). If you are constructing a 48-note calliope such as the one I finally built, you will need a larger top, about 3'6" X 1'6". A regulator valve is fitted on the base to spill excess air and is adjustable to set the required pressure. The cone shaped design was found to be better than a trap-door type because the high air volume tended to draw it closed due to the Bernoulli effect.

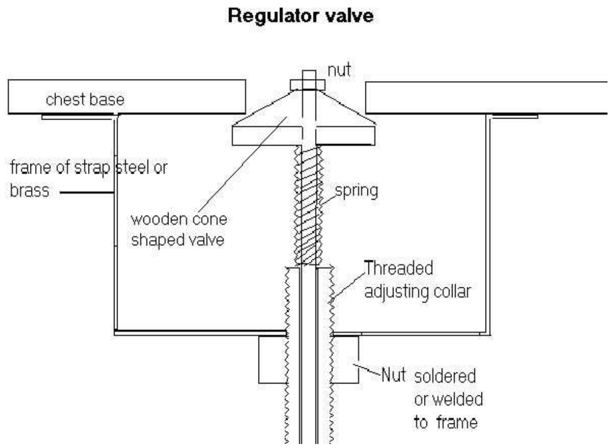


fig 2 Regulator Valve

O O O O O O O
7 5 3 1 2 4 6

O O O O O O O O O O
17 15 13 11 9 8 10 12 14 16

o o o o o o o o o o o o o
2 9 27 25 23 21 19 18 20 22 24 26 28 30

o o o o o o o o o o o o o
43 41 39 37 35 33 31 32 34 36 38 40 42

Pipe Layout on wind chest top (not to scale)

The air supply was from an old vacuum cleaner motor but any blower which delivers approx. 20 cubic ft per minute will do. The vacuum cleaner motor is very noisy and requires extensive covering with sound-proofing plastic foam. The box covering the motor will vary in size according to the dimensions of the motor. I used a 1200 watt motor but a smaller one (say 800 watt) would be adequate. Better still would be a blower powered by an induction motor since this would be almost silent. However, once the calliope is playing, it will drown out the noise of the motor!

In order to measure the wind pressure, you will need a manometer which is a piece of clear plastic tube bent into a u-shape and partially filled with water, and with a ruler at one side to measure the water column displacement (see fig 3)

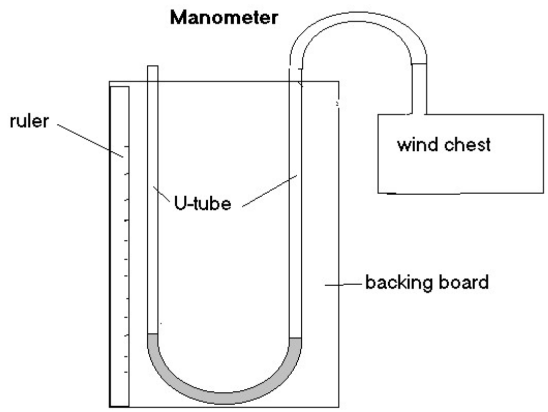
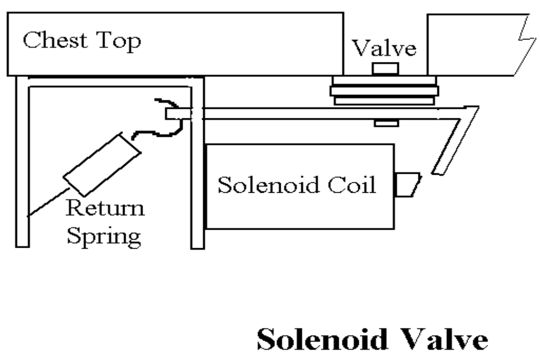


fig. 3 Manometer

The Solenoids
These are likely to the most difficult item to acquire. I used pipe organ solenoids as illustrated in fig 4. but suitable solenoids would be ones which have a shaft movement of about 8 mm and to which a circular disk can be attached to act as a valve (se alternative design below). They should operate on approx. 12 to 24 volts DC depending on the power supply you use. The solenoids are wired with one end of the coil soldered to an earthing rail of thick copper wire fixed to the underside of the chest top. The other end is soldered to individual wires to form a cable which is connected to the keyboard switches . Here I used computer ribbon cable of 50 wires (numbers 1 to 43 for the solenoids and number 44 and 45 for the earthing rail, leaving the remaining 5 as spares) which exits the chest laying flat on the edge between the top and sides of the chest. A gasket of leather or suitable material around the top edge ensures that there is very little if any air leakage.



