CHAPTER 1
GENERAL SETUP OF THE AVERAGE SHOP

When we speak of the necessary tools in the average one man shop, we must bear in mind that the small hand tools, which comprise the tool box layout of the average repairman can not be considered as part of the average shop setup.

It is for the aforementioned reason that we must list the shop or stationary tools and the small tools in separate categories.

Shop Tools

Lathe-Preferably of the Atlas or Delta Variety
Bench motor (1, 2, or 3) 1/4 HP 175 0RPM app.
Work bench 34" high, 3' wide, 5' long
Polishing lathe
Drill Press (Optional)
Assorted Dent Rods
Dent Plug Sets
Trombone Mandrels
Bell Mandrels (Trumpet and Trombone)
Bell Iron or Horn Stake
Vise (4" or 41/2" swivel base)
Compressor (Size depends on amount of pressure needed)
Torch (natural or manufactured gas)

IMPORTANT TOOLS FOR INDIVIDUAL INSTRUMENTS IN REPAIR SHOPS

Brass Work

1. Set of tapered mandrels
2. Dent hammers
3. Straight mandrels
4. Straight burnishers
5. Curved burnishers
6. Bell Mandrels
7. Dent plugs
8. Dent master
9. Hi-Heat torch
10. Lathe
11 Bench motors (2)
12. Trombone slide mandrels
13. Assorted files
14. Assorted pliers
15. Tin snips
16. Bell iron
17. Rod Holder (v-block)
18. Draw Plate
19. Set of carbon drills
20. Set of taps and dies
21. Scrapers (hook and straight)
22. Mouthpiece puller
23. Small dent rods

Saxophone and Clarinet

1. Screw drivers (large, medium and small)
2. Spring punches
3. Midget and regular hacksaw
4. Screw extractor
5. Pad slick (small and large)
6. Crack slick
7. Oil Stone
8. Spring hook
9. Hammer
10. Rawhide mallet
11. Pin vise
12. Bench vise (41/2" jaws, swivel base)
13. Wood mandrels
14. Post drilling jig
15. Screw blocks
16. Leak light
17. Calipers
18. Micrometer
19. Hinge cutters
20. Pivot reamers
21. Pivot counterbores
22. Pad seat reamers
23. Socket reamers
24. Ring machine
25. Tenon repair kit
26. Key swedging pliers
27. Bunsen Burner
28. Soldering jig
29. Sax dent rods
30. Pearl sets
31. Post drills and tap

Brass Repair Materials

1. Sheet brass (.010, .015, .020)
2. Assorted brass instrument parts
3. Valve corks
4. Waterkey corks
5. Valve felts
6. Valve springs, assorted
7. Waterkey springs
8. Solder (50-50)
9. Silver solder
10. Soldering acid and paste
11. Borax
12. Buffs

13. Polish
14 Brass rod (1/2" and 1/4" and 1/2" round
15 Assorted brass tubing
16. Pearls
17. JUNK PILE (it can't be too big)

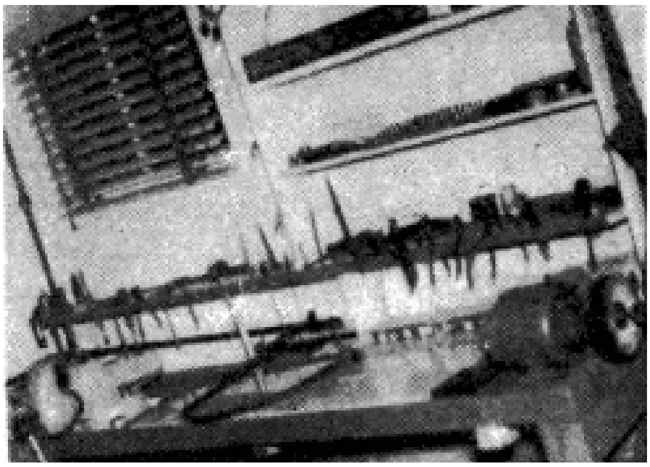
Taps and Dies
0x80. 1x72, 1x64, 2x64, 2x56, 3x56. 3x48. 4x40. 4x48, 5x40, 6x40. 6x32, 8x40, 8x32, 10x32, 10x24, 12x28~, 12x24, l/4"x20.

Reed and Woodwind Repair Materials
1. Sheet cork and bottle cork 1/64, 1/32, 1/16, 1/8, 3/32.
2. Sax pads
3. Clarinet pads (brown and bladder)
4. Flute and piccolo pads
5. Flat felts
6. Flake shellac
7. Gold wax for clarinets
8. Flush bands
9. Springs (needle and flat)
10. Post bushings and shims
11. Kerosene, alcohol and thinner
12. Norton Springs (Buescher)
13. Tone boosters
14. Pivot screws and rods
15. Neck corks

Shop Layout

The shop should be set up so that the mechanic has the least trouble getting to the different tools thereby cutting down the amount of lost motion in the average work day.

The vise is placed on the left side of the bench since it is easiest for the mechanic to work directly in front of his bench while an instrument is held on his left side out of his way. When assembling a saxophone, he can easily face his work and still be next to his parts and tools, assuming that the mechanic is using a saxophone mandrel to hold his work in the vise. This is a wise move since it gives the mechanic the free use of both hands while the saxophone is held securely in place, thereby acting as a third hand.



Reed instrument repair bench layout.

A bench motor should be placed on the right side of the bench, with an adapter for a grind wheel, drill chuck or a buffing wheel. This enables the mechanic to do most of his work without having to leave his bench.

The gas line should come from the top of the bench at the center. The hose should be at least 8' to 10' long to enable him to get around a saxophone or a trumpet, while it is held in place in the vise.

The lathe should be placed to the left rear of the work-bench so that the right side of the lathe is at least 3' from the vise at any point. This enables the mechanic to use the flat bed of the lathe for alignment of trombone slides so that they can be soldered together while lying on the lathe bed extended from the end.

In this manner we can utilize the flat bed of the lathe, thereby eliminating the Brown and Sharpe level, which is used to level trombone slides for mounting. In view of the fact that the slides would be extended from the bed of the lathe, no harm could come to the lathe.

Shop layout with proper lighting.

Small cabinets for materials such as clarinet, flute and piccolo pads can be placed on the bench at the furthest point from the mechanic. This is so placed since they are not in constant use. The same goes for the many small parts the average shop must have, such as pivot screw springs, etc.

Saxophone pad cabinets are kept at the opposite end of the room to keep them clean.

The best effect in lighting is achieved by the use of a florescent fixture with two 40 Watt tubes, placed approximately 8' above the floor over the edge of the bench, running parallel to the bench. The same type lighting is recommended for the lathe; however, it is advisable to have a gooseneck light for fine work.

The compressor should be placed under the bench so that the air pressure line can easily be brought to the top of the bench alongside the gas line so that the gas and air torch hoses can be secured together for easier handling. If the gas line has a double outlet the hose can remain permanently attached since the second gas outlet will take care of the Bunsen burner line.

Best results are obtained when the bench is placed in front of a window.

Polishing, lacquering and plating equipment should be in a different room that is well ventilated because of the fumes from the plating and polishing solutions.

Polishing, Plating and Lacquering Shop Setup

The polishing lathe should be set at the furthest end of the shop near windows if possible. A polishing lathe for silver and gold plated scratch brushing can be placed in the same end of the room. There are dual speed lathes for this purpose.

The tanks can be set up on the left side of the room so that the rinsing tubs are between the acid baths. (See diagram).

The strip tank must have a gas line for heating purposes as well as the regular hot tank for lacquer removal. The rinsing tank should be a double drain off bath so that clean rinse water can constantly be applied. Degreasing machines must be kept by a window for ventilation.

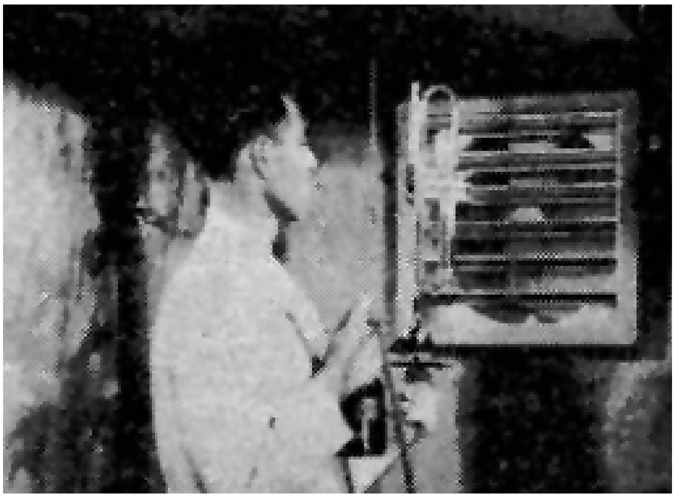
The lacquering equipment should be in a completely separate room to bring to a minimum the possibility of dirt and FIRES.

Plating equipment should be kept as close as possible to the rinsing tanks in the polishing room.

It is advisable to use stainless steel for all rinsing tanks.

There are many types of lacquering equipment available. It is advisable to consult your local equipment supplier or write the American Repair Service of Newark, N.J. for information for your particular needs.

The lacquering booth should be stone and steel construction with its doors on springs that open outwards. The blower for the lacquering booth should and must meet the underwriter's



Lacquering booth with ventilating fan.

approval for insurance purposes.

The blower for the polishing lathe will depend upon the size of the polishing lathe.

The hopper for the blower should be placed in the right hand corner of the polishing room. The bulbs used for lighting in the lacquer booth should be encased in explosion proof containers.

It is further advisable to use blower fans over all solutions to dissipate the fumes outside the building.

If a baking oven is used with the lacquering equipment it should be placed near the lacquering booth.

CHAPTER 2
BRASS INSTRUMENT REPAIR

Dent Removal With Dent Rods

Due to the fact that the position of each dent in a musical instrument presents its own particular problem. We shall have to describe the removal of them in separate categories. There are three procedures to be used in the removal of dents that can be reached with a dent rod. These three procedures are known as inside burnishing, hammering and the rebound method. We shall take them in this order for their description.

Inside burnishing is the application of the dent rod to the inner art of the glide bow for the purpose of pushing the dent out. This is done by using the dent rod as a burnishing tool on the inner part of the slide bow, applying pres-


Burnishing dents from the inside.

sure to the slide and moving it backward and forward, right and left, as desired to actually push the metal back to its original position. In doing this, you must be extremely careful not to overwork the metal lest we stretch it past its original shape. When removing dents in this fashion we use our dent hammer merely for the purpose of retaining the true shape of the slide bow. This is done by a feather touch when using the dent hammer. Care must be taken not to overstrike the metal with the hammer due to the fact that if we have a steel rod on the inside and are hammering the brass from the outside, hard hammering will stretch this metal, leaving a misshapen part with hammer marks, which is a sign of poor workmanship. The second method is used in those cases where the dent was caused by a sharp object putting somewhat of a cut or nick in the metal. By hammering in a light fashion directly on the cut, we may possibly close this cut sufficiently well, so as not to be visible. Bear in mind the fact that such hammering is done directly over the dent rod which is inserted in the slide bow. When such a cut is removed, we merely use the preceding method to put the slide bow back to its original shape. The third method known as the rebound method is employed very often where the brass is so heavy, as to make it impractical to remove the dents in any other fashion. This is done by holding the slide bow tightly against the dent rod, the curved portion of the dent rod resting directly on the dent, and striking sharp blows against the dent rod allowing the spring action of the rod itself to rebound inside with the same force of a little hammer. This will drive the dent up to the position desired. By striking the dent rod on the opposite side, instead of using the rebound method it will act as a direct hammer against such a dent. Again ‘I repeat, we must be careful not to overwork the metal or stretch it beyond its normal or natural position. We can. in most cases, through careful work, remove these dents so that practically no marks are visible. To make it appear extremely smooth to look at, we must do what is known as the finishing process, that is, the removal of any stretch marks or hammer marks on the metal through the use of emery cloth and the buffing wheel, The best strength emery cloth for this type of work. 2/ 0.

Use of Drawplate

In removing dents from a tuning slide or any larger slide bow, we will very often be confronted with the tubing losing its round form and becoming elliptical or oval. To bring it back to its original shape, we make use of a tool known as a drawplate. This tool consists of a series of holes in graduated form in a hardened piece of steel, the edges of the holes being beveled to prevent lines from appearing on the part to be repaired. This draw plate has many uses. One of its most important uses is to round out oval shaped tubing. By putting the tubing through the proper hole in a steady even motion, you can bring this tubing back to its original round appearance. We must be careful not to choose too small a hole on a draw plate. If a piece of tubing is forced through a hole having a smaller diameter than, the tubing itself, it will cause such tubing to shrink, changing the bore of the horn; this in turn, brings out the second use of 'the drawplate. which is to shrink oversized tubing.

Annealing Brass

All of the above methods are used in the dent removal of the slides of musical instruments. However, in some cases, the brass is so hard that it becomes necessary to soften it, prior to removal of the dents. This is done by a process known as annealing. To anneal brass, we use the following procedure: Using a torch, heat the brass part until it is red hot. Once it is red hot, you may either let it cool by itself or chill it in water. This will soften the brass to its softest point allowing for easier work: There is one point to be very careful of. Before heating the brass red hot, we must remove all traces of lead, soft solder or plating. If lead is heated red hot, it will crystallize and become extremely

Rounding out bell tubing with draw-plate.

hard so that we will have a great deal of trouble removing it. If plating such as silver plating is heated red hot, we will surpass the fusion point of the silver, causing the Silver to melt and run into little lumps on the material. The removal of dents herein described takes into consideration the dents in the small slides and tuning slides of any of the brass instruments. There are other methods for removing dents in different portions of the horns, and we shall deal with them individually.

The dents in the underside of tuning slides may be removed by inserting the dent rod in an upside down fashion, in the vise, facing it down toward the floor with the vortex of its circumference pointed upward. and using the direct hammer method against the dent. We must bear in mind that in bending this tubing, the brass on the outside circumference of the tuning slide is stretched, making this part weaker than the inside circumference, which is actually shrunk. It is for this reason that it is much harder to remove the dents from the underside of the tuning slide than the outside of the same.

If it becomes necessary to anneal a portion for the purpose of removing dents, be extremely careful to apply the flame directly to the dent and as soon as the dent is red hot, halt the heat application. In this way only the l)art to be worked on will be softened.

Dent Removal
Straight and Tapered Tubing

When removing dents from the straight tapered parts of the bell section of trumpets or curved sections of any of the larger brass instruments, where we can still use a dent rod, it is preferable to remove these dents through a process of burnishing from the outside against a dent rod which is placed on the inside. We should try to have our dent rod conforming as closely as possible to the shape of the part on which we are removing the dents. By crushing the metal between the burnisher and the dent rod. using a double handle burnisher to allow us the necessary power, we can flatten the entire part so that the dent will be removed, leaving the instrument not quite perfectly round. This portion is brought into round by little burnishing with a single handle curved burnisher, utilizing the same while turning the instrument with the opposite hand so as to be able to burnish against the curves or ridges.
This enables us , through the sense of touch, to bring back the round shape to the instrument. The ideal way to remove dents from a straight taper is to have the perfect fitting mandrel or dent rod, but due to the fact that we must realize that there is no such thing in this country as a musical instrument repair shop that can afford to keep even one tenth of all of the mandrels to fit all instruments perfectly, we must content ourselves with approximated or average sizes of tapered and curved dent rods. If per chance we had the perfect fitting rod to

remove the dents from a straight taper, this could be done through a process known as spinning, which is forcing a burnishing tool against the mandrel while the mandrel is turning in a lathe.I merely mention this due to the fact that spinning is a factory procedure and is the method utilized by all factories to bring up the perfect shape of the straight taper and the bell flare on brass instruments. However, it would cost many thousands of dollars to equip the average shop in such a fashion and I know of no shop that is capable of this.

In the event that there are only a few dents, and small ones at that, in a straight tapered part, we can very often remove these dents in the following manner: first, insert a tapered mandrel, and resting upon the middle of the mandrel, using as much pressure as possible, roll the instrument on the mandrel from side to side. This will very often remove approximately

Using double handled burnisher to burnish brass tubing to fit the mandrel.

ninety percent of the dent leaving just a small flat surface where the dent originally stood. Since it might prove to be more work than it is

Using single curved burnisher to round out flat spots.

worth, burnishing this out, we eliminate the burnishing process in this case and using the tip of the dent rod, drawing lightly against the flat surface until such time that you have pulled it back into its round shape using your eyes and sense of touch to keep the perfect shape of the horn. When the dent is removed in this fashion, it is

Rolling out the dent.

wise to use a single hand curved burnished over the same portion of the instrument, burnishing against the mandrel in an easy fashion, turning the instrument while burnishing.

If there is a dent caused by a sharp instrument leaving a cut in the metal, then remove the dent as described in the previous paragraphs. However, the cut will still remain and this can be removed in either one of two methods. If the, cut is very small, then you can

Using single curved burnisher to round out flat spots.

merely emery over the spot to make it disappear. However, if the nick is very definite, then it is best to hold the part against the mandrel so that the dent is held tight in place on the steel mandrel while hammering gently directly on the cut; this will have a tendency to stretch the brass slightly in that one spot and will cause the cut to fold together so tightly that the cut becomes invisible. Naturally, any hammer marks would have to be removed through the use of filing and the emery cloth.

Very often we hear musicians speak of taking away from a horn. These people speak without any knowledge whatsoever. It is a rare occasion when we can remove the dents from a musical instrument so perfectly that final finishing, using a file and emery cloth, becomes unnecessary. This process of finishing is utilized not only by mechanics but by every factory in existence today. Our spinning marks and burnishing marks must be removed, and the barrels of brass dust that are collected in the factories are strictly from sanding processes, which we call finishing and it is our opinion that there are very few jobs that will ever look good if they are not perfectly finished. Hammer marks and burnishing marks should be removed. They are the difference between a poor and a good looking job. However, there is one important rule to remember. We must always cross-cut our abrasives. If it becomes necessary for you to use a file on a part of a musical instrument, then remember that when you remove such file marks you should emery in the opposite direction of the file marks. This prevents the abrasive emery from digging the same cuts deeper.

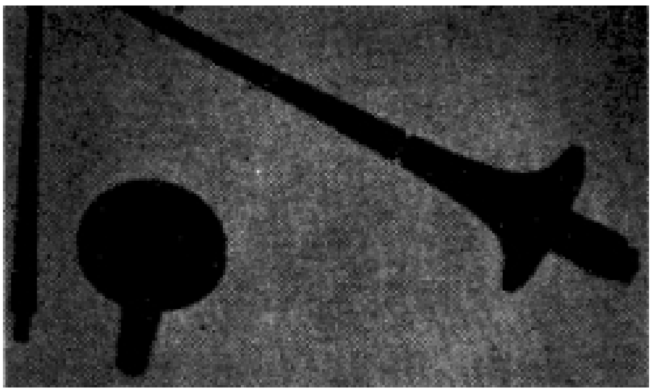
I will not be a prude! It is for this reason that I tell you that when you remove a dent, do not be afraid to use your emery cloth and a fine file if necessary, to remove hammer marks and burnishing marks and bring up a fine finish to the instrument. Furthermore, I will admit as anyone else must, that there is no such thing as a musical instrument repair shop if you take away their emery cloth.

Naturally the aforementioned goes under the assumption that the instrument is a base metal such as brass. In the event that the instrument is plated, and it has a small dent, we will undoubtedly attempt to preserve the plating without the use of emery cloth or other abrasives. However, such work becomes extremely tedious and does take a lot more time. Nevertheless, if it is a plated instrument that is badly smashed, we would have to consider ourselves extremely fortunate in repairing such an instrument without hurting the plating. Very often in my many trips through the factories, I have asked this same question: "In all your emerging, how can you be sure that the gauge of metal will remain consistent throughout?" For every time that I have asked that question, I have received the same answer: "We can't tell, but if the instrument gets thin in any one spot, we throw it on the side as a factory reject." This is an important fact to bear in mind because if nothing else, it will ease our conscience in doing our repair work so that we can arrive at the best conclusion possible, which is a fine appearing and playing repair job. Make no mistake about that which we have mentioned, we do not tell you in any manner, shape, or form to file out dents or to remove them with emery cloth. The dent should be removed first; hammer marks and burnishing marks are the only things which we remove by use of abrasives. Emery marks can easily be removed through polishing.