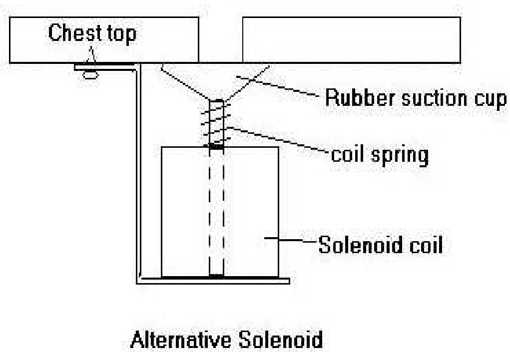


Fig 4. Solenoid fig 4a Alternative Solenoid

Pipe Construction

1. **Metal Pipes**
Thin walled brass tubing is no longer available. or, if available is very expensive. Drainage and water pipe in brass or copper is much thicker and the sizes available do not follow closely the ideal sizes listed in table 1.(given below in imperial measurements). You will need to select the most appropriate sizes available and make substitutions for sizes either side. The list in table 2 shows the relationship between the length and diameter of pipe, musical note and frequency in metric units, together with the substitution sizes for plastic pipes.

Table1

Tube No	Qty	Tube ID	Tube Length	Base Length	Gap	Inlet	Top Plate
1	1	3-7/16	20	2”	1”	11/16	3-7/16
2 & 3	2	3-7/16	18 1/2”	2”	1”	5/8	3-3/16
4 & 5	2	2 -15/16	17”	2”	7/8	9/16	2-15/16
6 & 7	2	2 -11/16	15”	2”	7/8	9/16	2-11/16
8 & 9	2	2-15/32	13-1/2	2”	7/8	1/2	2-15/32
10 & 11	2	2-3/16	1-7/8	2”	13/16	1/2	2-3/16
12 & 13	2	1-15/16	10-3/4	2”	5/8	7/16	1-15/16
14 & 15	2	1-11/16	9-5/8	1-1/2	9/16	3/8	1-11/16
16&17	2	1-11/16	8-5/8	1-1/2	9/16	3/8	1-11/16
18 & 19	2	1-11/16	7-5/8	1-1/2	9/16	3/8	1-11/16
20 & 21	2	1-7/16	6-7/8	1-1/2	1/2	3/8	1-7/16
22 & 23	2	1-7/16	6-1/8	1-1/2	7/16	3/8	1-7/16
24 & 25	2	1-3/16	5-5/8	1-1/2	5/16	5/16	1-3/16
26 & 27	2	1-3/16	5-1/16	1-1/2	5/16	5/16	1-3/16
28 & 29	2	1-1/16	4-5/8	1-1/2	5/16	5/16	1-1/16
30 & 31	2	1-1/16	4-1/8	1-1/2	5/16	5/16	1-1/16
32 & 33	2	15/16	4”	1-1/4	3/16	1/4	15/16
34 & 35	2	15/16	3-3/4	1-1/4	3/16	1/4	15/16
36 & 37	2	13/16	3-7/16	1-1/4	3/16	1/4	13/16
38 & 39	2	13/16	3-1/4	1-1/4	3/16	1/4	13/16
40 & 41	2	11/16	3-15/16	1-1/4	3/16	1/4	11/16
42 & 43	2	11/16	3-11/16	1-1/4	3/16	1/4	11/16

Metal pipes consist of six (6) parts: base tube, base plug, inlet pipe, saddles (or stand-offs), main pipe (which is the resonator) and tuning plug and is illustrated in photo 2. Plastic pipes have a one piece tube in which slots are cut and consist only of the tube, base or inlet plug, inlet pipe and tuning plug and is illustrated in fig 5.

Photo 2 Metal Pipe

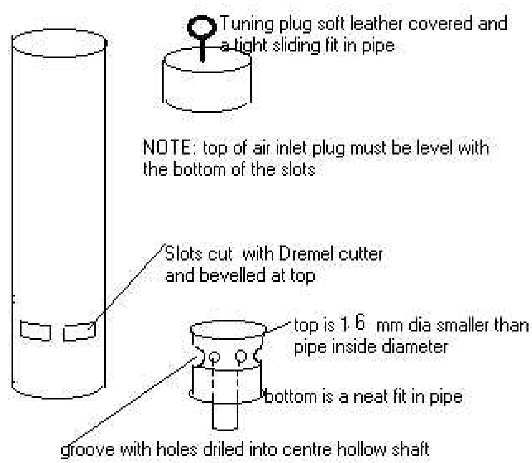


Fig 5. Plastic Pipe

Tube No	Musical Note	Frequency (Hz)	Tube I.D. (mm)	Substitute Dia*	Tube Length (mm)	Base Length (mm)	Total length (ins)	Total Length (mm)	Gap for high pressure	Gap for 3-4" pressure (mm)
1	F	174.614	87	3 1/2	508.00	51	26	660	25	21
2	F#	184.997	87	3 1/2	508.00	51	24	622	25	21
3	G	195.998	87	3 1/2	469.90	51	24	622	25	20
4	G#	207.652	76	2 1/2	469.90	51	23	578	22	19
5	A	220	76	2 1/2	431.80	52	23	579	22	19
6	A#	230.082	76	2 1/2	431.80	51	21	527	22	18
7	B	246.942	76	2 1/2	381.00	52	21	528	22	17
8	C	261.626	76	2 1/2	381.00	51	19	481	22	16
9	C#	277.183	76	2 1/2	335.28	52	19	482	22	16
10	D	293.665	56	2 1/2	335.28	51	17	444	21	15
11	D#	311.127	56	2	301.63	52	18	445	21	14
12	E	329.628	49	2	301.63	51	16	407	16	14
13	F	359.228	49	2	273.05	52	14	365	16	13
14	F#	369.994	41	2	273.05	38	14	349	14	13
15	G	391.995	41	2	244.47	38	13	323	14	12
16	G#	415.305	41	2	244.47	38	13	323	14	12
17	A	440	41	2	219.08	38	12	298	14	11
18	A#	466.164	41	2	219.08	38	12	298	14	11
19	B	493.882	41	1 1/2	193.68	38	11	277	14	10
20	C	523.21	37	1 1/2	193.68	38	11	276	13	10
21	C#	554.365	37	1 1/2	174.63	38	10	256	13	9
22	D	587.33	37	1 1/2	174.63	38	10	254	11	9
23	D#	622.254	37	1 1/2	155.58	38	9	238	11	9
24	E	659.255	30	1 1/2	155.58	38	9	235	8	8
25	F	698.456	30	1 1/2	142.87	38	9	221	8	8
26	F#	739.989	30	1 1/4	142.87	38	9	221	8	8
27	G	783.991	30	1 1/4	128.59	38	8	210	8	7
28	G#	830.609	27	1 1/4	128.59	38	8	210	8	7
29	A	880	27	1 1/4	117.48	38	8	197	8	7
30	A#	932.328	27	1 1/4	117.48	38	8	197	8	6
31	B	987.767	27	3/4	104.78	38	7	190	8	6
32	C	1046.302	24	3/4	104.78	38	7	187	5	6
33	C#	1108.731	24	3/4	101.60	38	7	175	5	6
34	D	1174.659	24	3/4	101.60	32	7	169	5	5
35	D#	1244.508	24	3/4	95.25	32	6	161	5	5
36	E	1318.51	21	3/4	95.25	32	6	161	5	5
37	F	1396.913	21	5/8	87.31	32	6	156	5	5
38	F#	1497.978	21	5/8	87.31	32	6	156	5	5
39	G	1567.982	21	5/8	82.55	32	6	152	5	4
40	G#	1661.219	17	5/8	82.55	32	6	152	5	4
41	A	1760	17	5/8	100.01	32	6	149	5	4
42	A#	1864.655	17	5/8	100.01	32	6	149	5	4
43	B	1975.533	17	5/8	93.66	32	5	137	5	3

pipes 37 to 43 were made from electrician's plastic conduit

* based on available plastic drainage and water pipe, these figures in inches because of varying I.D. in commercial pip