BELL REPAIRING

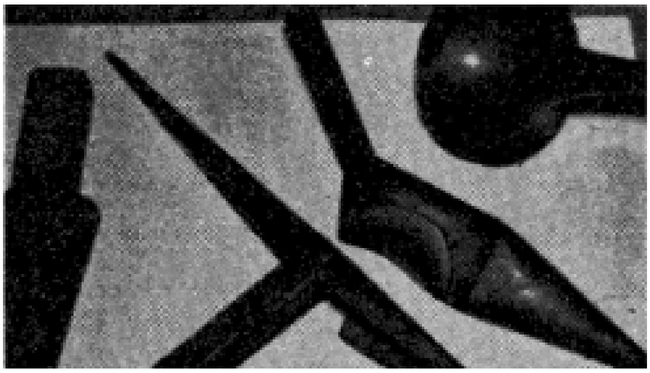
Dents in the bell may be of a great many varieties. The best way to remove these dents is with the use of a bell mandrel, a rawhide mallet and a straight burnisher. Using these tools, it is done in the following manner.

Place the mandrel in the vise so that it stands up straight. Rest the trumpet over the top of the bell mandrel. Using the rawhide mallet, hammer the bell ring so that it lays level on the mandrel and perfectly even all the way around. Using the burnisher, leaning against it, with the weight of your body, rub the burnisher up and down until you have completely covered every



Full bell mandrel with detachable tapered rod.

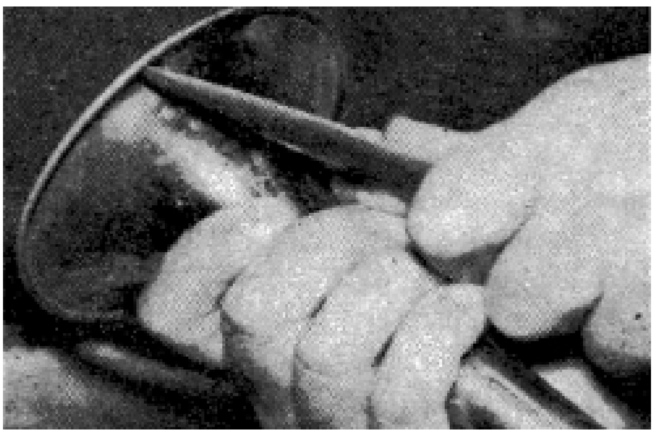
portion of the bell, burnishing the dents out. Use lanolin in preference to grease or vaseline as your lubricant. The one thing to be careful of is the fact that in so burnishing we may cause small flat surfaces that may not be visible to the eye, but the bell will not feel round to the touch of the hand. These can easily be removed by the same method of burnishing in a lighter fashion on the same bell. If there are small regions of dents near the bell ring these must be taken out last. They are removed by holding the instrument in the left hand using the



Bell mandrel, saddle and bell iron combination, horn stake and bell iron.

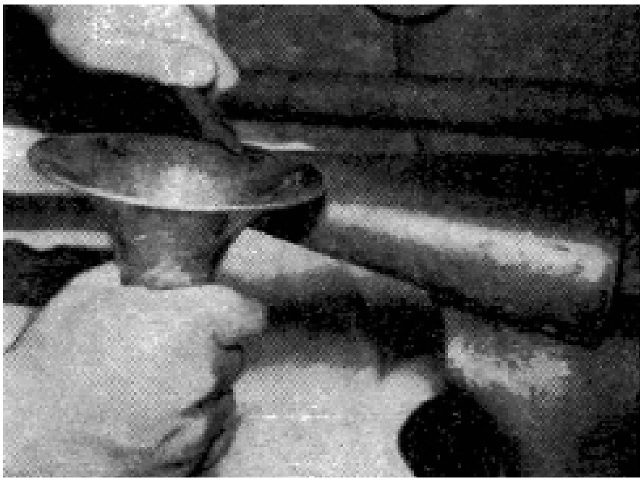
burnisher in the right and pressing the metal with the burnisher in such a fashion as to push the dent out. It is the rounded point of the burnisher that must do this work. We raise the dent and then burnish it evenly from the inner part of the bell.

The second method of removing these dents is with the use of a saddle iron or horn stake. This is done by resting the outer part of the instrument against the saddle and burnishing the inner flange of the bell. First burnish out the dent or crease, whichever the case may be, then round the instrument up by drawing the inside of the bell against the saddle. In using this tool, we may also rest the inside of the bell



Using tip of burnisher to remove rim dents.

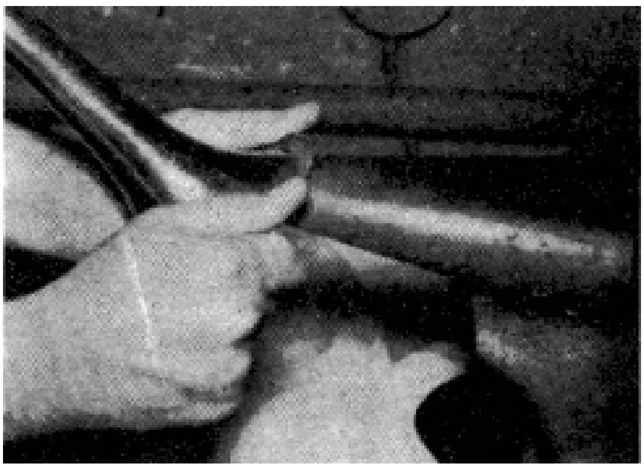
on the saddle and burnish the outside. It is a little bit more difficult to utilize the second procedure. However, not every shop can afford to equip itself with perfect bell mandrels for every type of brass instrument. Therefore, this saddle iron and horn stake becomes an extremely important tool in any repair shop since we can utilize this tool for the removal of bell dents on



Use of bell iron and burnisher to remove dents up to the rim.

every type of brass instrument up to the size of a French horn.

It is extremely valuable for use on French horn bells. In repairing an instrument which has a larger bell than a French horn it is advisable to burnish the dents in the same fashion

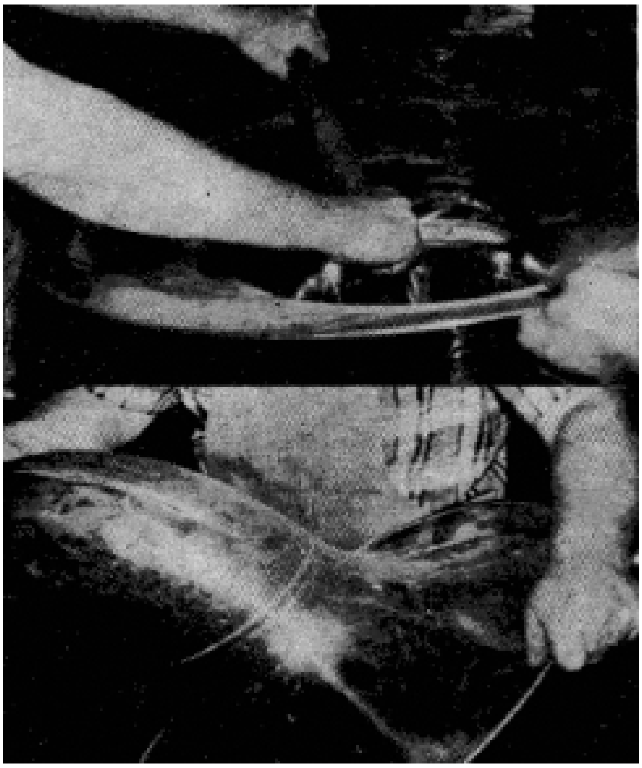


Using bell iron to roll out bell shape.

against a large round steel tube. If you have a lathe, you need merely purchase a length of pipe 2” in diameter and cut approximately 2 feet of its length to a smooth finish. If you are not capable of doing this, such a tube can be purchased.

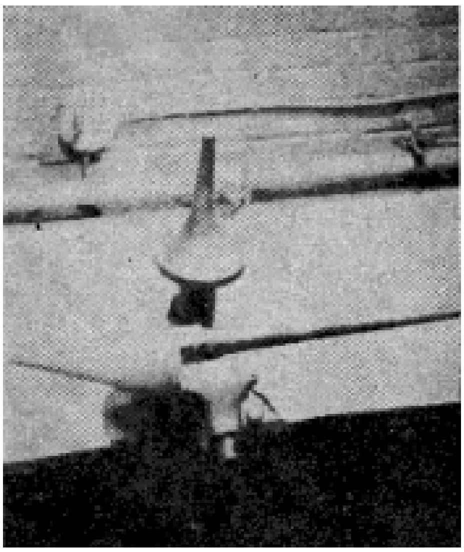
Very often a bell may be so badly dented as to have creases which are extremely bad. To remove the dents in this bell without cracking the material, it may be necessary to anneal the metal. However, in annealing the bell of an instrument, we must be extremely careful not to heat the ring of the metal red hot.

The reason for this is the fact that in manufacturing the instrument, the spun rim of the bell is soft soldered to prevent the vibration that



Top: Double handled straight burnisher to roll out creases. Bottom: Bell rolling on bell rod.

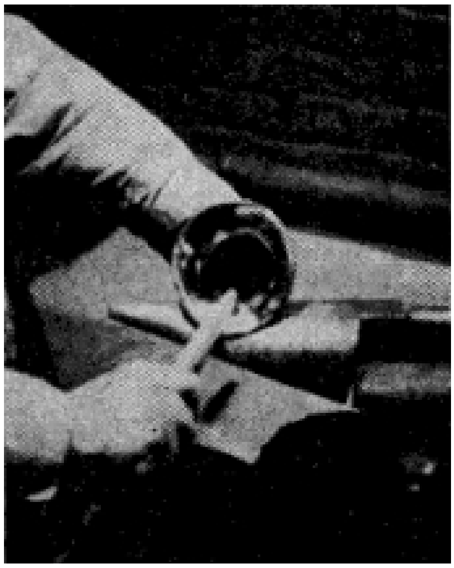
might take place where the metal touches itself. You must never heat metal that has soft solder there on red hot since it will tend to crystallize the solder and cause a great deal of harm.



To remove bell dents, you need a horn stake and a bell mandrel.

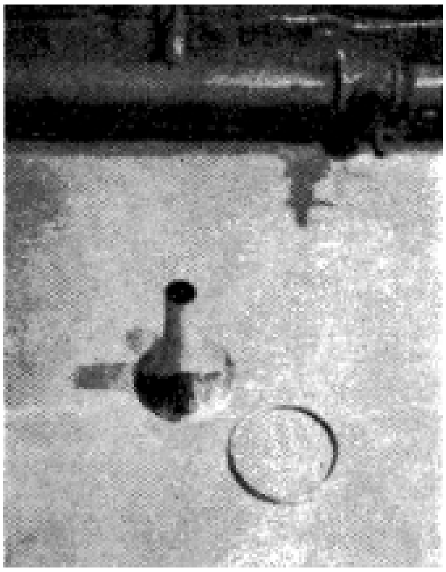
Bell Repairs

There are occasions when the bell ring may split. There are two methods of repairing this; one is to soft-solder a patch that curls from the outside to the inside over the bell ring. However, there is an even better method which may be done in two fashions, the first of which



The inner flange of the bell is being burnished on the horn stake.

is to uncurl the metal that was spun over the ring and thence to spin the metal over a new ring first cutting away the part that is cracked. Naturally, this will make the bell slightly smaller but not to any noticeable degree. It will not change the intonation of the horn.



A new bell ring is shown prior being clipped to an old bell.

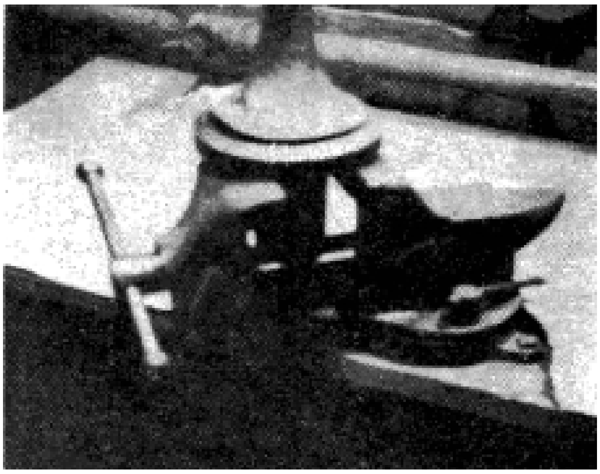
This, however, is a factory method and may not prove feasible to the average shop. The following is the method I prefer. Procure for yourself a length of 1/4" half round brass rod. This may be purchased from any brass house since it is standard stock. It is listed as 1/4" x 1/8" half round rod. Measure the circumference of the inner part of the spun ring. Cut this length of the half round rod, bend it around in a circle and silver solder it. Then lay the ring on a flat surface and using a rawhide mallet or plastic hammer, hammer the top of the ring till it bends over to approximately a 30 degree angle.

Next, cut the bell ring off the body of the

Here the new ring has been put on the bell and soft soldered.

instrument, cutting away the smallest amount of metal possible. This can be done by filing the outer rim of the bell till you reach the metal ring inside. If the crack is longer than the amount of material, cut away, then silver solder the balance of the crack. Lay the new ring on top of the bell and using a series of clamps, approximately 10 clamps are sufficient for a trumpet, clamp this ring to the bell itself. Naturally, all dents should be removed from the bell prior to this procedure. You will find that if the ring is at an approximately 30 degree angle, it will fit very nicely against the trumpet bell and you merely have to soft solder this ring in place. Upon the completion of the soft soldering job, merely finish the edge of the ring so that it is smooth. A job so repaired will not even prove noticeable as a repair job to the average person and will look as though it came from the factory in this fashion. At the same time, the bell remains almost the same length and will not change the intonation in any way. The clamps used may be made of small pieces of brass approximately 1 inch in length by %" in width and should be approximately .025" thick.

These small pieces of brass are merely bent in half so as to allow for a small amount of pressure to hold the bell against the ring. We make



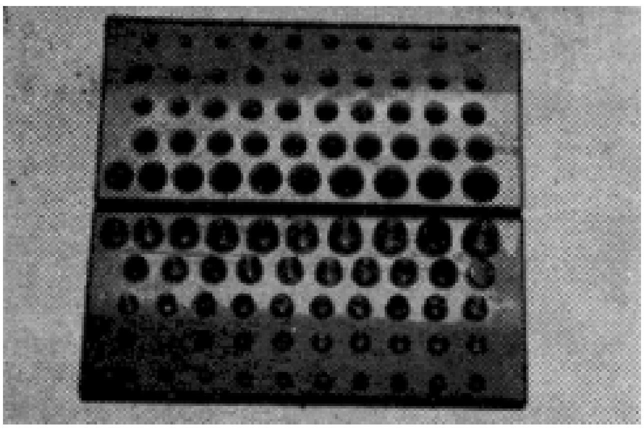
The hammered bell is then smoothed out with a burnisher and lanolin as the lubricant.

these clamps out of flat stock so that it will leave no marks on the bell. They may also be made of steel. Steel clamps are preferable. However, you may not have this type of metal on hand.

Dent Removal Curved Portions
Use of Dent Master
Use of Dent Balls or Plugs
Use of Draw Plate

Dent Plugging

To remove dents in curved portions, which are inaccessible through the normal use of dent rods, we make use of the set of tools known as dent plugs. These may be either of steel or brass and consist of approximately 100 plugs shaped in the form of a little barrel ranging in

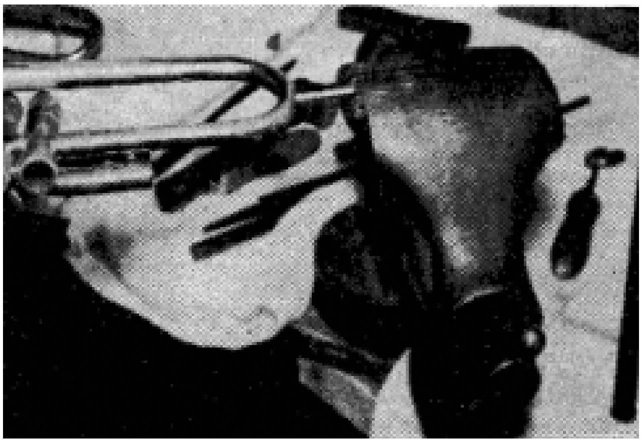


Dent ball set of 50 balls.

size from .250 to .750 graduating by approximately .005 to .010 of an inch. There are two methods of using these plugs. The first method that we shall describe is the most widely used. This consists of dropping the proper size dent plug into the tube and forcing it under the dent

Shaking the bell, with dent plugs inside.

with the use of a driving plug. This is done by shaking the instrument in such a way as to allow the driving plug to hit firmly against the dent plug so that it acts as a hammer. When the dent plug is under the dent, we use our dent hammer tapping lightly around the sides of the dent to round out the tubing. To remove this plug from the tubing, we put in a back driver and reverse the hammering procedure. This



Yanking out dent at back turn.

process is repeated until the perfect size dent plug is under the dent at which time, the dent will no longer be visible. In some cases, it may be necessary to put the back driver in prior to the dent plug so that we may have the means of extracting the plug at all times. In the event that the dent is extremely sharp, it may be necessary to anneal the dent prior to the dent plugging procedure. In some instances if the dent is too deep such as could occur on the back curve of a trumpet or cornet it becomes necessary to yank such a dent prior to the dent plugging procedure. This is done by soldering a piece of brass rod firmly in position in the center of the dent which has already been annealed to make our work easier. Then place the rod in the vise and with one sharp pull yank the instrument away from the rod. This will undoubtedly break loose the soldering job but will, in turn, pull out a good portion of the dent allowing us then to have sufficient room to use the dent plugs in the normal dent plugging procedure. I repeat, this is only used when the dent is so deep so as not to allow us to use the normal procedure of dent removal. There is also a procedure known as hollow balling and hammering. In the event that the dent is in such a place where it would be difficult to remove a perfect fitting plug, then we insert a smaller plug which can easily be removed and turning

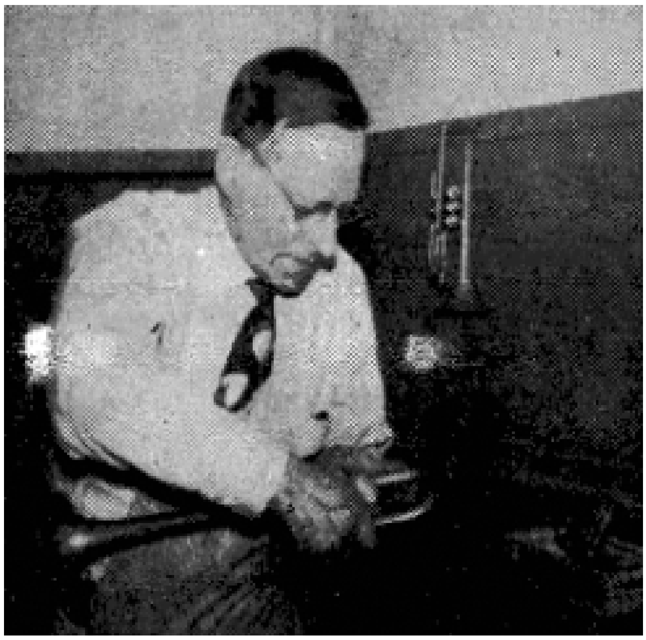
Hammering outside, with dent plugs inside.

the instrument to such a position as to allow the dent ball to rest on the dent itself, we tap lightly with the dent hammer directly on the dent so that the ball on the inside is caused to bounce and rebound against the dent. It is in this position that we may sometimes remove the dent somewhat, However, this never is the perfect repair job since we actually cause the tubing to go slightly out of round. However, this method is used to definitely improve the appearance of a repair job and to save some time.

There is another method of dent removal with dent plugs which was brought about through the innovation of the Dent Master. To utilize this tool, we must first drill a hole through the center of the dent plug using a No. 39 drill. The cable is then placed through this hole. The cable is then threaded through a spring to which is attached a handle. On the back end of the cable there is a small stud which holds the dent plug in position. This plug is then jammed into place until the dent is removed. When the dent is removed, the cable is then tightened in the vise and with the light yanks is pulled out of the horn. There is only one thing to be careful of in using this tool. Do not try to rap the cable around the hand nor to jam the spring too tight since this would cause it to get many bends and would make the tool difficult to use in the future. For an even more complete description for use of the dent master, I refer you to the manufacturer of the tool, Eric Brand Co. of Elkhart, Indiana. In the earlier part of this article, I did state that a normal set of plugs ranges from .250 to .750. However, there are plugs that range in the larger size with larger graduations. These larger plugs are a definite necessity for the removal of dents from French horns, alto horns, baritone horns, etc.

Upon the removal of all dents from these curved positions, you may possibly find slight ripples which are left in the metal due to the driving plug, the back driving plug or the graduation between the plugs. This can be removed by a method known as smooth hammering. This smooth hammering is done by the use of a small tool which consists of a piece of solid brass, the inside of which is cut to a small radius approximately 1 and 1/4 times the radius of the tubing itself. By placing this part against the tubing, moving it gently across the entire length while tapping lightly on the smooth hammer itself, it will have a tendency to smooth out most of the tubing. We must be extremely careful when working on plated instruments lest we cause the plating to be disturbed to a noticeable degree. However, if the instrument is of a brass finish, it is advisable to dress its outer appearance to a perfect finish through the use of emery cloth and the buffing wheel. If it cannot be reached with a buffing wheel, the emery marks may be dressed out through a process of stropping in a shoe-shine fashion using as the counter abrasive, fine pumice stone and water. There is an important fact to remember when plugging dents from a curved tapered tubing, that is, always start from the smaller end and work to the larger. The dents will gradually be pushed out as we work our way around, using one plug after the other until finally the biggest dent comes out without any trouble whatsoever. One of the best tips I can give you is to keep your dent plugs in perfect order of graduation at all times. If the end of a dent plug becomes marred from hammering, this can easily be dressed without any damage to the plug itself by merely inserting the plug in the lathe and touching it lightly with a file.

If dents are plugged from a curved portion of tubing which is cylindrical in bore, the perfect shape can be brought into being with the use of a draw plate. This is the tool which we described in the preceding article. The draw plate may also be used on curved tubing that is conical in bore. However, we must be careful to use the draw plate only as a burnishing tool since there is a graduation in the diameter of the tubing. In other words, assure yourself of the fact that you are using a larger size hole in the draw plate. To cause it to fit better, merely tilt the draw plate to the side. It will straighten itself out as you come to the larger diameter.



Rounding out bell tubing with draw-plate.

However, it will give you an effect of curved burnishing. Be careful not to press too hard since you must bear in mind the fact that you are burnishing this portion of the instrument hollow.

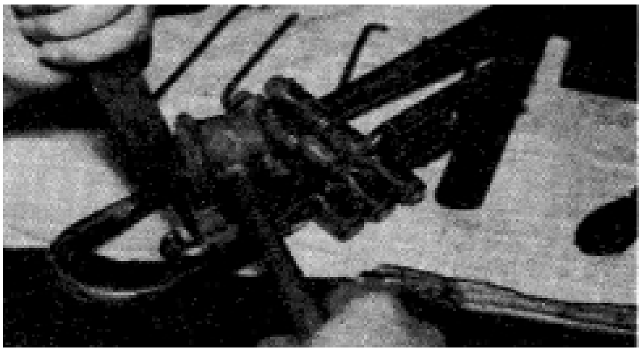
Valve Caps

When a valve cap appears to be. frozen to the valve casing, this is easily removed by striking light blows against the cap (at the threads) with a rawhide mallet. This will break the corrosion allowing you to unscrew the cap. Be careful not to strike the cap too hard or you will cause damage to the valve casing.

Freeing Frozen Slides

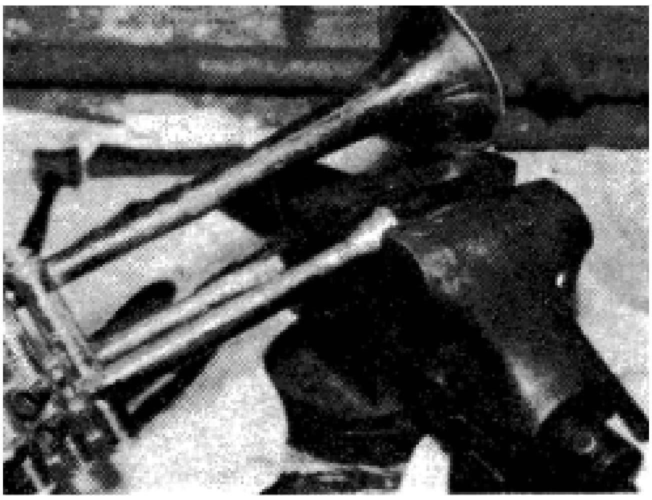
Frozen slides are removed in the following manner:

The small slides (1st, 2nd, and 3rd) are easily removed without unsoldering by placing a piece of heavy leather against the inside turn of the bow. setting a tang of a file against the



Use of file tang and heavy leather to remove frozen valve slide.

leather and striking blows against the tang with a rawhide mallet. Don't strike the tang too hard or you may cause a strain on the valve casing. In most cases this system will work. The slide hammer serves the same purpose. If you, however, have trouble using this method, it is advisable to unsolder the bow, solder a piece of brass rod into the ferrule and holding the brass rod in the vise, use a turning, pulling motion,

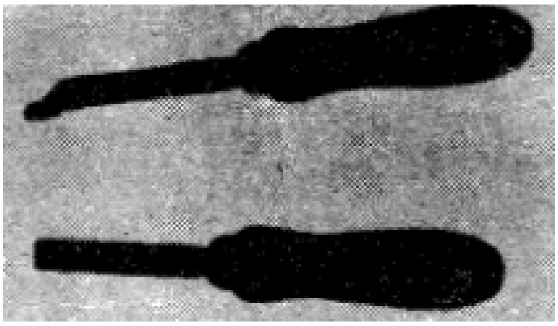


Using old mouthpiece and vise to remove frozen slide.

remove each individual slide tubing. Clean and remount the slide. It is always advisable to use this system on all tuning slides since the inner curve of the slide can easily get damaged in trying any other method.

Refitting Tight Threads on Valve Caps

Although we do not have taps and dies to fit the valve caps of the various trumpets, we do have tools known as thread chasers. These tools are hand cutting tools for use on the lathe. The cutting edge is a series of teeth as on any tap or die. By turning the lathe at a slow speed, we can use these tools to follow the threads, dressing out the thread in the cap a few thousandths larger. until the cap fits the casing. These tools come in various sizes ac-

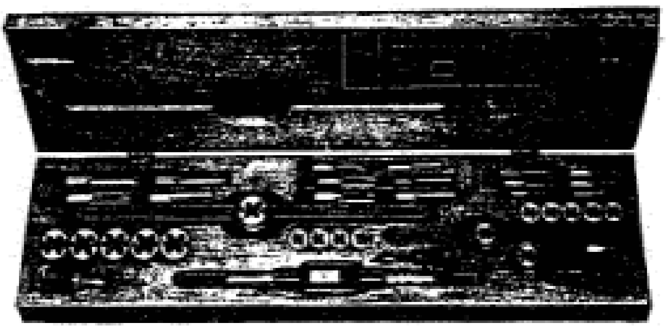


Inside and outside thread chasing tools.

cording to the number of threads per inch. They also come as inside and outside chasing tools. With a little practice, one can cut any number of threads per inch on a part of any diameter.

TAP AND DIE
THREADING DRILL SIZE

The taps and dies used by musical instrument repairmen comprise one of the most important items in any repair shop. We use them for every type of instrument and in making many of our tools. Very few repairmen are fully aware of proper use of these tools, the formula for determining the diameter of the num-



Tap and die refered to as "screwplate"

bered thread sizes and the proper place for each size thread. Complete and useful information for the repairman is the purpose of this article.

A tap is a threading tool used to cut the threads in a HOLE.

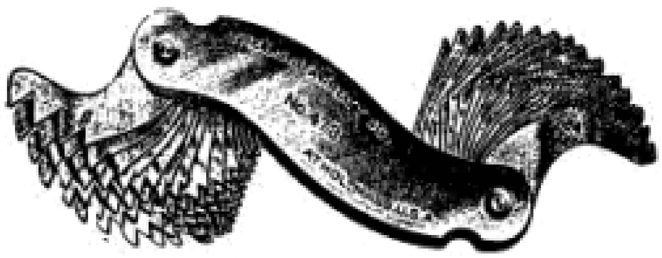
A die cuts the outside or male threads.

There are right and left hand threads. Since repairmen never have use for left hand threads, our discussion will take only the right hand threads into consideration.

Taps may be of three different varieties; Starting, Plug, Bottoming. Repairmen only have use for the Plug and the Bottoming type. The most commonly used sizes are:

0x80 Flat Spring screw on sax and clarinet
1x72 Flute pad screws, Clarinet, screws
1x64 Small clarinet rods, Flute pivot screws
2x64 Penzel Mueller pivot screws
2x56 Small sax rods, Pedler pivot screws, Norton springs for Clarinet
3x48 Most sax rods, Buescher, Martin, Holton, King pivot screws (Sax) valve guides Norton Sax Spring etc. This is one of our most important sizes.
3x56 Conn pivot screws
4x48 Large Selmer rods. Small Selmer rods can be changed to use the 1x72
5x40 Brass instruments
6x40 Lyre screws, neck screws (old Buescher)
6x32 Valve buttons, lyre screws
8x32 Post bushings, neck screws, Valve buttons
10x32 Brass work
10x24 Brass work
12x28 Brass work
12x24 Brass work
14x20 Brass work
l,4”x20 Brass work

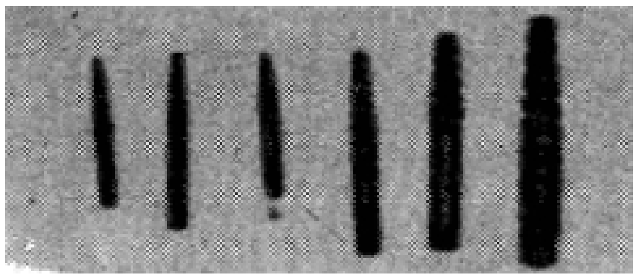
Please note that the largest numbered tap is 14x20. After that size, we go into fractional sizes. The numbers designating the size have a very important meaning. The second number tells us HOW MANY THREADS THERE ARE PER INCH. The first number tells us THE DIAMETER OF THE THREAD. The first number is in CODE. To figure the diameter in thousandths of an inch, we must understand the formula and its use. The formula is 13 times the number and add 60. This will give you the answer in thousandth of an inch. For instance, to find the diameter of a 3x48 thread, substitute 3 in your formula; 13x3 and add 60. This answer is .099. This tells us that if we wanted to cut a 3x48 thread on a sax rod, it would be necessary for us to dress the part to be threaded to .099. At this measurement, it would receive the die perfectly and cut a perfect thread without hurting the die. The formula may be used in reverse. If you measure a thread and find its size to be .138”, subtract .060 leaving .078 and divide by 13. The answer would be 6. The number of threads per inch can be determined with a thread gauge. It would have to be a 6x40 or 6x32. n the absence of a thread gauge, use your tap to see if the threads mesh when placed together. In view of the fact that



Thread gauge

we do not wish to make the use of taps and dies sound complicated, we shall purposely avoid discussion the major and the minor diameters of threads. They present no problem in our type of work. It is sufficient if we realize that when using the die, the full diameter of the thread should be present before cutting the thread. If it is undersized, the end result would be a loose fitting thread. If it is oversized, the die would be abused and may possibly break in the process of threading or the stock could break off in the die.

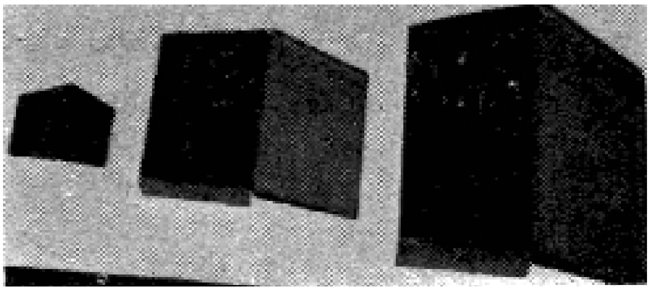
Removing a broken piece of stock from a die is accomplished in this manner: Drill a hole with a No. 50 drill in the center of the



E-Z out screw extractor set

stock. Spread the die by tightening the adjustment screw. Use a No. 1 E-Z out extractor to turn the broken piece out.

When purchasing the different sizes of dies, bear in mind that all the sizes used by repairmen are standard equipment in the 13/16" outside diameter. If you use any other outside diameter dies, some of our sizes would become special order and would cost a great deal more. Our recommendation is the purchase of the O.K. B-10 Jr. set by the Greenfield Company. The smaller sizes could be purchased separately. When a threaded hole is desired, merely consult your drill index, find the size thread you want listed under tap sizes. Locate the tap drill directly under the thread size. For instance, find tap size 8x32. Directly beneath it, you will find the number 28. This will drill the perfect hole for the 8x32 tap. There is another line of numbers marked clearly on the body drill. A hole made with this



Drill indexes

size drill will allow the screw to fall through without binding. Don't mistake this body drill for the tap drill.

There are high speed taps and dies and carbon taps and dies. Carbon is cheaper and serves our purpose just as well.

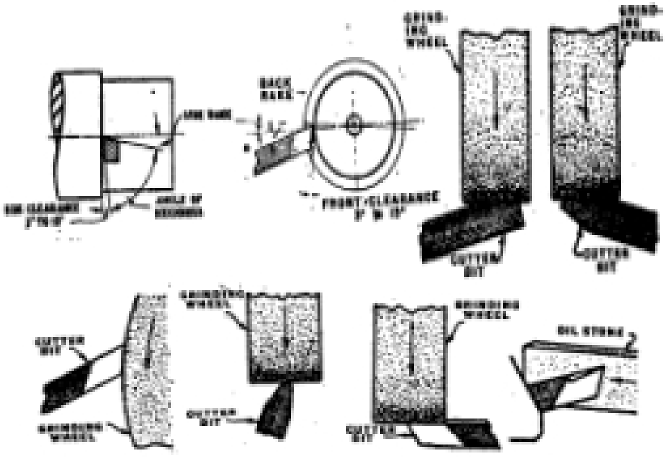
The following are the drill sizes for taps

Tap	Drill
0x80	56
1x72	52
1x64	52
2x56	48
2x64	48
3x48	44
4x48	40
5x40	36
6x32	33
6x40	32
8x32	28
10x24	23
10x32	21
12x24	15
12x28	15
14x20	10
l1/4"x20	7

Tool Grinding

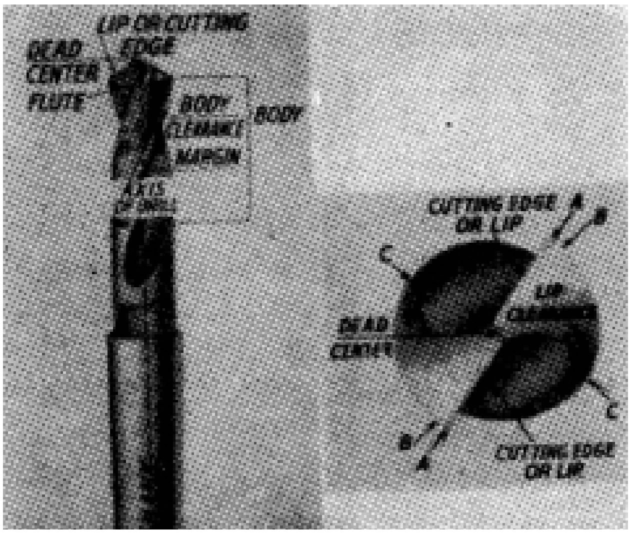
Unlike most tool grinding as performed in the average machine shop, tool grinding for musical instrument repair is extremely simplified. This holds true for the grinding of lathe tools, as well as scraper or any other type of tools used in a shop. In view of the fact that the type of material cut by the average mechanic in the use of his lathe is either wood, rubber or brass (soft materials) having a back rake angle on the cutting tool, becomes completely unnecessary and unwanted. Actually, a flat face to the tool insofar as the rake angle is concerned, is all that is necessary to allow for a smooth cut. Therefore, the musical instrument repairman has a simplified job in tool grinding. He merely has to grind the front face of the tool so that the cutting edge remains foremost and that the angle of the cutting edge should be less than a 90° angle. This, in fact, actually requires the grinding of only the sides of the tool making our tool grinding operation a simplified process.

Hollow grinding of this tool is easily achieved by grinding on the circular surface of



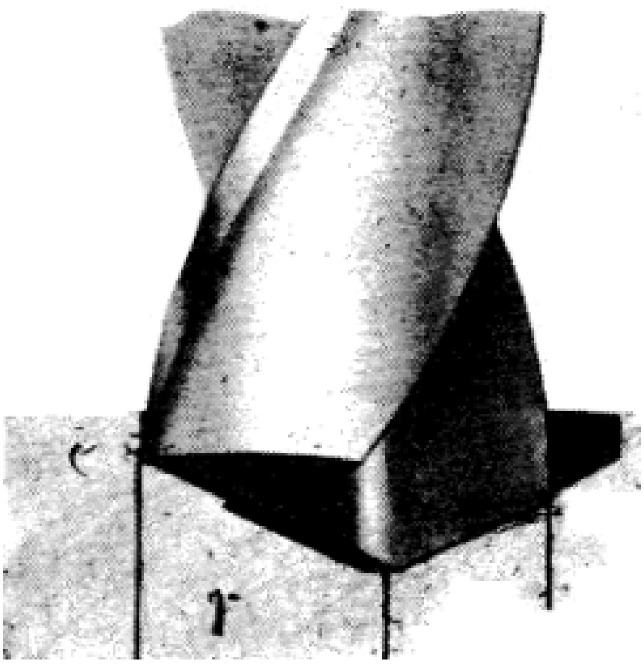
the front of the grinding wheel. The grinding of scrapers is accomplished in the same way and manner. To sharpen one's drills, we merely have to hold the drill at the proper angle to allow for approximately a 59° angular grind against the face of the wheel and holding the drill in such a position so that the front of the cutting edge is the first portion to touch the wheel.

We flip a drill at it so that it causes the grind



on the back of the drill to grind further at the bottom than it would at the cutting surface of the top, thereby giving us a slight back drop allowing the cutting edge to become the foremost part. We must be careful to maintain the equivalent angle on both sides of the drill. so as to maintain the proper size cut of the drill. If one of the sides is ground improperly or at the wrong angle, it will tend to allow the drill to drill an oversized hole.

Once a tool has been hollow ground (all grinds except those on drills), sharpening of the tools is quite simplified since the sharp edge can easily be brought back on any oil stone. Lathe tools should be glass hard. The screw-driver should have the temper drawn



Improper drill grinding shows un-even sides.

from glass hard to a light straw color. Sometimes dark straw is preferable. Springs are drawn to a perfect blue. (See tempering brass and steel.)