Table 2

In making either metal or plastic pipes you will need to make the base plugs and tuning plugs. I used fine grained Australian hardwood (Jarrah) but any dense timber which is fine grained and stable should do. Avoid softer woods as these will dehydrate an fall out of the pipe. The base plug should be a driving fit in the base of the pipe. It consists of the base, a semicircular section groove about 3/4 of the way up into which holes are drilled towards the centre, meeting a vertical hole from the base. This is the air way (or languid of organ pipes). The top of the plug is 1.6 mm (1/16th inch) smaller in diameter than the base to allow a circular stream of air to be directed against the bevelled lip of the main tube (see illustration, fig 5). This 1.6 mm difference is consistent throughout the range of pipes. This results in 0.8 mm gap respectively all the way around. This is very small and requires a measure of precision in manufacture, and in reality, requires a lathe. An alternative plug could be made from 3 flat disks separated by spacers, either metal or perspex or somesuch, the top disk being 1.6 mm smaller diameter than the other two.(see fig 6.) **Tip:** *to fit the base plug so that the gap is even all around the inside of the pipe, use a bearing or gear puller. Fit the claws in the slots (see below) or over the top part of the base pipe and fit a small piece of metal over the base hole for the tip of the advance screw and then simply screw it up until the top of the plug contacts the claws..*

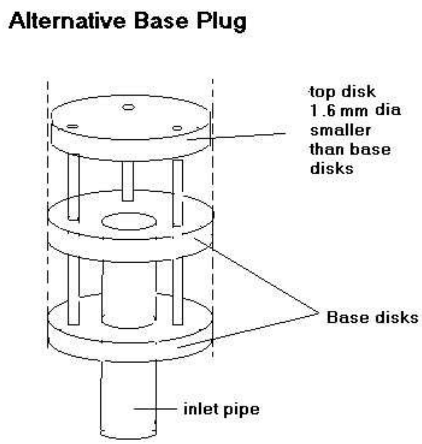


Fig 6. Alternate Base Plug

The tuning plug is straightforward. It is a disk about 12mm thick (thicker for the larger pipes) which is covered in soft leather and a firm to tight fit in the top of the pipe. For leather you could try a leather clothing maker for scraps and offcuts. The thinner the better, like the leather in kid gloves. You will need to overlap the leather over the lower edge of the plug to stop it jamming and wrinkling up. Screwed into the top of the plug is a screw eye of appropriate size to allow the plug to be pulled up the pipe for tuning. You may need to braze or silver solder the join of the screw eye to stop it opening when pulling the plug up.

Voicing metal pipes

With metal pipes, make the base first and attach the bridges which should be bent inwards slightly to firmly clasp the base of the main tube or resonator. This will allow you to slide the tube up and down to find the best position of the gap (called the mouth in organ pipes) for the pipe to sound best. The tuning plug should be in place and when the pipe sounds best, try to get the tuning plug at about the right position for the note being tested. This will ensure the best gap for that note. The gaps given in the tables above are approximate and will vary slightly according to other factors e.g. the size of the languid and the air pressure used. The bridges are made from brass or copper strips about 5 to 10mm wide and about 25mm long, depending on the size of the pipe. You will need 6 bridges for the larger pipes, reducing to 3 for the small pipes (less than 25mm diameter). I made a former from steel bar for making the bridges as illustrated below. The centre piece is hinged and to make the bridge simply lift the centre flap, insert a strip of brass or copper, let the flap down and belt it with a large hammer.

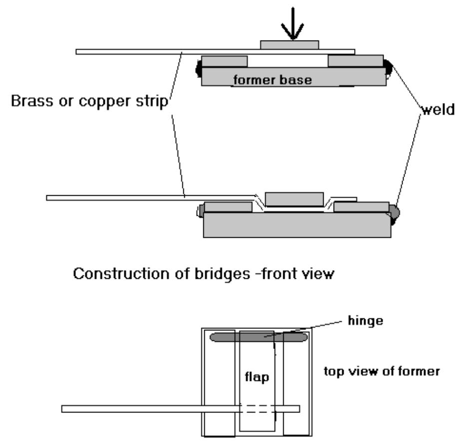


fig 7 Bridge Former

Voicing Plastic Pipes

Plastic pipes need to have slots cut in the side to form the mouth. Before cutting the slots you will need to determine the width of the slot (mouth) which can be done by making a collar as in fig. 8 . This a piece of pipe, about 2 inches long with openings cut in it and with a vertical cut to allow it to be slipped over a base, again about 2 inches long into which a base plug is fitted. The collar should be glued to the base, this will then allow you to slide the main tube up and down to find the best gap for voicing as with the metal pipes. The bottom of the top tube should be bevelled at an acute angle (less than 45 degrees).Once the best gap is found for that note it should be carefully measured with vernier callipers (one of the most useful measuring tools you can have) for this will be the width of the slot. For the larger pipes, six slots will need to be cut around the tube, reducing to three for the smaller pipes. The length of the slot is determined by measuring the outside diameter of the pipe and multiplying this by Pi (22/7 or 3.14285) then dividing the result by the number of slots required. Leave 10mm between the slots for the supports , that is, the slot is 10mm shorter than the figure derived above.