Soft Soldering

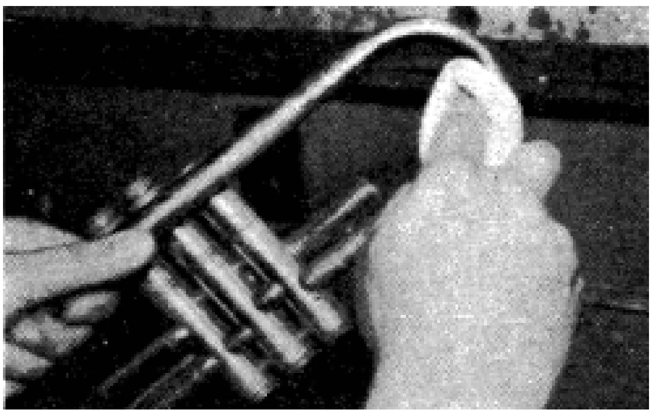
There are a few different types of soft solder. The average type used by musical instrument mechanics is known as 50-50. The first 50 standing for the content of tin, the second for the content of lead. In many cases, mechanics prefer a 40-60 soft solder. The higher content of lead, the more ease you will find in using the material. The high tin content solder will harden too rapidly and will be a little tougher to work with. Above all soft solders I prefer the 40-60. The flux used with this solder may be of different varieties. There is ordinary soldering paste which is put out by many companies such as Kester and Nokorode. These will do the job. However, they are very sloppy to work with since they leave a greasy film wherever they are used. There are two types of flux made from acid. In both cases, the acid used is muriatic (hydrochloric). The first type is made by mixing muriatic acid and glycerine at the rate of 60% glycerine to 40% muriatic acid. These may be mixed in any fashion whatsoever, merely shake the bottle well. The second method of utilizing this acid as soldering flux is to put zinc metal into the acid whereupon a chemical reaction will take place releasing hydrogen gas. We merely add enough zinc until finally there is no reaction taking place. This tells us that all the hydrogen is then out of the solution. The solution that is left is no longer an acid but rather is chemically known as zinc chloride. This is a perfect soldering flux. However, it is dirty and prior to using, it should be strained through a piece of cheese cloth. Of the three different types of flux, my preference is that of muriatic acid and glycerine since it is the quickest to make and the easiest to use. However, it is also the most expensive. The cheapest is muriatic acid and zinc. One of best methods of removing excess solder, especially on large braces, is by warm scraping.

The acid serves a two-fold purpose. Its primary uses are first to keep the part clean and secondly, to make the solder flow easily) We can in many instances through application of flux and heat, cause the soldering acid to actually clean a part but this is not too advisable and should only be used in an emergency such as when the tonehole of a saxophone is open in a small place and must be soldered. If we cannot reach it to clean it, it can be cleaned through the application of heat and soldering acid. Another place where it may be used which will be described in a later article more completely is in the passage of a valve that may be very dirty and may have a slight hole therein. Through heat and flux application, we can bridge such a hole neatly and cleanly with soft solder. There is one important thing to remember: Do not use soldering acid in any form on chrome plating since muriatic acid will strip the chrome plating and completely ruin such an instrument. If soft soldering has to be done on chrome plating such as on bugles, use a soldering paste to do the job. The excess of the paste can easily be removed with any hand polish.

In soldering, there are certain definite procedures to follow and I shall name them in order:

1. Fit the part as closely as possible.
2. Clean the part prior to soldering.
3. Apply soldering flux.
4. Apply the heat.
5. Add more flux.
6. Apply the heat.
7. Apply the solder.
8. Keep the solder out of the flame when applying it. Let the heated metal melt the solder.

Very often too much solder is applied. Naturally, we try to avoid this. However, it may happen. The removal of excess solder is done by one of three methods. The first is to heat the solder and while it is soft, wipe it away



Wiping away warm solder.

using a clarinet swab. The second is to scrape the excess away when it is cold. However, there is a third method, one which I prefer by far. This is known as warm scraping. Heat the solder slightly, so that it does not run like water but yet is not fully hard, using an old scraper, merely knock off the excess solder. It

One of best methods of removing excess solder, especially on large braces, is by warm scraping.

will take very little practice to make one quite proficient at this. After the excess solder is removed, put a drop of soldering flux on the joint and re-heat so that the solder will flow evenly and neatly around the solder joint. It is preferable to use an old scraper since the heat applied to the scraper would tend to draw

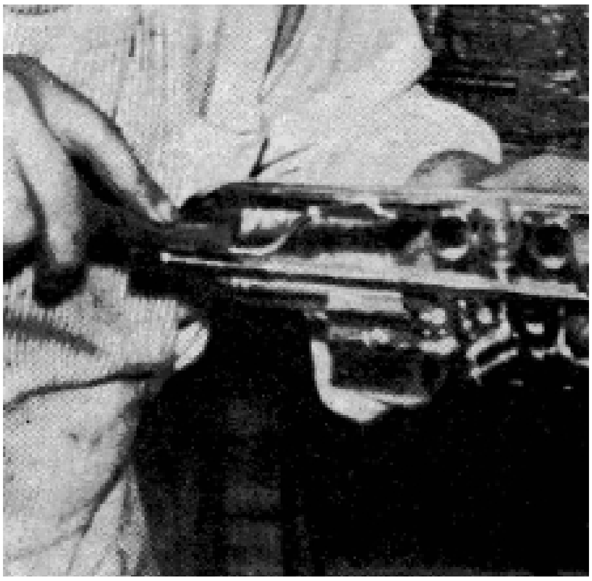
The part of the instrument to be repaired is usually tied in place with a piece of binding wire.

the temper of this tool. This process of war scraping is extremely helpful especially in the soldering of large braces such as on sousaphones but works equally proficient well in the soldering of small ones. We must be careful of the method in which our heat is applied. Heat should be applied in such a fashion as to allow the flame to by-pass any other soldered joint so that we are heating only that part which we want soldered. If there is the possibility of unsoldering another part while doing our job, it is advisable to tie these parts down with binding wire. This binding wire should be 22 B. & S. gauge black annealed. The best torch for this type of work is known as a Hi-Heat. This torch may be purchased from any company in the U.S. selling supplies. It has 3 tips for different type flames. The best type flame for our work is a small pencil light flame of concentrated heat.

There are two types of scrapers used for finishing our work. One is a 3-cornered hollow ground scraper, which may be made quite simply from a 3-cornered file. The other is known as a hook scraper and is made from a piece of round drill rod 3/8 in diameter the end of which is flattened out and bent over, and sharpened so that the cutting edge is on the inner circumference of the bend. This should be hardened and have the temper drawn to a light straw color. This scraper is used to reach those parts that are not easily accessible with the use of the 3-cornered straight scraper. The completion of soldering should be proper cleaning. A sharp distinct edge of the joint is made by drawing the scraper around the part.

In finishing a solder job, the hook scraper is used to reach those parts not easily accessible.

Emery cloth should be used if necessary and finally, buffing. In the event that such soldering must be done on silver or gold plating, it is advisable to obtain for yourself a small quantity, of anti-flux. This can be purchased at a jewellery or dental mechanics' supply house. The anti-flux should be applied to the outside



The emery board should be used where necessary in smoothing out surface after soldering.

of the joint. This would prevent the solder from adhering to those portions of the instrument that would be harmful to the plating. Anti-flux is not expensive. In such cases, it is advisable to tin the parts prior to soldering, however, it is not necessary to tin any part of a musical instrument in preparing it for soldering. You need merely to have the parts clean. One important thing to remember when working on brass instruments, is to apply the solder from that point that is easiest to reach when removing excess solder. Upon the completion of the job bear one thing in mind—if you can see the solder, you have done a poor job. You can assure yourself of ease in working by spending a little extra time to properly fit the part.

If in the application of solder, the solder does not seem to run quite as easily as we prefer, another application of acid will solve the problem. If upon such application you still have trouble, immediately warm scrape the excess and apply more flux and continue your job as before.

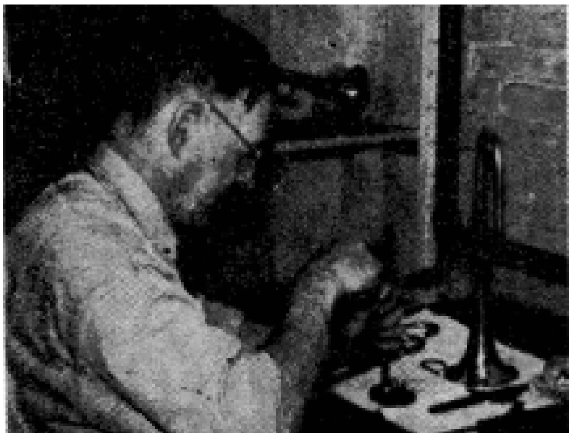
When using binding wire, we have a tendency to press the knot in as we tighten the wire. This may sometimes cause a dent under the wire. This can be avoided by remembering to pull the wire toward you as you are tightening it. Be extremely careful not to feed the solder too close to the binding wire, since solder will take its road of least resistance and may have a tendency to run along the wire.

To properly clean parts prior to soldering there are two quick and simple methods. One is to bright dip the part that is to be soldered. In the event that you do not have a bright dip solution on your premises the second line of procedure will prove extremely important to you. Purchase a 4” steel wire wheel. This is known as a satining wheel. It can be purchased with any size hole so that it will fit any shaft of any small bench motor you may have in your place. Merely run this steel wheel against the parts that are to be cleaned. It will do an excellent job quickly.

Patch Making

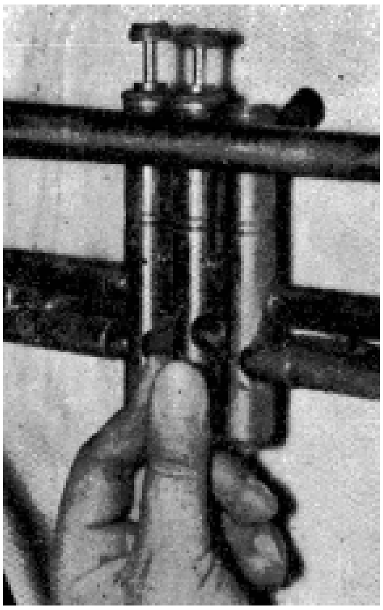
There are basically two types of sheet brass used by musical instrument repair men in the repair of brass instruments. They come by sizes, namely, .010 of an inch thick or .015 of an inch thick. The heavy stock is used for plates in the manufacture of braces or the replacement of the same. The thinner material is used as patch brass for making soft soldered patches to cover holes or worn spots on your brass instruments. The simplified type of patch is that which is placed on straight or tapered tubing such as the mouth pipe or bell of the trumpet at a straight portion. To get a perfect curvature on this type of material, it is wise to follow this procedure:
(1) cut the desired piece of material using the type shape that will seem to fall coincidental with the shape of the braces on the instrument. That is; if the brace plates from bell to mouth pipe are diamond-pointed, cut the same type of shape from the patch brass material so that it will have conformity with the rest of the instrument. After making certain that the edges are even and smooth, anneal this piece of material by heating it red hot. It can be chilled after heating since it will not cause it to harden. At this point, the brass is extremely workable since it is in its dead soft state. It can then easily be formed to fit that portion of the instrument on which it is to be applied. The patch is most easily cleaned by slightly warming it and then dipping it in a soldering acid. This will eliminate any dirt from that portion of the patch that is to be soldered to the body. After the patch and the body are prepared for soft soldering, the patch is tightened in place with binding wire,

The binding wire used for this particular job of soft soldering should be 22 gauge black annealed. When tightening this binding wire, it is wise to remember to pull the pliers from the part as the wire is being tightened so that the knot of the wire does not cause a dent in either part of the patch or the part to which the patch is being attached. Solder this patch in place (see Soft Soldering). The more difficult type of patches to cut are those which must receive curves to match the curvatures of the body. A small patch over the second valve is curved with the aid of a lead block. After the form of the patch is set in the lead block by means of a curved piece of steel which is held into melted lead until the melted lead hardens, light tapping strokes against this curved piece of steel while being placed in the lead block will tend to give you a smooth curvature in the lead block so that it can be used as a mold for curving all patch brass.When the size of the patch is cut, it must be annealed as heretofore described. It is then placed directly over the center of the mold in the lead block. The steel bar used to make this mold is placed directly on top of a piece of patch brass and the top edge of the steel bar struck with a hammer so as to drive the patch into its mold, there-by



Sinking curved patch in lead block.

forcing the curvature of this patch so that it becomes a perfect fit against the slide. When the patch has been curved correctly so as to be the perfect fit, it is then wired down and soldered as described herein (see Soft Soldering). This type patch fits the outer curve of a slide and it is advisable to use the lead block for curving outer curve patches. However, should a patch be necessary on the inner curve of a tuning slide, the draw plate can expedite matters, (see Use of Drawplate). Very often the outer passages between the valve casings become thin, either from having dents removed or from buffing and they require patches. It is imperative to cut an approximate curve that will look the shape of

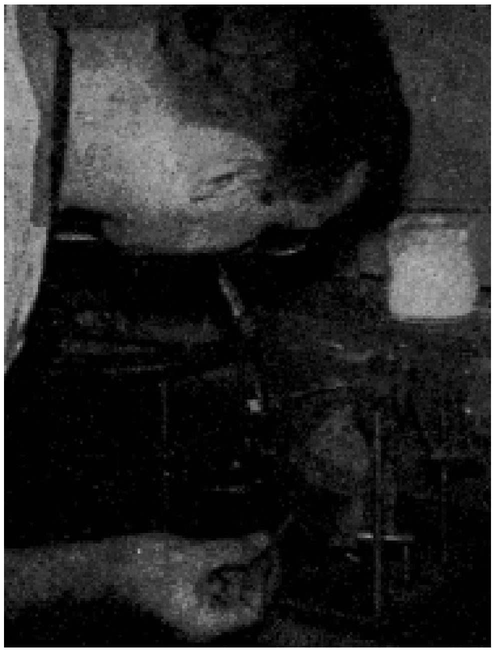


Fitting curved patch to casing knuckle.

a small Napoleon hat so that when this patch is curved with the use of a lead block and a steel rod, it must fit exactly between the valve casings so that the upper portions of the curvature blend to the shape of the valve casings. The final dressing of this patch to fit is extremely important. If the fit is as close to perfection as possible, the top curvature will blend to each casing and the other corners will wrap halfway around the passage so that they are not easily discernible. Furthermore, the rounded shape given it by the lead block will have a tendency to make it as if they were never patched in the first place. It is important that there be no marks or dents on these parts prior to soldering since it will be quite difficult to straighten these pieces after they are soldered in place. It is also wise to bear in mind one thought when making a patch. Although a patch is a sign of a repair in many. cases, the patch can so be applied as to make it look like a design on the instrument. This should be done wherever possible to eliminate the appearance of repaired work and allow the part to rather assume the appearance of factory procedure. In some instances, a hole may be worn on the underside of the bell caused by normal wear and tear. In many cases, it is advisable to saddle patch this part in preference to soft soldering a patch. This will be for appearance 's sake only (see Hard Soldering.')

Hard Soldering

The solder we shall discuss shall have silver as its basic element. The lowest fusion point silver solder is without question the easiest to work with and the best for our purposes. It is preferable to purchase your silver solder in wire form approximately 1/32 of an inch in diameter. The flux used with this type of solder

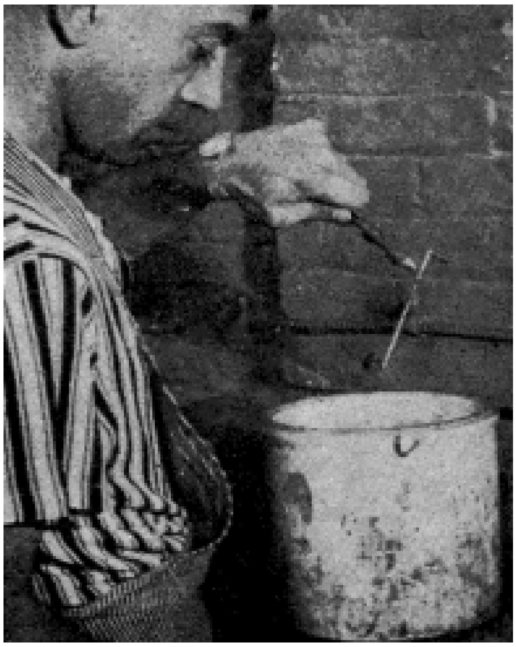


The part to be repaired may be held in a jig

must be of a borax base. There are many products on the market sold as silver soldering flux and will work very well. The cheapest material, however, is Borax. This, however, has a tendency to swell when heated and may give us some difficulty in soldering our parts. Nearly all of the special preparations of hard soldering flux on the market today have eliminated this one fault so that the flux will melt rather than swell up when heated. Since the conductivity rate of silver is quite high, heat travels through our silver solder rapidly. To eliminate burning one's fingers. it is suggested that we saw a piece of a tubular hinge from an old saxophone key. Insert the silver solder wire through this key. The key should be approximately two inches long. The silver can be pushed through the back applying it at the front end. The front end of the key should be crimped to hold the silver solder to retard its feed. We use silver solder on both brass and reed instrument repairing. There are a few tricks in each method. The most important of all that is common to both types of repair jobs is to allow the heat of the key or brass part, not the torch, to melt the silver solder. The smaller the amount of silver used, the better

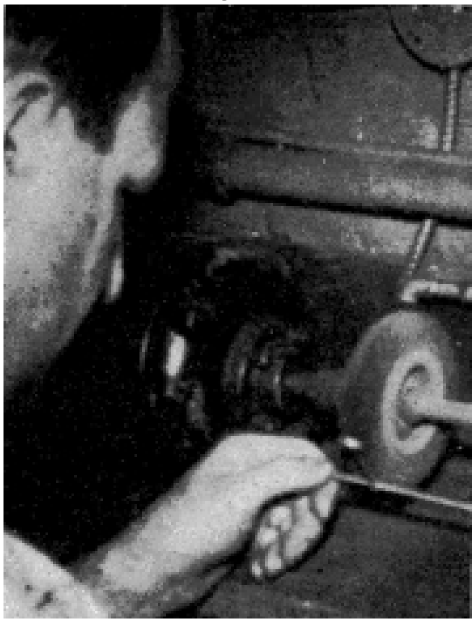
If you prefer, a small clamp may hold the part.

the repair job. We should never apply more silver solder than is 'necessary but strive always to feed exactly the right amount. Silver solder has a tendency to flow along the road of least resistance. It is for this reason that prior to silver-soldering, the proper fit is the most important item. Flux should be applied prior to silver soldering, whether the part be held in a jig or in a small clamp. The silver solder flux should be mixed quite loosely using water for its cutting agent. To remove the silver soldering flux upon the completion of the silver soldering job it is suggested that a pickle be used. This pickle is a combination of sulphuric acid and water mixed in the following manner; to ten parts of water add one part of sulphuric acid. It is important to pour the



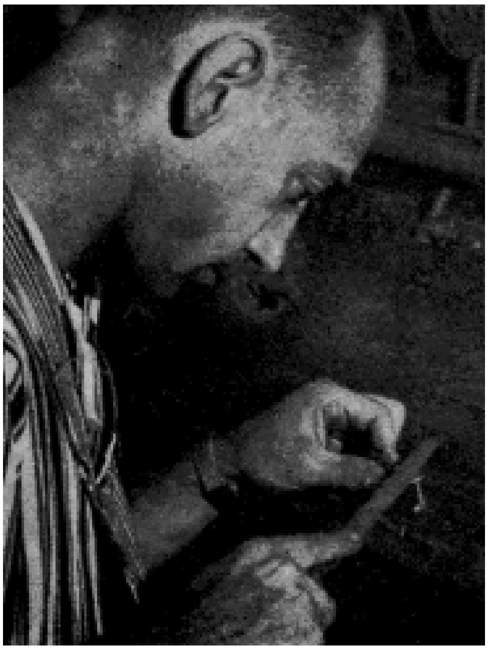
To remove silver soldering flux, use a pickle.

sulphuric acid into the water. The key is immediately immersed in this solution and left there until the flux is eaten off. This pickle may be strengthened and weakened as desired. It is extremely important to properly clean the part prior to silver soldering. All traces of dirt must



Final polishing is done on a buffing wheel.

be removed. This can easily be achieved with the use of a steel wire wheel which can readily be purchased in any hardware store. Do not silver solder any part that has lead on it until all lead or soft solder is completely removed, since this lead would crystallize when the part is heated red hot. Over concentration of the flame at one particular spot could possibly burn a hole through the brass. This can be eliminated by dancing the flame slightly while applying the heat.