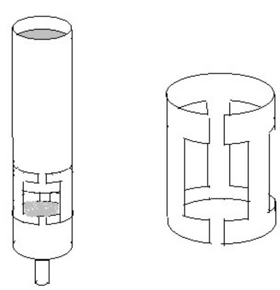


Fig 8 Voicing Collar

Cutting the slots

This is a delicate operation. I used a Dremel tool with a 3mm cutter to make the slots for the smaller pipes and a 6mm cutter for the larger pipes. First mark the position of the slots on the pipe with pencil and then mount the pipe on the lathe spindle. The Dremel tool was mounted on the lathe tool post, first at 90° to the pipe, advanced, cutting into the pipe with the cross slide advance at the lower end of the position of the slot. The pipe is then rotated by hand to cut the bottom part of the slot, the Dremel is withdrawn, the pipe rotated to the next slot position and the process repeated for each slot. On the last slot the Dremel is moved to cut the top of the slot with the saddle advance and the process repeated as for the bottom of the slot. (Make sure you cut the slots slightly narrower than the required width because the final cut is done with the angled cutter). The Dremel is withdrawn and angled to cut the bevel at the top of the slot. First position the cutter at one corner of the slot and rotate the pipe by hand to cut the bevel, withdraw the cutter using the compound slide, check the width of the slot with the vernier callipers, rotate the pipe to the next slot and advance the cutter with the angled compound slide. Repeat this process for all slots. I know this sounds complicated but once the process has been established, it only takes a couple of minutes to cut the slots in a pipe.

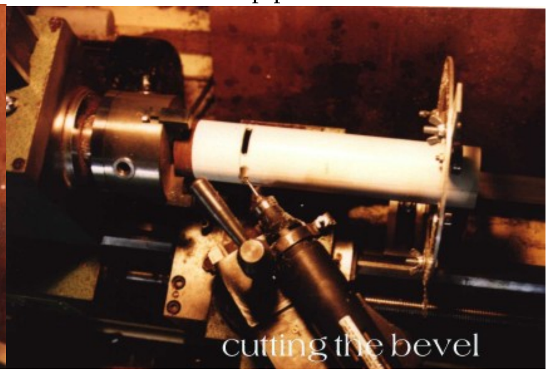


Photo 2 a Cutting the Slots Photo 2b Cutting the Bevel

Now, those of you who have been paying attention will ask "*why bother with cutting slots in the pipe ? Wouldn't it be much simpler to make collars for each pipe as in fig.8 Construction would be similar to the metal pipes. Voicing would be simple, just glue the collar to the pipe at the point where it sounds best. No need to bother with the hassle of Dremel tool and lathe The base plugs and tuning plugs could be made on a wood lathe by exercising sufficient care.* Well of course you could, but you will need a glue which is shock resistant and I haven't been able to find one. The tuning slide needs to be tapped down in the pipe and if quite tight it sometimes requires quite a thump which is enough to break the bond between the collar and pipe. I suppose you could try fixing the collar with PK screws or pop rivets but this is likely to effect the timbre of the tone. The second reason is one of aesthetics - a slotted pipe looks much neater and professional than one with a collar, but it's a matter of taste really.

Mounting the Pipes

The inlet pipes on most of the whistles are 1/2 inch (12 mm) copper pipe except for the largest whistles which are 3/4 inch pipe (20 mm). This means that the smaller pipes will sound much louder than the larger ones so you will need to fit chokers which are simply pieces of dowel with small holes drilled through the centre fitted inside the inlet pipe to reduce the inlet size. Some experimentation might be needed here but holes of 1/4 inch (6.5 mm) or smaller will probably do the job. Once the whistles are complete they are fitted on the wind chest as in the layout diagram given above in the wind chest section. This layout is not the only one, The Tangley calliope had the larger pipes arranged around the outside with the smaller pipes in the centre (see photo 1) . This was to allow the larger pipes room to speak, if too crowded, they will not speak or speak poorly and need about 1 inch separation between pipe surfaces. The National calliope had a layout similar to the one given above but had the rows arranged in steps or tiers to overcome the same problem. You should have no problem with the above layout because of the lower operating pressure provided you have sufficient separation between the bass pipes. The inlet pipes should not protrude more than the thickness of the chest top below the base of the whistle. Tangley calliopes had threaded inlet pipes which screwed into the base plate. This firmly fixed them in place during transport in street parades etc. You could run a rough thread on the inlet pipes and screw them into the holes in the chest top.