Excess silver solder may be removed with a file.

The finest torch I have found for this type of work is the high heat torch with a filtered tip.

In silver soldering plates on trombone braces or 3-piece trumpet braces, it is a smart trick to insert a small piece of silver in the tube that is being held fast to the plate. Apply the flux and heat red hot. This will eliminate the separate application of silver solder. There is another type of silver solder which because of its high fusion point and its yellow color is referred to as brass solder. This solder takes the color of brass and should be used where the color of silver is unwanted but silver soldering is necessary such as in saddle patching which shall be described in a later article. This solder is a silver solder. Due to its high fusion point which is, incidentally, very close to the fusion point of brass itself, we deviate slightly from the aforementioned facts and apply the heat to the part and solder alike allowing the solder to melt off in small pieces and then allowing this solder to flow out through direct application of the flame to the solder.

Brass Soldering

In this chapter we shall continue the discussion of hard soldering to take into consideration the use of a low silver content silver solder which assumes the color of brass when hard. We shall here-in-after refer to this material as "brass solder." It is used primarily in the same manner as the normal silver solders. However, this brass solder has a high fusion point. Therefore, we must be careful in applying the flame. If the flame is too concentrated, it could possibly burn the material by the time the brass solder would melt. To avoid this, we must dance the flame slightly when the metal has been heated red-hot. Contrary to the rules, we gave you in silver soldering, we apply our heat to the brass solder as well as to the part being soldered. The same flux is used. Likewise we utilize the exact type of pickle we used in silver soldering to remove the hardened flux after the job is completed. Brass soldering has its best use for two different types of work.

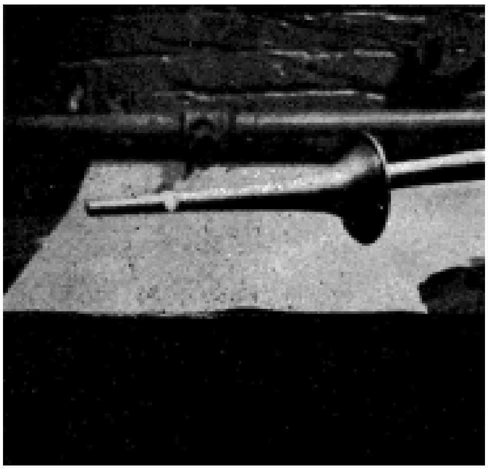
Let us assume that there is a crack in a mouthpiece pipe or a bell of a brass instrument. This can be repaired in one of two fashions; the simple method is to make a patch to fit this part and soft-solder it in place.

First, the worn section is cut for patching.

However, this will definitely show signs of having been repaired. The second method involves the use of brass solder. First we must clean that crack by filing or scraping the edges of the crack. The important thing to remember is that it must be clean enough to accept the brass solder. Unlike silver solder, brass solder does not flow too readily. As a result we must melt small portions of the brass solder onto the crack when that portion that is to be brass soldered is red-hot using the same flux that we use with silver solder. The flame must then be danced lightly directly at the brass solder as well as the part until such time as the brass solder seems to melt to a liquid state. It is advisable to use brass solder in excess of the amount that we would ordinarily use where we silver solder a part. When cooled the excess can then be filed away and final finishing done with emery cloth and the buffing wheel. The brass solder will assume a color very close to that of brass. So close, in fact, that when polished, it will be impossible for the human eye to detect the difference. There is still another procedure wherein brass solder is used to great advantage. Let us assume that on the bell of an instrument, a man has worn a part very thin, presumably on the tapered section near the valve casings.This is a usual occurrence.

Then the saddle patch is soldered in place.

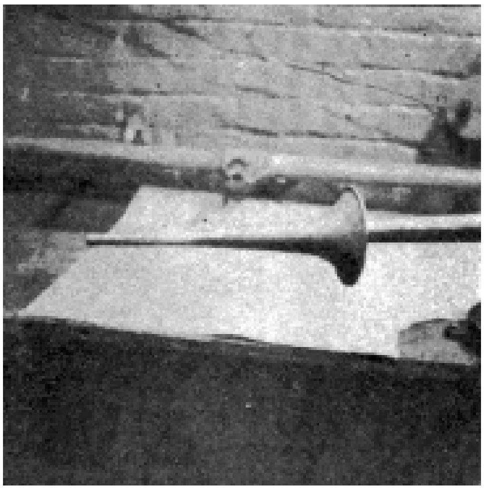
Through the use of brass solder and saddle patching, this job can be repaired so that the repair job cannot be detected. This is done in the following manner: using a half round file, of the smooth cut variety, that is large enough to cover the worn part, file the instrument as



Next step is to remove the dent from the patch.

shown in the illustration.

Then using a scaper, cut away at the excess edge which we refer to as the saddle. Cut this job, it will be impossible to detect where the patch was placed. This procedure can very often prevent the sloppy job of soft soldering patches as well as the cut away at the excess headache and trouble of supplying, a new bell.



You can't detect the patch on the finished job.

How to Take Accurate Measurements

The ability to take accurate measurements can be acquired only by practice and experience. Careful and accurate measurements are essential to good machine work. All measurements should be made with an accurately graduated steel scale or micrometer. Never use a cheap steel scale or a wood ruler, as they are likely to be inaccurate and may cause spoiled work.

An experienced mechanic can take measurements with a steel scale and calipers to a surprising degree of accuracy. This is accomplished by developing a sensitive caliper feel" and by carefully setting the calipers so that they "split the line" graduated on the scale.

Setting Inside Calipers

To set an inside caliper for a definite dimension, place the end of the scale against a flat surface and the end of the caliper at the edge and end of the scale. Hold the scale square with the flat surface. Adjust the other end of the caliper to the required dimension.

Measuring Inside Diameters

To measure an inside diameter, place the caliper in the hole and raise the hand slowly. Adjust the caliper until it will slip into the hole with a very slight drag. Be sure to hold the caliper square across the diameter of the hole.

Transferring Measurements

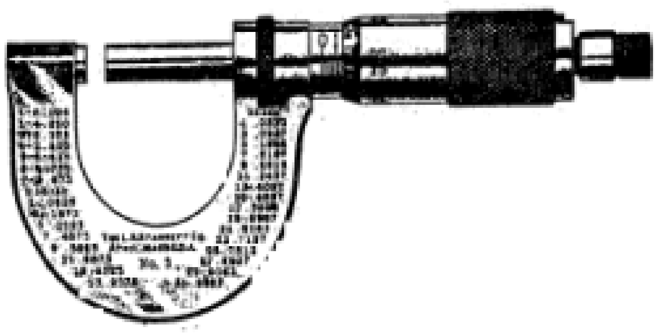
In transferring measurements from an outside caliper to an inside caliper, the point of one leg of the inside caliper rests on a similar point of the outside caliper. Using this contact point as a pivot, move the inside caliper and adjust with the thumb screw until you feel your measurement is just right.

Caliper Feel

The accuracy of all contact measurements is dependent upon the sense of touch or feel. The caliper should be delicately and lightly held in the finger tips, not gripped tightly. If the caliper is gripped tightly, the sense of touch is very much impaired.

How to Read a Micrometer (English Measurements)

Each graduation on the micrometer barrel represents one turn of the spindle or .025 in. Every fourth graduation is numbered and the figures represent tenths of an inch since 4x.025 in = .100 in. or 1/10 of an inch.



English measurement micrometer.

The thimble has twenty-five graduations, each of which represents one-thousandth of an inch. Every fifth graduation is numbered, from 5 to 25. The micrometer reading is the sum of the readings of the graduations on the barrel and the thimble. For example, if there are seven graduations visible on the barrel, since each graduation represents .025 in., the reading on the barrel is 7x.025 in. or .175 in. To this must be added the reading on the thimble which is .003 in. The correct reading is the sum of these two figures or .175 in. +.003 in. = .178 in. Therefore this micrometer is set for a diameter of .178 in.

Metric System Micrometer

Micrometers for measuring in the Metric system are graduated to read in hundredths of a millimeter. For each complete revolution the spindle travels 1/2 mm or .50 mm, and two complete revolutions are required for 1.00 mm. Each of the upper set of graduations on the barrel represent 1 mm. (two revolutions of the spindle) and every fifth graduation is numbered 0,5,10, 15, etc. The lower set of graduations subdivides each millimeter division into two parts.

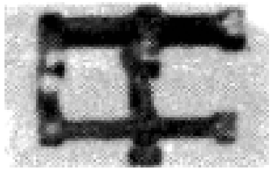
The beveled edge of the thimble is divided into 50 graduations, each of which represents .01 mm.

The micrometer reading is the sum of the readings on the barrel and the thimble.

Removing Stuck Mouthpieces

There are many pullers on the market which make removing stuck mouth-pieces a very simple job. The puller works in this manner:

Set the mouthpiece in the puller with the



Mouthpiece puller

proper dies to fit the shank of the mouthpiece. Turn the lead screws evenly until the mouthpiece is held firm in the puller. At this point, a slight amount of further pressure will release the mouth-piece.

Lathe Operation for Brass Work

Unlike the average machine shop, the musical instrument repairman must use his tools for his own benefit and not always according to the prescribed methods set down in the regular manuals. For instance, the first rule we break. Metal turning bench lathes the fact that most of the work we do on the lathe in the cutting of brass is done with the use of a hand tool and not with the compound rest as all normal texts prescribe, whereas most of the turning we do on wood clarinets is done with the use of the compound rest.

It would be virtually impossible to make special form tools for each individual job. For this reason, we do most of our work with a diamond faced hand tool made for this purpose from square drill rod. (see Tool Grinding).

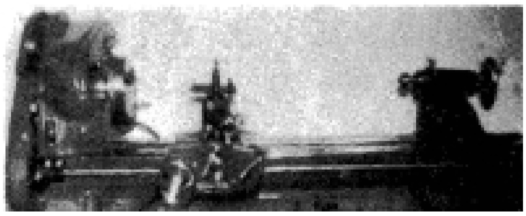
For the aforementioned reason a small wood turning lathe is sufficient to do all the work in the brass repair department.

Use your lathe for the following brass repairs:

a. Making bow knobs (see Tool Grind-ing)
b. Facing off the edge of tubing
c. Cutting beads on the end of outside tubing (see Tool Grinding)
d. Making braces
e. The bed of an Atlas lathe is a perfect leveling block for trombones.

The chuck most applicable for our work is a three jaw universal chuck. Although this is not the most accurate it is more than sufficient for our work.

When the lathe is used for drilling a part

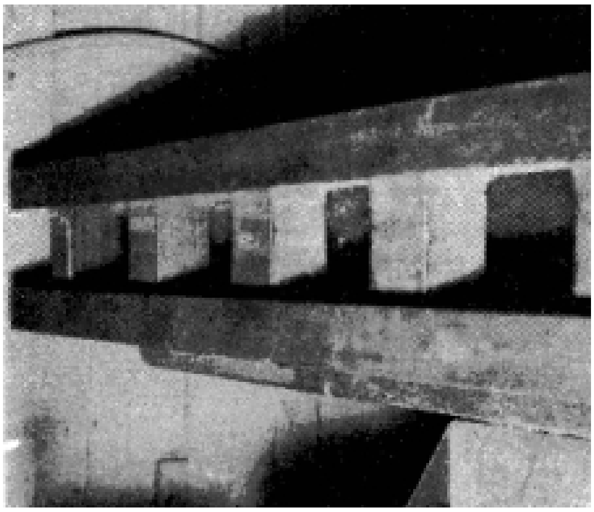


Metal turning bench lathe

in dead center, we recommend the use of a Jacobs chuck in the tail-stock. If the part is to be drilled through the side of a piece of round stock, put the drill in the chuck at the head-stock and use a crotch center. Use your lathe for cutting a part down to receive threads. (see Tap and Die Threading).

Bow Knobs

These small parts are the pieces soldered on the small slides which allow one to grip the slide. It is wise to make one hand tool to cut these bow knobs out of 14 brass rod. (See tool grinding.) In this manner, each bow knob will be the same each time. The bottom of this knob is filed half round to fit the curvature of the slide bow. Soldering this knob in place is accomplished in this manner. Make a small clip of a piece of small drill rod approximately .100 diameter. When applying the heat, be careful to throw the flame away from the rest of the slide. This will allow the knob and not the rest of the slide to get hot enough to be

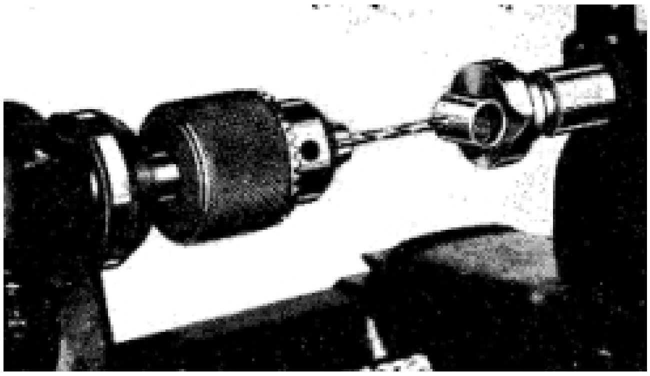


Flat bed or rails of "Atlas" lathe.

soldered.

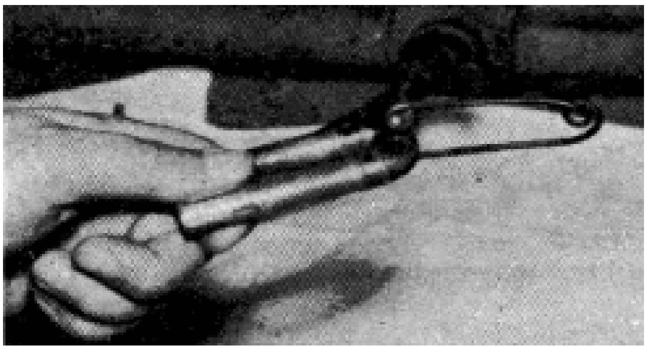
Slide Alignment

After each slide is fitted correctly, assuming that parallel lines are maintained, there is only one other point of trouble to look out for. Don't try to solder the slide while all the tubes are in perfect place. Merely tack or spot solder them. Move the slide back so that the tubes do not solder together and complete the. soldering



Using crotch center in tailstock

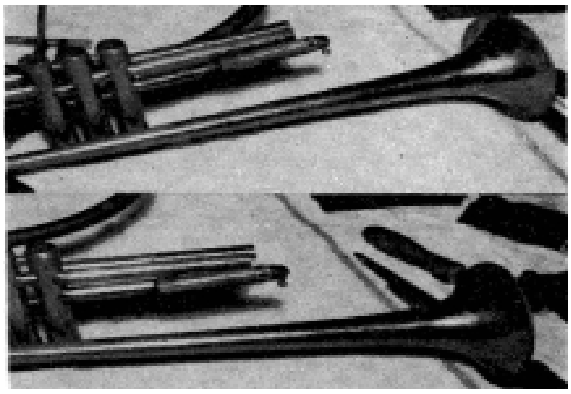
jobs. Always grease the slides before mounting. Do not let the grease get on the part to be soldered. If the slides are put together in this manner, you can always be assured of having perfect butted ends.



Clamp is used to hold bow knob for soldering

Valve and Casing Cleaning

Many of these items, though the causes and the repair of the damage be different, will show the same symptoms. The proper diagnosis of the trouble is the most important phase of valve repairing. A mechanic must first determine what is causing a valve to work improperly before he can proceed with the normal procedure in the proper repair of the same. Very often a valve will act sluggish if the valve and casing are dirty. This is the simplest repair job that a mechanic can have on valves. The valve should be removed and properly cleaned prior to replacement. There are many methods used in properly cleaning valves. Of all of these, I prefer the following: if the valve is nickel plated, first degrease this valve by boiling it in a hot solution or if such a hot solution is not available, thoroughly wipe off the valve and buff it lightly, being extremely careful not to cut the valve nor to fold over the edges of the passages. The inside passages must be cleaned as well as the outside of the



Top: Proper slide alignment shows parallel lines. Bottom: Improper slide alignment.

valve. Upon the completion of the buffing process, the valve must be thoroughly wiped off to remove all traces of buffing dirt.
If the valve has a silver plated finish, it is suggested that we do not buff this valve for two reasons, namely: 1. silver plating is very soft and as a result, you would undoubtedly remove some of it possibly causing the valve to leak. 2. silver plating is very porous and too much of the buffing dirt would remain on the valve despite the high luster that would show after. In the event a valve is silver plated, it is suggested that this valve be cleaned by the scratch brushing process, using soap bark and water and a very smooth, soft brass brush, turing it at a speed of approximately 4 to 6 hundred R.P.M. If the valve is chrome plated, it is suggested that this valve be washed with warm water and thoroughly wiped off.

Copper plated or German silver valves should be treated in the same way and manner as silver plating. The valve casings should be cleaned by a thorough wiping using cotton or wool flannel wrapped around a rod. I cannot stress the fact that the wiping of these casings must be a strenuous one if we are to receive a smooth working valve. We must actually strive to bring up a polish on the inside bore of the valve casing. When placing the valves in the casings, assure yourself of the fact that there is no free lint on the valve or in the casing, since a tight fitting valve will not ‘have the tolerance necessary to allow for this. The valve should then be sufficiently oiled and replaced in the casing allow-ing the oil to distribute itself all over the valve. Sometimes dirt will collect itself in the passage between the valve casings. If this should happen, it is suggested that they be cleaned prior to the replacement of the valves.
DO NOT USE OIL ON CHROME PLATED VALVES. When cleaning these valves, they should be lubricated with cold cream and water. Then the packing, known as valve felts and cork washers, are placed under the caps of the valves to align the ports of the valve in the upper position. The proper adjustment of this position is the perfect alignment of the ports in the valves to properly match the like openings in the valve casings. The washers necessary under the finger button are for the purpose of aligning the valve in the down position.

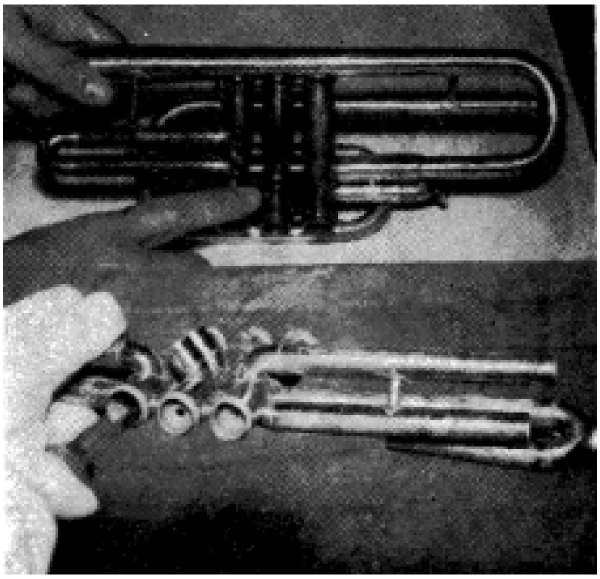
Valve Casing Repair (Dents)

Dents in valve casings are always of the very small variety, usually caused by the mouthpiece falling loose in the case. It is not wise to try to remove these, but rather to eliminate them. If we can roll back a small portion of the dent on a surface dent rod, it will not give complete freedom of working to the valve but it will bring the damage to a minimum.
The balance of the internal nick is removed by gently scraping in the casing of only the nick, thereby not causing the valve to leak. In extreme instances, the casing may have to be

lapped out.