Solenoid Power Supply

I made my power supply from a transformer from an old TV set, using a secondary winding tap to give approx. 10 volts AC. This was rectified by a solid state bridge rectifier with a large electrolytic capacitor connected across the output and gave about 12 volts DC. However, you should be able to get a power supply commercially which has an output current of about 3 amps. Each solenoid will pull up to 500 milliamps so you need enough current to drive about 6 solenoids since it is unlikely that any more than 6 notes will be sounded at a time. Alternatively, use a 12-volt car battery and a charger.


photo 3 temporary frame

Mounting the wind chest and keyboard

Photo 3 shows the chest an keyboard mounted on a temporary frame to enable final adjustments and tuning to be undertaken. Traditional Calliopes had an angle iron frame covered with sheet metal and when the brass pipes were mounted the whole thing weighed about 200 kilos or more and took four men to lift. By using timber and plastic you should get a unit which weighs around 50 kilos or less. A cabinet can be made from MDF to enclose all the works.(photo 5.) This also assists in muffling the noise of the blower. The way I have mounted the pipes and blower on the wind chest allows the whole unit to be slid in from the back, allowing easy removal for repair or maintenance. You will notice that in photo 5 there are actually 48 pipes and a pedal board. These were added as an afterthought to allow the instrument to be played like a spinet organ.

Tuning the Whistles

Tuning can be done using a portable keyboard to sound the notes for comparison. First position the tuning slide so that the note sounds similar to the reference note on the portable keyboard. Then sound both together, if out of tune the notes will beat against one another, the faster the beat the more out of tune. Try to get the notes sounding the same without any beats. There are alternative methods, the most accurate is an electronic instrument used by piano tuners but if hard pressed you could use a mouth organ or harmonica! if the tuning plug is very tight, you can use a lifting arrangement such as in fig 9 to lift the plug so the note is flat, it can then be tapped down to the right position with a piece of dowel or piece of pipe.

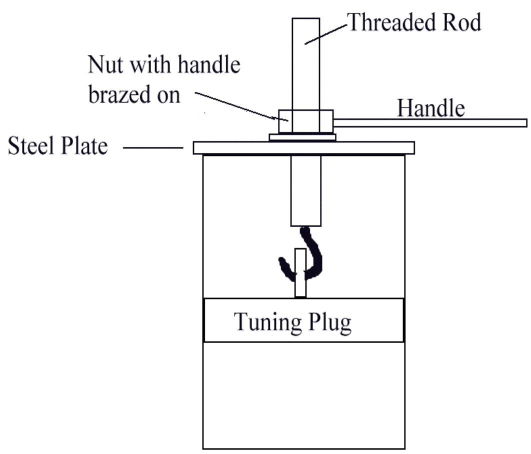


fig 9.Tuner

Painting the pipes

The whistles can be painted any colour you like. I used paint spray cans (Taubman's Fiddly Bits) in gold to simulate brass pipes and I found it superior to cheaper varieties. Painting should be done after the whistles have been completed, tested and tuned because you will need to spray the inside of the top of the whistle to complete the illusion. Pulling the tuning plug up over a layer of paint is quite difficult so they need to be tuned first.

Automatic Operation

I mentioned earlier that it was planned to convert the instrument to automatic operation using electronics. There are several ways of doing this but the current thinking is that MIDI might be the way to go since second hand computers with an appropriate sound card (e.g. an old 486 with a Soundblaster card) are quite cheap**-** all you need is a decoder and drivers for the solenoids.

Enjoy your calliope!