Valve Casing Repair
(Retruing oval casings)

Oval casings are the result of a slide being pulled out of line thereby causing a terrific strain on the valve casing. This, is a usual occurrence on the second valve casing. It is caused by the musician (usually a student) putting the instrument in the case upside down. When the case is closed, it bends the second slide down causing such a strain. This will, in turn, pull the casing out of round. To alleviate this situation, we. must reverse this procedure. Since we cannot always get the proper leverage on such a small slide, a good trick is to place the third valve slide in the place of the second slide. Keep the valve in its proper casing. Ease the slide upwards slightly until you feel that the valve is completely free. Replace the slides in their proper positions. To determine whether or not it is the casing, merely try the valve in a different casing. If it works free in one of the other casings, it is a



Top: Note nick in valve casing. Bottom: Using scraper to shave nick slightly.

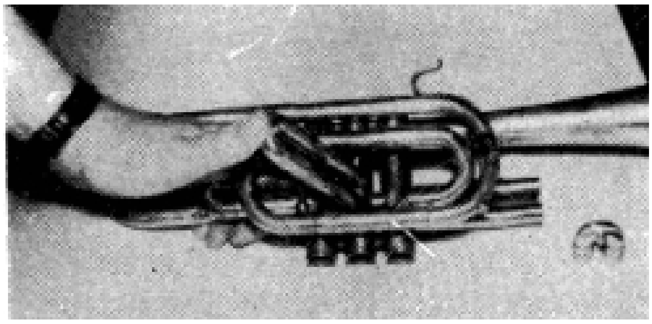
sure sign that the casing is strained. If the valve jams in the other casings, it is a sure sign that the trouble is with the valve.

Bent Valve Repair

After determining that the valve is bent, the bend must be located. This is done by holding a straight edge against the valve up to the light. Rotate the valve. To straighten this valve, place the valve in the proper casing up to the point of the bend, going in from the bottom side. Strike the valve at the top solid side of the valve near the stem to reverse the bend with a raw hide mallet. Strike very lightly. Repeat this procedure if necessary until valve is straight.

Valve Passage Repair

It is not proper to replace passages in valves in the normal field of instrument repair since when new passages are inserted in the manufacture of new valves, the valve shell is extremely heavy. However, since we often have the problem of the parent who tries to remove the valve for his child by hammering at the bottom of the valve with a screwdriver, we are faced with the problem of repairing this



Relieving pressure on second valve casing third using valve slide to obtain better leverage.

valve. This is the proper procedure of completing this repair:

Using a small ball end dent rod, press the edges of the hole in the passage back to as close to a normal position as possible. Apply a very small flame to the passage. Apply soldering flux. Bridge the gap with solder. Service the valve to work properly in the casing.

Valve Casing Thread Repair

Quite often the threads on valve casings rot or rip These can not be repaired and must be replaced. The male thread for the top cap is no problem, since it is on a marrel and the barrel is replaceable. The male thread for the bottom cap is the one that usually presents this problem. The following is a description of the method of replacement. To understand the procedure, we must understand the original makeup of a casing. In most casings, the part is made from one piece of brass tubing. Some casings consist of two pieces of tubing, one inside the other. To replace these threads, the old threads must be cut away and a new piece of tubing with the proper threads must be put in its place. Since the new threads can only be held in place by means of an insert, the valve casing must be prepared, for this. The tool used for cutting off the threads and boring out the casing is a fly cutter. It can be made simply in your own shop in the following manner: Cut a piece of 1/2" drill rod 6" long. Drill a hole 3/16" through the side of the rod at a point approximately in center. (Three inches from end) Grind a cutting tool bit edge on a piece of 3/16 " drill rod. Insert this tool bit in the 3/16"hole so that the tool looks like a cross. This tool should be locked in place by means of a lock screw preferably an Allen Screw (headless) with a 4x48 thread. Upon the completion of this procedure, you will have an adjustable Fly cutter. This tool is a lifetime tool and can be used for any size valve in the future.

To properly guide this tool, a pilot must be made for each particular job. The pilot consists of a piece of brass 11/2" long, the outside diameter of which is a snug, smooth fit in the valve casing, with a 1/2" hole drilled through the dead center of it lengthwise. At this point you are fully prepared to do the repair job.

Repair Procedure—

Insert the pilot into the valve casing so that the bottom of the pilot is at a point approximately 1/2" above the bottom of the valve casing. Your cutting tool is inserted into the hole of the pilot. Set the tool bit to cut 1/2 " the thickness of the valve casing wall. Using your lathe or drill press, let the cutter bore out the casing to a depth of 1/4". At this point. your casing is prepared to receive the new threads.

Making the Insert—

The insert is made from a piece of brass, the inside diameter should be exactly the size of the inside diameter of the original valve casing. The outside diameter should be a perfect fit into the bored section of the valve casing. The threads are put on the insert by means of THREAD HAND CHASING TOOLS. These tools can be purchased from the JONES AND AUERBACHER CO. of Edison Place, Newark, N.J. They are ordered by the number of threads per inch. There are inside and outside Chasers. Their cost is approximately $1.50 each.

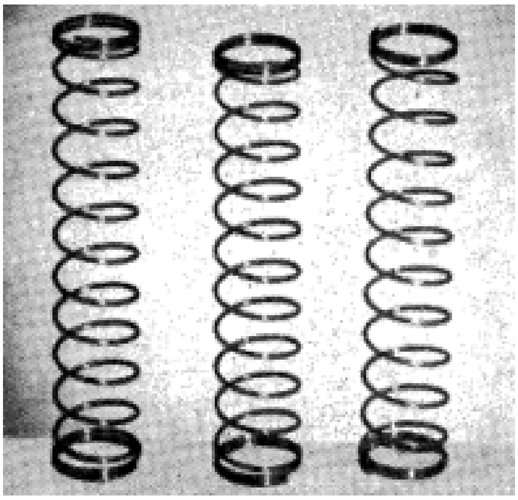
The final procedure is to solder the insert in the valve casing and lap out the casing to fit the valve. If you center all your work, there will be little or no lapping necessary. This procedure takes a long time to describe, but a short time to perform. Remember, once the tool is made, it lasts a lifetime.

Valve Spring Adjustment

Very often the springs of a valve cause more trouble to the musician than the valve itself. The valve may be free and easy working in a trumpet or like instrument. However, if the valve spring tension is maladjusted, the musician will find it an impractical horn to play. There are three types of valve springs; namely the top outside, the top inside, and the bottom springs. The top outside spring is a spring that utilizes the stem of the valve and a retainer plate. This retainer plate hits the shoulder of the valve casing so that when the valve is pushed down, this retainer compresses the spring against its stud at the top of the valve stem. Very often scratching noises are heard with the use of these springs and it is caused by the valve spring being crooked possibly on the first or last coil or on a center one. We must be careful to see to it that this spring compresses evenly without rubbing against the stem itself. It is only in this fashion that we can eliminate the scratching noises that make a musician feel uncomfortable in playing his horn. The only way we can check this on the valve spring is to stand the valve spring up on a flat surface. If it leans to one side and does not stand up perfectly straight, we must then tilt the bottom coil to allow this spring to stand perfectly perpendicular to any level surface. We will then reverse the spring and repeat the same procedure. The tension of a spring is determined by the spread of its coil. We can increase the tension of a spring by pulling the coil apart on the overall length. We can decrease the tension of a spring by cutting down the number of coils. However, the top coils must be refitted so as to lay flat against any level surface with the spring in a perpendicular position. We should strive to make the tension on all springs actually the same, except in those rare instances when the musician requests the feel of some valve a little

heavier than that of another.

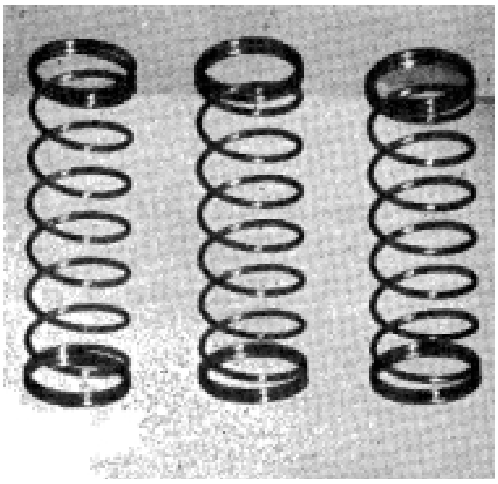
On the top inside springs the same procedures are followed with this one difference. The scratching noises are the cause of the outside of the spring coil rubbing against the inside part of the spring barrel. We must be careful to see to it that our spring coil is small enough to allow, for clearance in the spring barrel just as we should be careful to allow for clearance on the top outside spring against the stem. On the bottom valve springs, the same procedures are followed with this exception. The bottom coils of the spring must be larger than the size of its own circumference. Upon setting the spring in the bottom cap, we must assure ourselves of the fact that the spring stands perpendicular to the cap. These springs usually are wound in a tapered form.



Wrong—All springs not of equal length.

In all cases if there is a clicking noise, this is a certain sign of the fact that there are too many coils on the spring. This noise can be eliminated by cutting the coils off the spring. We can retain the same tension of the springs by spreading the coils.

Valve guides (Keys or Splines) are made from three eighths round brass stock, the end of which is cut down to receive threads. The size of the thread depends upon the old guide. The usual thread is either 3x48 or 4x48. On larger than usual valves such as sousaphone, the thread size is sometimes 5x40. Dress down the side edges so that they

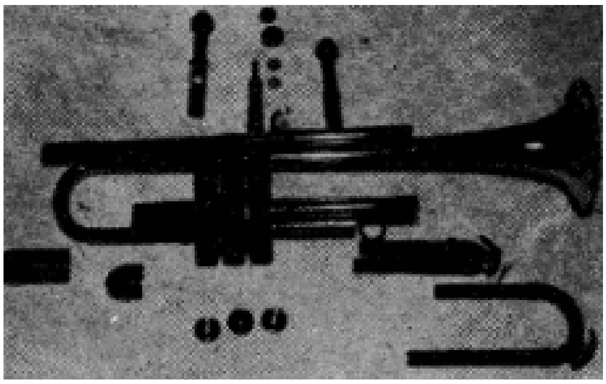


Correct—Each spring is as tall as the others.

are squared off to a perfect fit in the guide track. This is easily accomplished by drilling and threading a hole in the side of a brass rod. Fit the guide in the rod and in this manner, you will be able to tell when the guide is a perfect fit in its track. The thickness of the guide is dressed when the guide is replaced in the valve.

Valve Stems

Valve stems are of two varieties usually. The simplified type is used on valves having bottom springs. This is merely a piece of round brass rod with a male thread on one end. This thread is usually a 10x32 or 10x24



Trumpet breakdown

thread. The opposite end has a female thread. This thread is either an 8x32 or 6x32 thread. The female thread receives the valve button.

The other type valve stem is the type used where there is a spring barrel for inside top action springs. These threads are chased. The size thread can be either a 38 or 40. If it becomes necessary to change the size thread in the female thread of the stem, thread a brass rod with the size thread in the stem. Screw it in place. Silver solder it. Redrill and tap the new hole to any desired size.

Valve Pearl Replacement

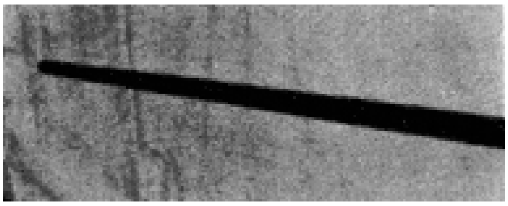
Before replacement of a pearl can be effected, it is necessary to remove the old pearl. The easiest method for this job is to burn the old pearl. This will cause it to flake and fall out. After assuring yourself that the recess is deep enough to hold a new pearl, set the pearl in place and tap the edges down with a dent hammer. There is a tool for this particular job. This tool is called a pearl set. The tool is placed over the pearl with a button resting on the edges of the vise. One solid hit with a rawhide mallet will bend the entire recess edge holding the pearl in place. This tool can also be used in the lathe to spin the pearl tight. If used in this manner it acts as a burnisher to spin the edge down. The tool must have its recess large enough to hit the brass edge of the button and not the pearl. The recess of this tool has a slight taper.

Mouthpipe Repair

The mouthpipe is one of the two tapered parts on a trumpet. If there are only small dents in the tubing these are removed in the following manner:

The dent rod used is 14" diameter. The end of the rod is rounded. The rod should be approximately 14" long. If pressure is exerted on the end of this rod, the rod will have a tendency to bend in the middle, thereby disallowing the use of the end of the rod. Since the end of the dent rod is the important part for dent removal, we must strengthen this tip. This is done by putting a gentle rise on the end of the rod. This will eliminate the possibility of middle bending. This rod can then be used to remove the dent by inserting it through the mouthpiece receiver.

If the mouthpipe is badly (lanlaged, it must be unsoldered from the tuning slide and braces after which a tapered mouthpipe mandrel can be inserted from the larger opening and the dents can easily be burnished out. When a mouthpipe is broken or cracked, the leaks can be repaired by soldering a patch in place. This sometimes creates the appear-

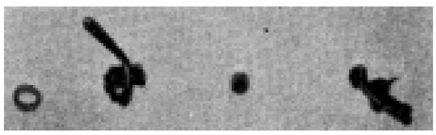


Mouthpiece mandrel can be used where pipe is unsoldered from the tuning slide.

ance of a repaired part, which is the very thing we must try to avoid. To maintain the appearance of factory work, it is sometimes wise to cut the pipe in half, since such a crack will appear short of the valve brace, After removing the dents in the pipe, solder a sleeve over the receiver and so that it allows a small portion to extend past the end of the cut off pipe. The amount of the extension is determined by the distance that the tuning slide bead allows from the third valve casing so that when the extension is soldered to the balance of the mouth-pipe, the extension will be the same distance from the first valve casing as the tuning slide will be from the third valve casing. When this is soldered together, it will look like the original pipe from the factory, provided that the same type bead is cut on the extension as is on the tuning slide.

Water Key Assemblies

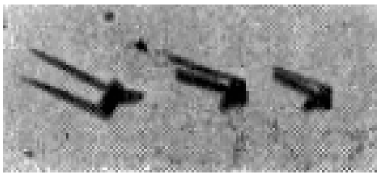
A waterkey assembly consists of the waterkey, gutter (posts that hold the waterkey), rod, and the spithole. Some assemblies are one unit type such as on the cheaper type foreign makes. The American type is a two piece variety. The important thing to remember is to make certain that the soldering on the hole is perfect so that no leak can occur. The spring for the waterkey is usually made of Phospor Bronze. There are two types. The inside type is of a smaller gauge and the hole in the coil is also smaller. The outside type has a large enough hole in the



Trombone and trumpet water key assemblies.

coil to allow the coils to fit over the tubular hinge of the water-key. In both instances, the ends of the spring are cut to size after insertion. These springs come ready made.

The trombone waterkey differs from all other waterkey in the fact that they demand more coils on the tubular hinge than the other waterkey springs. As a result, the trombone waterkey springs come coiled on one side only, since the second side must be coiled on the waterkey. If the ends of the waterkey spring are short making it difficult to insert the water key with the spring attached, cut two lengths of tubular hinge 1" long of clarinet key stock. Place each tube over the ends of the spring and crimp the tubes slightly, thus giving



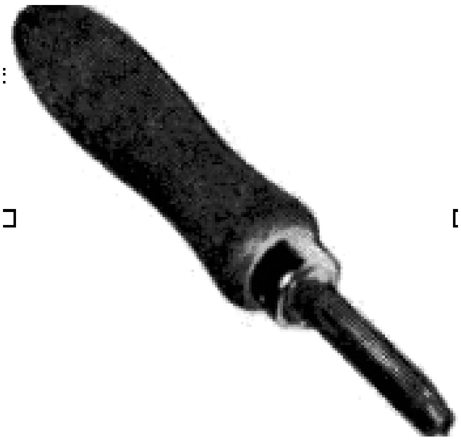
Water key springs.

yourself the added length to allow you to easily insert the key in place. After the key is in place, remove the tubes.

Ferrule Replacement

If a ferrule is so badly damaged that it must be replaced. it is performed in the following manner:

The tubing used for the ferrule must be the same size as the outside slide. Face off the end of this tubing. Solder it to the inside slide



Bead cutting form tool.

so that the inside slide goes halfway into the ferrule. Cut the length of the ferrule after it is soldered to the inside slide. The usual ferrule has a bead cut in the brass on the bow side of the ferrule. This is done after the ferrule is cut to size, and faced off. The ferrules should be soldered to the inside slides before they are soldered to the bow. When the both ferrules are on the inside slides, grease the tubes slightly, thus giving yourself side slides so that they are flush fitting to the outside slides. Insert the bow and merely spot a tack mark of solder on each ferrule against the bow. Now pull the slide slightly so that the solder cannot adhere to the outside slide. Complete the soldering job. This method will tend to give you perfect alignment for a perfect working slide.

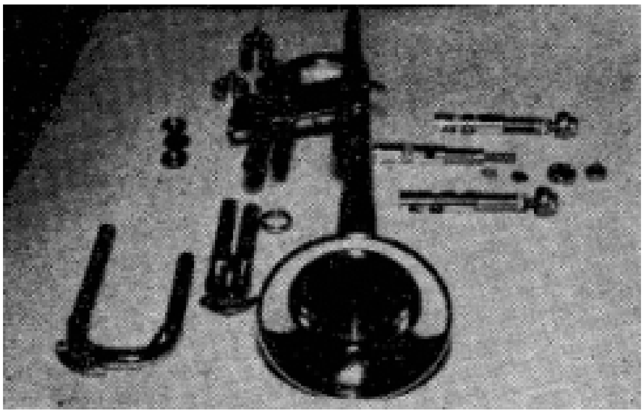
Making Adjustable Braces

Adjustable braces are used in two different places to accomplish the same purpose. They are placed between the bell and the mouthpipe of a trumpet and wherever the necessity for strengthening an instrument involves the use of a longer brace than the average. The use of this type brace is a big advantage to the repairman since it allows him the clearance for perfect fitting in the length of these braces, whereas the set brace cannot be changed in length, thereby causing extra problems in doing the job. The adjustable brace consists of three parts, the two end brace studs and the center bar. The end studs are made by cutting two short lengths of 1/4" brass tubing (Standard stock) the length of which depends on the length of the brace required. For design, it is smart to cut a bead on the ends of the two tubes. File the opposite ends of the tubes half round to fit the curvature of the part it fits against. The plate for the bottom of this brace can be either diamond shaped or round depending on the other braces used on the instrument. Curve these plates to fit the tubing.

Silver solder these tubes to the corresponding plates. The length of the brass rod between the plates is determined by the length of the desired brace. When soldering these braces in place, the important thing to remember is that the plates must be soldered first. After this is completed, the center bar is easily soldered in the tubes.

Fitting Solid Braces

To maintain the instrument without strain against the tubings thereby allowing the horn to remain in perfect alignment, it is necessary to fit the solid short braces as nearly perfect as possible. If a solid brace is slightly short, it can be lengthened by causing the plates to have a slightly sharper curvature. This will allow a slight gap in the center of the brace fit which can easily be filled with solder. If the



Trumpet breakdown.

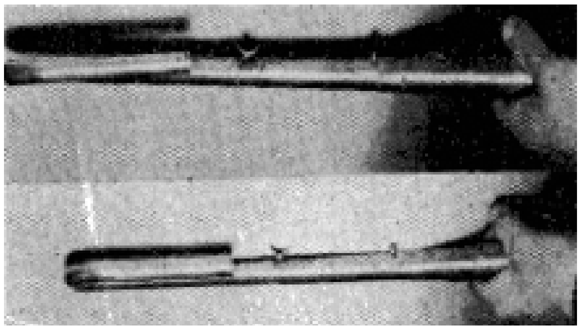
brace is too tight thereby causing a strain on the tubes which tends to force them apart, the brace can be shortened by crushing the brace in the vise. However, in order not to destroy the curved plate, it is advisable to place a round piece of drill rod in the curvature of each plate and apply the pressure against the drill rod. This will cause the center bead of the brace to shrink in length and expand slightly, though unnoticeably, in width.

BRASS INSTRUMENT MOUNTING

A.Trumpet and other brass line horns

The basic point to remember in the mounting of a trumpet is the maintenance of a guide line as well as the maintenance of parallel lines. If a slide is to be dismantled on a trumpet, never unsolder the entire slide, that is the outside as well as the inside slides. Let the outside slides remain mounted on the horn until the work is completed on the slide itself. After remounting the slide, using the outside slides as the guide line or jig for this remounting, the outside can then be unsoldered to complete any work that is necessary there on. This allows the instrument to act as a perfect jig for all slide mounting and removes the possibility of guesswork in the maintenance of perfect parallel lines for slides. Remember that a slide on an instrument is a perfect rectangle. If the parallel lines on the rectangle are disturbed, the slide will have a tendency to be extremely hard working.

When remounting the bell on a trumpet, the first joint to solder is the small end of the bell into the first valve casing. Before soldering this, be certain that the bell back is perfectly parallel with the first valve slide. The bell will have a tendency, due to its weight, to lean over. If you allow this to happen prior to soldering, the front of the bell will have the appearance of lining up below its level line. If this bell joint is mounted according to the parallel lines with the first valve slide, the bell will fall in perfect alignment with the balance of the instrument, provided that the back tube of the bell was set parallel with the center of the tapered section prior to mounting. Next, solder the brace between the first valve slide and the bell back. Finally, solder the braces on the tapered section of the bell. When solder-ing the brace at the center of the bell, the heat



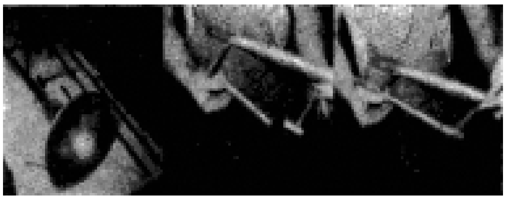
Improper and proper alignment of back turn to bell center prior to mounting.

should be thrown in such a way as to allow the excess heat to clear the rest of the instrument, thereby not causing the valve casing to be overheated. This will eliminate the possibility of any other part becoming hot enough to unsolder itself.

The mouthpipe will be easily replaced since it will automatically follow the center line of the bell. When applying the solder, be sure that you feed the solder from the point that excess can most easily be scraped from, allowing the solder to run just to the opposite end. When soldering, apply a small amount of solder at a time. Remember that you can always add more solder simply but it is a lot of work to remove excess solder.

B. Trombone

On the bell section, the important guide line is the tuning slide. Since this is not a complicated section, it is a simple matter to maintain the parallel lines by the use of the tuning slide as a soldering jig for the balance of the instrument. Do not forget that the collar pipe of the bell section of a trombone. must have a curva-



Allowing for curvature in collar pipe of trombone bell.

ture away from the bell to maintain the necessary clearance for the main slide when the horn is completely assembled. Dents in the collar pipe should not be burnished. They must be raised up with a dent rod from the inside. This curvature is maintained by means of the adjustable brace between the bell and the slide receiver on the collar pipe. For the proper mounting of the basic trombone slide, see the article on trombone slides.

TROMBONE SLIDES

In view of the fact that there are many things that can go wrong causing a slide to be tight, we shall have to take them in separate sequence.

Slide Dents

Never try to remove more than one dent at a time in any slide. Bearing in mind the fact that a slide (outside) is made with spring tempered brass, by virtue of the tubing being Hard Drawn Brass, we must realize that the conventional method of removing dents can riot be used on spring brass. The use of the dent hammer is an art on slides. It must be used in the following way:

Place the index fingers and the thumb of the left hand on either side of the dent. Press down as strong as you can with these two fingers. Using the small side of the hammer, barely tap in the middle of the dent. The tapping should be so light as not to leave any mark. Hammer marks are sure signs of stretched metal. Keep up this procedure until the dent springs back out. Light burnishing after the dent has been removed is advisable. Naturally we must use a mandrel inside the dented slide while tapping and burnishing, the dent rod should be as snug fitting as possible. Always work one side of a slide at a time. Complete burnishing of a slide is only used when the slide is oval shape. When burnishing the slide, use a curved or hook burnisher. While using the burnisher lengthwise. keep the slide rotating. In this manner, we eliminate the possibility of getting oval slides.
NEVER ANNEAL A TROMBONE SLIDE.

Sprung Slides

Burnishing outside of trombone with rod inside.

Sometimes a slide is sprung or bent with no marks or dents. To repair this we must first determine where the pressure point on the slide is. Place one inside slide in its corresponding sleeve. Apply pressure with your finger at various points on the outside slide to determine which point will release the slide. When you have located the correct pressure point, remove the inside slide and with the palm of your hand. apply a stroking pressure on the point requiring the pressure. If this is not sufficient repeat the procedure until the slide operates correctly.

Slide Alignment

When both stockings and sleeves are correct, the proper alignment becomes essential. Please bear in mind that we MUST maintain perfect parallel lines. To achieve this, we must set the outside slide and match the inside slide to it in the following manner:

Remove the bottom bow. Lay the outside slide on a leveling plate so that both tubes run perfectly parallel. Solder the top cross brace after spacing the brace to the exact measurement of the ends of the bottom bow. Check the length of the slide to assure yourself that there is the same distance between the slide at the top as there is at the bottom. To achieve this end we can bend the brace closer together or further apart.

Slide remounting is easily achieved if the following is performed. Clean all solder from the bottom rings and from the side bow. Assure yourself that the bow fits each slide ring easily. The distance between the ends of the slide bow should be the same as the distance between the slide itself. When putting the bow in place the bow should fall in place. Never have the bow tight fitting. This will cause a strain on the slide and give you the impression of a sprung slide. When the bow is in place, solder it. To check its parallel lines measure the distance between the top of the slide and the bottom. They should be the same. Next, lay the slide on your leveling block and check the parallel lines in the following manner: The two outside sides, the cross brace and the bottom bow form a perfect square. Place the left index finger at one end of the cross brace. Check for rocking motion cross corner. A heavy block of glass or the bed of an Atlas lathe makes an excellent leveling block.

Checking alignment of inside slide to outside slide.

Inside Slide Alignment

To align the inside slide, place the inside slide in the outside slide heating the top brace so as to allow the inside slide to adjust itself to the outside slide.

To check this slide, place one slide stocking in its corresponding sleeve and check for parallel lines alongside the opposite slide. When both sides check out, check the distance between the ends of the inside slide and the opening of the outside slide.

Slide Cleaning

Every slide should be cleaned prior to attempting any repair work on the same. It is cleaned in the following manner: The inside is cleaned by light huffing and vigorous wiping with cotton flannel. The outside slide is cleaned by wrapping a 2” piece of cotton flannel around a trombone cleaning rod so that all the length of the rod is covered. Vigorous stroking in and out of the slide does a fine job. Slide grinding is not recommended except in extreme rare instances since grinding tends to cause a leaky slide.

C. Sousaphone

Most mechanics run into a terrific amount of difficulty when remounting a sousaphone because the normal tendency is to follow the old brace marks left when the horn is dismantled for dent removal. To eliminate this problem, remove the old brace marks when the horn is dismantled. The sousaphone is usually disassembled up to the machinery so that each individual turn can be burnished for the purpose of removing all dents. These dents are pushed up on the ends of the ball end dent rods and burnished on smooth curved rods. Between all this and the necessary use of the dent hammer, each turn has a slight tendency to lose some of its original perfect shape. However, this is not visible to the eye. Nevertheless, when the instrument is remounted, the old brace marks cannot be used for this reason. The normal tendency is to follow the machinery by replacing one turn after the other until the sousaphone is completely remounted. This is the wrong thing to do since there will undoubtedly be a differential between the factory jigs and the human eye. As a result, the last turn will have a tremendous strain since it will be the very ends of this angle. Since the horn must be mounted without any strain, we must

1) Using heavy ball on rod to remove main dents.

2) A double handled curved burnisher evens out the curvature when used against a curved mandrel.

3) Using an electric sander to remove nicks and marks left by burnisher and hammer.

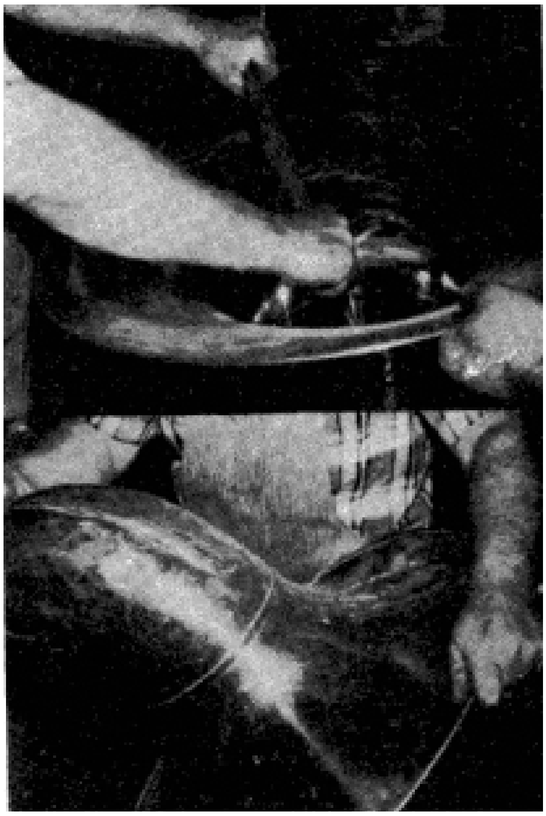
4) Belly band is wired down for mounting.

5) Dents in large knuckle are rolled from inside.

reassemble the instrument from the back end, by first placing the curved turns together to form the circle of the sousaphone. When these turns are completely mounted, the machinery is put in place and soldered wherever the braces fall against the turn of the tubes. This procedure will maintain the balance of the horn. The final part to be mounted is the neck of the body and this is the only part on which we use the old brace mark as a guide to the proper setting of the bell. This procedure also eliminates the possibility of having the sousaphone look oval shaped. When soldering the braces on a sousaphone, the principle of warm scraping becomes a most important feature. (See article on soft soldering.)

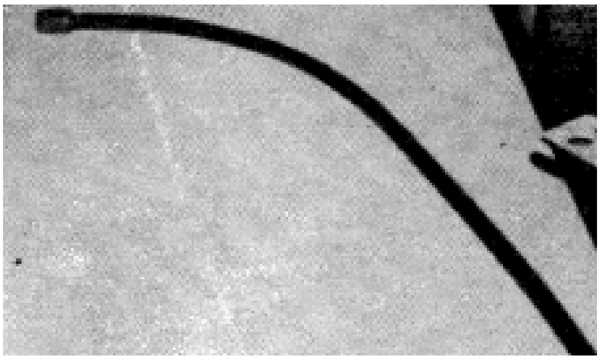
French Horn Repair

The French horn presents a few basic problems to the repairman due to the fact that the dents are not so easily removed as on any of the other horns despite the fact that the gauge metal used on a French horn is thinner



Sousaphone bell burnishing and rolling.

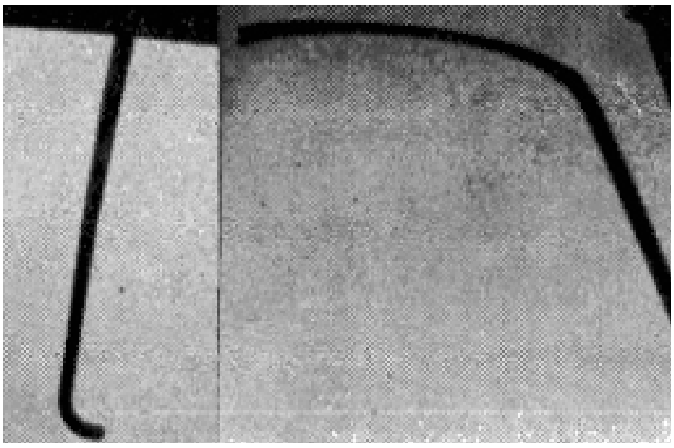
than all other horns. This problem in dent removal stems from the fact that most of the portions of a French Horn must be balled out. It is on this instrument that the Dent Master plays its most important role. The important thing to remember when removing the dents from the slides is that the use of a slightly undersized ball on the Dent Master will remove the dents more efficiently than the perfect fitted dent plug. Furthermore, the use of a smaller plug will eliminate the plug from getting jammed in place as well as the fact that this allows the smaller plug to more easily make the turns of the slide without damaging the curvatures. The same adheres to the curvature on the mouth-pipe. Any dents in the connecting tubes between the valve casings



Curved ball end rod used for removing dents from French horn bell.

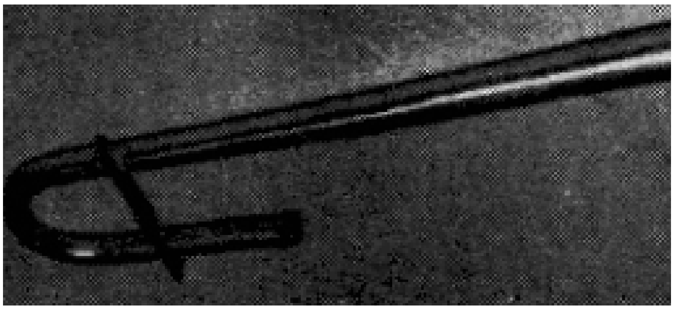
and outside slides are simply removed by using the ball end dent rods as previously described.

The bell presents the next major problem. The bell flare dents are removed by first gently hammering the bell ring into its proper place with a rawhide mallet. Next, burnish the dents from the flare over the saddle iron or horn stake, taking a small portion at a time, then blending the burnished sections so that the smooth curved feel of the bell is maintained. The worst dents on a French Horn usually occur on the first turn of the bell. These dents should be gently pushed up after which the part must be burnished on a curved rod to maintain the proper curvature. thereby eliminating the stretch marks that will take place. Final finishing of this part is done by light emerying and huffing. We must reach as



Rods should be curved to fit the shape of part to be burnished.

far as possible in the bell with a circular rod with a ball on the end to try and cut down the amount of plugging to a minimum. This can be accomplished to a point past the finger rest opposite the third valve. We must then remove the dents from the back turn of the bell with a dent rod that is curved almost in the shape of a question mark. (?) This type rod will allow you to reach the dents to a point opposite the first valve. This will leave a distance of approximately four to five inches that must be plugged out. This is accomplished by using the larger set of dent plugs. The one troubling factor to be careful of is the fact that

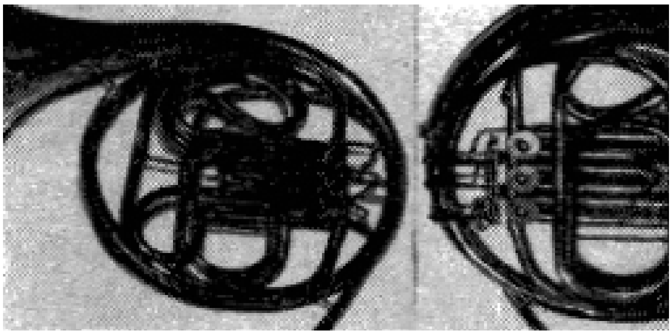


Holding bar prevents tubing from spreading when being plugged out.

the bell will have a tendency to want to straighten itself out of its curve when all this dent removal is being done. To eliminate the chance of this happening, solder a bar across the turn of the bell. This will hold the curve of the bell intact. When all the dents are removed, remove the bar brace, finish the dent work by emerying and buffing. Resolder the bell in place.

Rotary Valves

There are two types of valves, namely, the pump type and the rotary type. The pump type is the average valve used on the regular brass instruments. The rotary valves are the type used on the old Italian trumpets etc. and



Rotary and string actions

on French Horns. The rotary valve is basically the same even though the action is of two varieties namely, string action and machinery action. The rotary valve is actually tapered slightly and must be a perfect fit in the valve casing. The top stem of the rotary valve is also tapered to fit the tapered tube on the top cap of the valve casing. The bottom plate which holds the rotary valve in place must be a perfect bearing surface in its tube over the bottom stem of the valve. This plate has marks there on. The mark on the outer edge must be aligned with the mark on the valve casing. The mark on the tube of the plate is the guide mark for the distance the valve must be allowed to turn in the casing to properly align the portholes. This turning allowance is determined by the thickness of cork bumpers on the top cap. These bumper corks are cut to a point that allows the marks on the bottom stem to correspond to the mark on the bottom plate. After the bottom cap is screwed in place. assuming that the valve and the casing are fitted and cleaned properly, if the valve binds, it is a sure sign that the bottom plate is not set perfectly. To correct this, tap the top stern very lightly with a rawhide mallet. This will allow the valve to work freely. The valve must be completely free to give the proper allowance for spring tension to operate the valve.

a. Valve Stringing

Valve strings on a rotary valve can be either fishline, nylon, or gut about the thickness of a violin gut A string. This string is tied on in the following manner:

Put a knot in the string about one inch from the end. Put this string through the hole in the valve key from the outside to the side nearest the valve. Bring the string past the valve stem around the back of the same stem. Coil it around the string screw. Pull the string to a point that allows the valve key to come to the desired height. Tighten the string screw allowing the string to continue around the valve stem. Complete the circle of string around the valve stem and put the string through the front hole in the valve key next to the string screw on the valve key. Draw the string tight around the string screw on the key. Tighten the string screw. The last coil pulls the valve around when the key is operated and the first coil uses the spring tension to return the valve to its original position. If the string is not taut in both positions, there will be lost motion in the operation of the valve.

b. Machinery Action

There are two specific types of machinery action. The difference is in the spring action.

The first type utilizes the same type springs as the string action valve. The spring is wound around the tubular hinge of the fingerkey. Solid pieces of German silver are the joiners between the valve stud and the fingerkey. To give mobility to these parts, they are hinged together. The rods that act as pins between these lever bars, although riveted on each end, must allow the tubular hinge to be perfectly free moving. In this manner, the levers take the place of the taut string.
The second type machinery utilizes the flat type coil spring, such as found in small clocks. This flat coil spring is inserted in the barrel of the fingerkey, hooked to the small slot in the barrel. The opposite end of the spring is hooked to the hinge rod of the fingerkey. The tension of the spring is applied by winding the post leg of the key assembly.

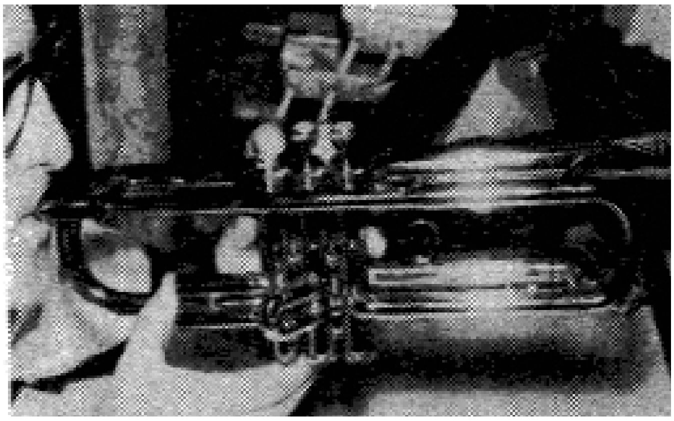
Use of the Drawplate

Through the facilities of the A.R.S. and the Eastern School laboratories, another use for the drawplate was discovered. Patches on tuning slides, mouth-pipes etc. can be perfectly curved by use of this method. After the shape of the patch is cut from sheet brass, the patch is then annealed. Place the patch against the tubing it is to fit. If the tubing is not tapered, insert the tubing, with the patch held against it, into the correct size hole in the drawplate. Smoothly draw the tubing through this hole. The patch will come through as a perfect fit to the tubing. In many cases, it is wise to gradually work one's way to the perfect' size hole. If perfection is not achieved on the first try due to the temper of the brass, repeat the procedure.