Modifying the Calliope for 48-note operation

Additional Pipes:

For 48-note operation you will need an additional five bass pipes from C to E. These are constructed in the same way as the other pipes with the dimensions as follows:

Note	Total Pipe length	Pipe Diameter	Gap (mouth)
C	28 3/4"(730 mm)	3 1/2"(89 mm)	24 mm
C#	26 3/4"(680 mm)	3 1/2"(89 mm)	24 mm
D	26"(660 mm)	3 1/2"(89 mm)	23 mm
D#	24 1/4"(616 mm)	3 1/2"(89 mm)	23 mm
E	24"(610 mm)	3 1/2"(89 mm)	22 mm

If you are pressed for space, you may find that the bass pipes will not speak properly because of crowding problems (see "mounting the pipes", above) in which case you could employ an alternative pipe design which reflects traditional organ pipes with a single mouth. This may look odd, particularly if you are trying to present the instrument as a calliope with the traditional circular mouth of calliope pipes.

Alternative Pipes

Construction details for these pipes differ very little from the calliope pipes above. The greatest differences are **(1)** a single mouth which is a third of the circumference of the pipe and much higher (that is the gap or mouth is almost half as much again) and **(2)** The base plug has the air gap going only a third of the circumference (see diagrams below)

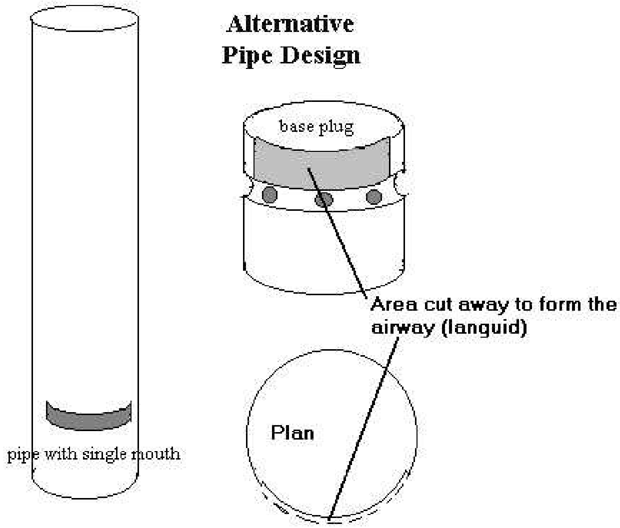


Fig 10. Alternative Pipe Design

The base plug is turned the in the same way as other base plugs except that it is the same diameter all around, except for the groove. The air gap or languid is cut with the Dremel tool in much the same way as the slot in the pipe except that the material is cut away with the front of the cutter. This air way must line up with the slot in the pipe when fitted together. If the pipe squeals when blown, it is overblowing and needs to have the mouth cut higher, the dimensions given above is a guide only and will depend on the pressure used. You will probably find that the length of these pipes (i.e. from the languid to the tuning plug) is much shorter that the traditional calliope pipes.

Making The Cabinet

The cabinet was made from Medium Density Fibreboard (MDF). I used 6 mm (1/4") thick board but you might need to use heavier (e.g. 12 mm or 1/2") if the instrument is to be lugged around to fairs etc. The length and width depend on the size of the wind chest. The cabinet I constructed has an internal frame so that the wind chest can be slid in from the back. In addition the top of the wind chest is hinged at the front with a cupboard hinge (like a short piano hinge).and has a folding strut attached to the side. This makes it easy to service the solenoids and wiring without having to remove the pipes (see photo 6). The top is fastened to the chest with screws along the back and sides. The keyboard (i.e. the top of the white keys) should be from 32 to 34-1/2 inches from the ground depending on whether you have installed a pedal board or not. The rear of the cabinet is closed off by double doors and castors are fixed to the base, underneath at the corners.

Photo 6

MIDIfying Your Calliope

Basic Requirements

In order to MIDIfy your calliope, or make it play music automatically, you will need a MIDI interface and a computer with a Soundblaster card with a Joystick/MIDI output socket. The computer I used is an old 486 with a soundblaster card. You can pick these up second hand for about $50. The software you'll need is a MIDI player which will play the midi files through the MIDI output, I used AudioRack, which came with the soundblaster card. It allows you to create a play list for the output. The second piece of equipment is a MIDI interface board. There are several of these available but the most satisfactory one is a 64-note controller board manufactured in England by *jw electronics* who can be found on the Internet at:- http://www.j-omega.co.uk/mtp6.htm or by e-mail at:- john@j-omega.co.uk. The boards cost $US142 or 86 English Pounds. (about $Aust246 depending on the exchange rate)

The following table lists the MIDI note numbers needed for configuring the board. You will need to supply these to the manufacturer in order that the e-prom on the board can be programmed for the calliope notes

ouput No	Midi Note	Note	Connector Pin	ouput No	Midi Note	Note	Connector Pin
1	32	g#		33	64	e	17
2	33	a		34	65	f	18
3	34	a#		35	66	f#	19
4	35	b		36	67	g	20
5	36	c	coupled	37	68	g#	21
6	37	c#	coupled	38	69	a	22
7	38	d	coupled	39	70	a#	23
8	39	d#	coupled	40	71	b	24
9	40	e	coupled	41	72	c	25
10	41	f	coupled	42	73	c#	26
11	42	f#	coupled	43	74	d	27
12	43	g	coupled	44	75	d#	28
13	44	g#	coupled	45	76	e	29
14	45	a	coupled	46	77	f	30
15	46	a#	coupled	47	78	f#	31
16	47	b	coupled	48	79	g	32
17	48	c	1	49	80	g#	33
18	49	c#	2	50	81	a	34
19	50	d	3	51	82	a#	35
20	51	d#	4	52	83	b	36
21	52	e	5	53	84	c	37
22	53	f	6	54	85	c#	38
23	54	f#	7	55	86	d	39
24	55	g	8	56	87	d#	40
25	56	g#	9	57	88	e	41
26	57	a	10	58	89	f	42
27	58	a#	11	59	90	f#	43
28	59	b	12	60	91	g	44
29	60	c	13	61	92	g#	45
30	61	c#	14	62	93	a	46
31	62	d	15	63	94	a#	47
32	63	d#	16	64	95	b	48
			Output Common (positive)				49 & 50

I used a 50-way ribbon cable to connect the calliope solenoids to the MIDI interface board, the pin numbers above refer to a 50-way connector similar to the connector which allows me to plug the solenoid cable either to a keyboard or the MIDI controller.

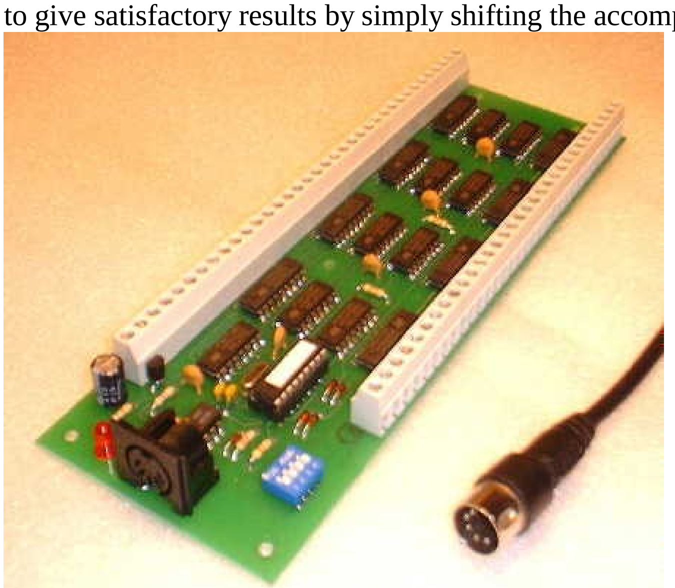
Selecting MIDI Files

There is a large number of MIDI files available on the internet. Most of them are multi-channel since MIDI can respond to 16 channels. However, the MIDI controller board can only respond to one of 16 channels which is selected by on board dip switches. This means that unmodified MIDI files will only play one channel on the calliope so we need to combine the channels to the one channel the calliope can respond to. This means we have to select music which has few channels since combining several channels can lead to unpredictable and confusing results.

The simplest MIDI files to select is piano since it usually only consists of two channels, channel one for the melody and channel 2 for the accompaniment. The problem now becomes combining the two channels to one. This is done by mapping both channels to the one channel. There are several pieces of software that will do this including Cakewalk and Noteworthy composer but there are many others. These allow you to modify the MIDI files to map several channels to one and also allows you to edit the music itself.

Coupling

You will note from the table above that the calliope can only play down to C below middle C but there are available outputs for an octave and a half below this. In order that the calliope can respond to these base notes they are coupled or hard wired to the octave above so that output 36 is jumpered to output 48 and so on up to output 47 coupled to output 59. This seems to give satisfactory results by simply shifting the accompaniment base notes up an octave.



The 64-note MIDI controller from *jw electronics*