Bending Tubing

Since tubing will have a tendency to fold when bending into the proper place or shape, we as repairmen fill this tubing to make it into a solid rod. Firstly, the tubing must be annealed. Secondly, the tubing must be packed or filled solid without air pockets. Some people use sand, pitch, or lead as the filler. It could even be filled with a coil, spring. The material preferred by most repairmen is

SEROBEND. It is a material similar to actual lead. However, its fusion or melting point is that of boiling water. This material is easy to work with, both in filling the tubing and in removal of the material. The end of the annealed tubing is plugged. The tubing is filled with the boiling water that is in the same pot as the water lead. The water lead is poured into the tubing, thereby forcing the water out of the tubing. When the tubing is perfectly filled, it is carefully lifted out and allowed to cool off slowly. After the lead has cooled so that the tubing is now a solid bar, light taps with a dent hammer will give you assurance that the tubing has no air pockets. At this point, the tubing can easily be bent into any desired shape. Small blisters may appear at the inside curvature of any bend. These



Testing for leakage on first valve.

should be tapped back down in position as fast as they appear. Do not wait until the complete bend is accomplished. If the tubing is not perfectly filled, the tubing will have a tendency to crease and crack. There are bending machines on the market that do not need to have the tubing filled prior to bending. However, these machines do require a special die for each bend that is to be made. Therefore, they are not practical for repairmen. Since any bend that a mechanic has to make has to have a decent radius, it is wise to make these bends around a piece of wood doweling.

Use of the Valve Casing Lap and Valve Block

The valve casing lap is a tool used to dress out small imperfections in valve casings, such as small nicks, clogged corrosion, or it may also be used gently to dress out a casing to a more perfect true round. There is a valve casing lap on the market which has lead sleeves. A piece of wood dowel, split in the center, with an inserted small wedge will have the tendency to act as a casing lap since the wedge will give it enough spring to allow the outside diameter of the dowel to press against the walls of the valve casing. This lap is used with pumice stone and oil to grind away imperfections. The lap must be used in a twisting up and downward stroking motion to eliminate the possibility of continual stroking in the same position, since this would cause grooves instead of a smooth grind.

The valve block consists of two pieces of wood hinged together with an oval shaped hole between the two blocks. This allows sufficient spacing around the average valve so that slight pressure can be applied while using the block. The block is used with pumice stone and oil against the valve with a stroking motion while the valve is turning slowly in the lathe. This stroking of the valve eliminates the possibility of grooving the valve.

Testing for Leaky Valves and Slides

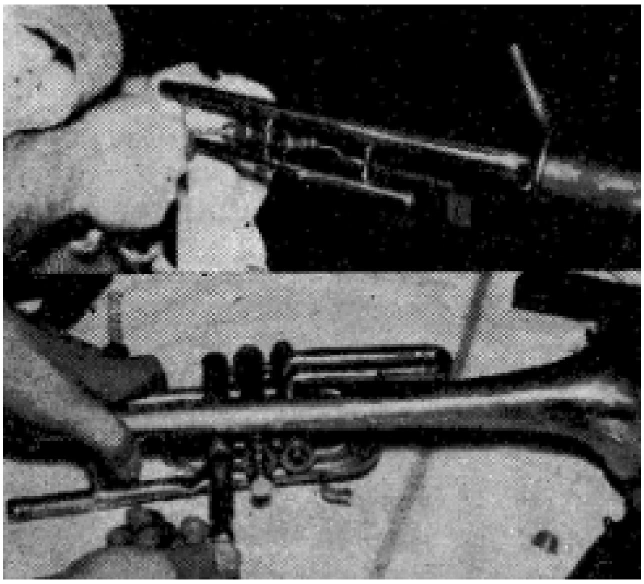
a.Valve testing

Since the air passage must be blocked when testing for a leaky valve, we must test each valve individually. To test the first valve, remove the first valve slide. Place thumb against the lower tube extending from the valve casing. Press the first valve down. Now blow air or smoke through the mouthpipe of the horn as hard as you can. If there is a leak, you will be able to feel the air escaping. If you are testing with smoke, the smoke will escape through the valve caps if the valve is leaking. if the smoke comes from the other valve casings, it is a certain sign of a leak on the first valve. The second valve is tested by removing the second valve and repeating this procedure. Likewise the third valve. To eliminate the possibility of cross leakage while testing an individual valve, it is wise to grease the two valves that are not being tested at the time. This grease is easily removed with kerosene, with-out damage to the horn. By the same token, the slide should be sealed in a like manner. In this fashion, only the valve in question is actually being tested.

b. Slides are tested in the same manner. However, the slide itself must first be tested off the instrument in order to check the solder joints. Then each individual stocking of the slide can be tested for leakage in its own sleeve, testing the tuning slide as the first section of the horn. There is no particular order for testing the rest of the instrument.

Repairing Leaky Valves

The repair of leaky valves entails plating of the valve to a point where the valve is too



Hand lapping in valve to fit casing.

tight to fit the casing, after which, the valve is ground to a perfect fit in its own casing. This is the procedure to follow:

1. If the valve has a nickle plating on it, it must have the plating removed, as described in the article on removing of plating. (Stripping)
2. Copper plating is used to build the valve up to a point where the valve will fit in the casing from the bottom 14 of its own length. (See article on Plating.)
3. The valve is then ground lightly as in the valve block to remove any high spots on the plated surface. (See article on use of Valve Block.)
4. The casing is lapped out with the casing lap to remove any imperfections.
5. Clean out the casing thoroughly.
6. Solder a brass rod in the bottom of the valve. This rod should be a smooth fit in the inside wall of the valve. Be certain that the-solder does not extend above the valve.
7. Place the brass rod in the vise firmly.
8. Apply lanolin to the valve.
9. Gradually work the instrument on the valve with a twisting-turning motion, until the valve will fit tight but smooth through the entire length of the casing.
10. Add a few grains of fine pumice to the lanolin and repeat the procedure as outlined in the previous step.
11. Remove the lanolin and replace the same with No. 10 motor oil and a few grains of pumice. Repeat the procedure as outlined in step No. 9.
12. When the valve feels free enough to be able to continue this procedure by hand, unsolder the brass bar, replace the valve stem and button, tie a piece of twine about the valve button and wrapping the twine around your hand to complete the grinding procedure. This grinding should continue until the valve feels smooth and firm yet with a free motion in the casing. Rather than over-grind a valve, it is wise to clean off the valve and wipe out the casing and try the valve once or twice. If the valve still requires more grinding, the past procedures can be repeated. When the grinding of the valve is completed, it is wise to apply a nickel flash plating to the valve since the hard surface of nickel plating will give a better bearing surface against the soft brass wall of the valve casing. (See article on nickel plating.) All screw type valve guides must be removed prior to plating of the valve. Replacement of valve guides on valve plating jobs is definitely recommended.

Repairing Leaky Slides

If the slides of a brass instrument are worn to a point of leakage, they can be repaired by building the slides up with plating and grinding the slides to fit. They may also be stretched slightly and refitted in their respective outside sleeves. Stretching of these slides can be accomplished by either burnishing the slide while it is on a smooth fitting mandrel or by striking light blows against the slide with a dent hammer while the slide is on the same type mandrel. If the stretching is done by the hammering method, it is important to remember that the hammer marks must be kept smooth, light and even. After the slides have been stretched, the slide should be ground to fit smoothly.

Tempering Brass and Steel Brass

Brass is one of the base metals used by repairmen that fall into the soft or malleable category, that is to say that it can easily be worked with. Temper in any metal is descriptive of the tensile strength or hardness of the material. When brass is purchased from the mill, it may come in any degree of temper desired. When there is a complete absence of temper to the brass, it is referred to as "dead soft." The other points of temper in the material are: medium soft, soft, medium, half hard and hard drawn. The highest degree of temper in brass is sometimes referred to as spring temper. Temper is added to brass by actually working on the material. This can be done by burnishing, hammering, stretching, shrinking, bending or drawing and spinning. For this reason, some dents cause the material to become too tempered for easy removal. To bring brass back from a high degree of temper to its malleable or workable state, it is sometimes necessary to anneal the brass. This softening process, known as annealing, is performed by heating the brass on a soft flame till it is red hot, then either let it cool slowly or chill it suddenly by immersion in cold water. Sudden immersion will not affect the state of the material. If a dent is in the form of a crease, annealing of the metal will have a tendency to lessen the chances of the material cracking.

Steel

Unlike brass, temper cannot be added to steel in a gradual fashion. It can only be added suddenly. Temper can gradually be removed from steel. To properly understand the process involved, it is necessary to segregate the types of steel. For the most part, the steel used by repairmen falls into two categories, namely, carbon steel and high speed tungsten. Since the tools made by the average repairman are made of drill rod which is carbon steel, we shall confine the discussion of the tempering and drawing of temper to the carbon steel. When steel is purchased from the mills, it comes in a malleable or workable state. We can soften this steel further by applying heat. When steel is red hot, it becomes medium soft. When steel is yellow or orange hot, it is dead soft. Molten steel is referred to as white hot. Sudden chilling of red, orange or yellow steel will cause the molecules of the steel to freeze causing the steel to be extremely hard or brittle. At this point, it is referred to as glass hard. Any further heat application will cause the temper of the material to draw out, thereby lessening the degree of hardness of the material. Heat application to glass hard steel will cause color changes to take place. These color changes will take place in this order: light tan or straw color, dark straw color, purple, blue and gray. The full hardness is used for tools such as lathe bits, etc. where the glass hardness will maintain a cutting edge for the longest period of time. However, this degree of temper leaves the steel extremely brittle. The light straw color can also be used for cutting tools. However, some of the temper being removed leaves the steel hard yet not quite so brittle. This degree of temper works well on chisels, etc. The dark straw color will work efficiently for screwdrivers, etc. The purple color will be best for heavy duty screwdrivers. The blue color designates the perfect spring temper. The gray color designates the original state of the steel. Remember that temper can only be drawn from and not added gradually to steel.

CHAPTER 3

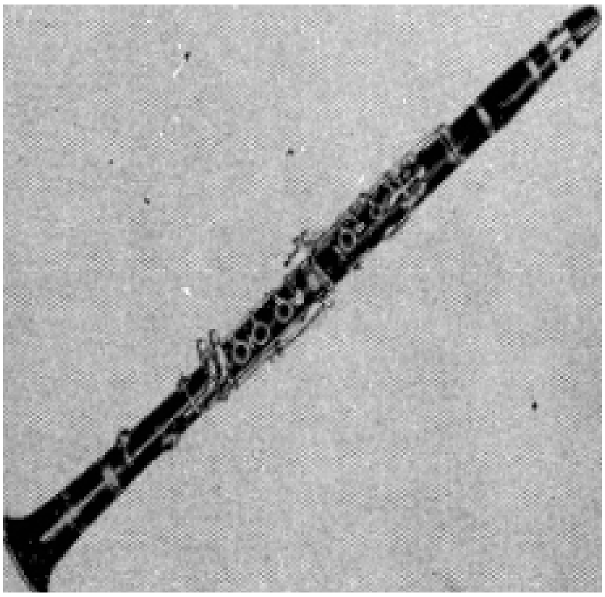
CLARINET REPAIR

Metal, Wood and Rubber Composition Metal

Very few fine metal clarinets have been made. There have been clarinets such as the French Selmer, the SilvaBet by Bettoney and the King by the H.N. White Co. Aside from the imported cheap variety clarinet, the bulk of metal clarinets in the U.S. were made by three companies, namely, Pedler, Bettoney and the Penzel Mueller Co. These clarinets as a rule were made of German Silver. However, some of these companies could not obtain as much German Silver as they wanted during World War II and they had to resort to using whatever metals they could to complete their manufacturing schedules. For instance, the Penzel Mueller Company put out the Gloriatone clarinets with copper bells. The Bettoney Company put out the Bettoney clarinets with many brass parts on them. Although metal clarinets do not break such as the plastic and the rubber types, they do get bent easily. When this occurs, it has a tendency to break loose the soft soldered tone holes. These instruments are easily repaired since the toneholes are above the body unlike the recessed variety on the wood or rubber clarinets. Metal clarinets are usually plated. In most cases either nickel or silver plating is used to give these instruments their final finish. The posts on these instruments are always silver soldered to the body except for the one model of the Pedler clarinet that used ribbed posts. On these instruments, the posts are silver soldered to the rib and the rib is soft soldered to the body.

Wood

Wood clarinets are easily recognized by the definite grain in the wood. The wood used is an extremely hard variety known as Madagascar or Mozambique Grenadilla. There are many grades of this type wood. This wood can easily crack since the widening of any portion of the grain of this wood must be considered a crack. Should a tenon joint break on a wood clarinet, it would have a tendency to splinter rather than to break cleanly, since it would have to break cross grain. The normal color of Grenadilla wood is dark brown. Its

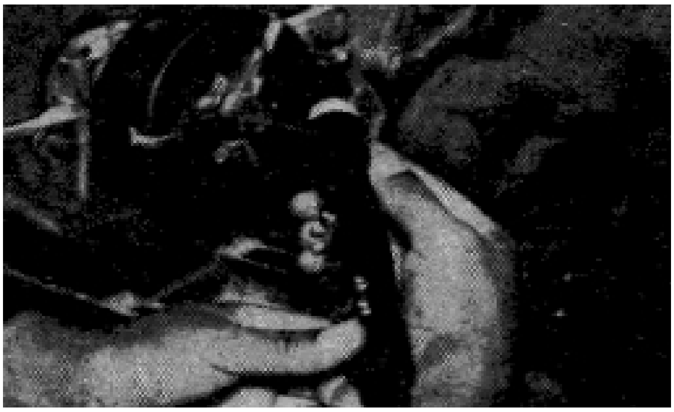


Boehm System Clarinet

black color is achieved by a series of treatments in seasoning of the wood as well as the use of dyes. Since it is the common belief of the musicians that wood clarinets produce the best tonal qualities, all of the better and the more expensive clarinets are made of this material. Oboes and English Horns are made of the same material. Raised fingerholes are separate pieces usually threaded and glued in place. Therefore, these pieces are easily replaced. Being a hard wood, Grenadilla is also a brittle wood. Therefore, all small ends that require some strain such as the female tenons, must be braced and this is usually done by means of a metal tenon ring

RUBBER AND COMPOSITION

Rubber was one of the first members of the so-called plastic family. Hard rubber clarinets have been given many names, Ebonite, Processed wood, rubber, etc. The Ebonite clarinet is merely a high polished rubber and is not to be confused with Ebony which is a very black expensive hard wood. Hard rubber is very brittle and will break easily, leaving a very clean break on its edges very similar to glass. Hard rubber can be softened easily with heat since heat will soften the sulphur in the rubber. Hard rubber is an extremely nice material for a mechanic to work with since it cuts easily, accepts threads simply and is quickly made pliable. Plastic materials on the other hand are extremely difficult to work with. To thread plastic, a special tap and die must



Drilling hole for pinning wire.

be used which is called a “backed off cutter.” Plastic, such as used on the Bundy Resonite, some Bettoney and Conn Clarinets, is extremely brittle and will break with the least amount of strain. These plastic joints are replaceable at very reasonable prices by the individual concern manufacturing them.

CRACK FILLING

The filling of a crack in a clarinet, oboe or any other wood instrument is basically done for the purpose of disguising the said crack. Actually this is not a guarantee that the crack would not still reopen thereby causing a leak. To properly disguise this crack, a crack filling material is used which is comprised of shellac and ground wood. The two mixed together give a black appearance to the crack filler. The crack filler is then used in the same manner as any stick of hard shellac. Small dots of the crack filler are applied along the length of the crack. This crack filler is then melted with a hot slick, and forced into the open crack. After this procedure is completed, the excess crack filler is dressed away by means of filing. Filing marks are removed with fine emery cloth. These marks are removed by use of pumice stone and oil. Hand polishing instead of buffing is recommended, since buffing with the machine will have a tendency to remove some of the crack filler.

CRACK PINNING

Pinning of a crack is actually an obsolete method of repairing a crack. This is done by one of two methods: the first method is to use threaded wire of a standard thread variety. In this method, we must not only drill the hole to receive the pin but we must also thread the hole. These holes are drilled at irregular angles to act as cats. These holes should be drilled to approximately half of the thickness of the wood body. The usual wire used for this type of work is threaded with a 2x56 die. It is for this reason that a similar tap is used to thread the holes. The drill size for this tap should be a number 50 drill.

The important thing to remember when threading these holes is to remove the tap frequently to allow the chips to fall out. Otherwise, they will pack up in front of the tap thereby causing the tap to possibly break. These catted pin holes should not intercept the bore of the clarinet, nor should they show themselves on both sides of the body. After these holes are threaded, the pinning wire also threaded with a 2x56 die is screwed in place. The pin is then measured so that the length of the pin would fit below the outside edge of the body of the clarinet. At this point it is marked, removed, and cut to size. The top of this screw is then slotted so that a screwdriver may be used.

When this screw is firmly in place, the open hole above it is then disguised by the use of crack filler (see article on Crack Filling). The second method of using pinning wire is self threading hardened steel wire being forced into the pin hole. If this type of wire is used, it is imperative to remember that a smaller clearance is allowed for the thread lest this wire break off. We should not allow more than .010 of an inch for these threads. The length of this wire must be first measured and a slot filed in the side of the pinning wire. The lathe is then used manually to force this Wire into place. As soon as the wire is firmly set, it can easily be snapped off at the marked point by bringing a little pressure against the wire in a bending motion. Being hardened this wire will snap at that point. Crack filler is then used to disguise the open hole as heretofore mentioned.

POST TIGHTENING

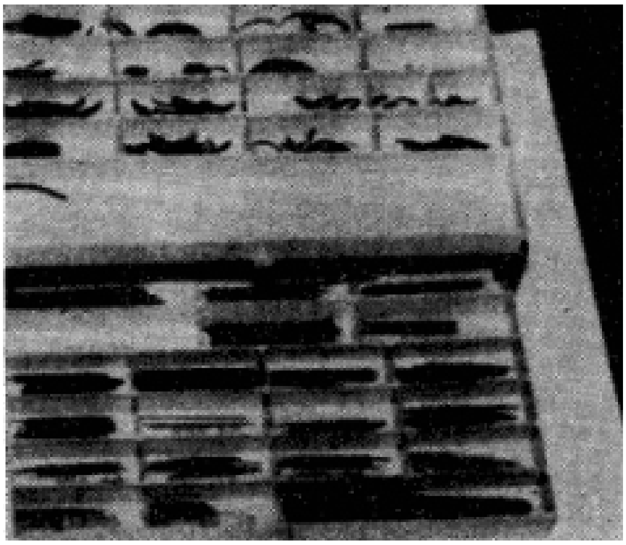
Posts in all wood instruments are thread-

ed into place. As a result they may have a tendency under normal spring tension to turn slightly. This would cause the posts to improperly align themselves on the pivot points.
To correct this situation, this post must be made extremely tight in its proper position. To accomplish this, we have three methods; the first method is done by removing the post and using a small doughnut shaped piece of paper under the post. Replace the post. This small paper will have the tendency to build up the shoulder of the post, there-by causing the post to hold firm in its proper position. The second method is to tighten the post by means of applying a small amount of pumice stone in the post hole before returning the post to its proper position. This will cause the same effect. The third method is to tie a small quantity of string around the bottom of the post just below the shoulder. This will give the same effect as the post shim. Of the three methods, the most advisable method to use is that of the post shim. Post shims cut to actual size are priced reasonably and can be purchased from any instrument supply house.

POST BUSHING

Post bushings are used only if the threads in the body of the instrument are completely demolished. This requires replacement of the thread and it is completed in the following manner: Since basically, the average post is approximately the size of a No. 6 tap, we must then use a No. 8 thread, preferably an 8x32. To put this thread in the body it is usually necessary to re-drill the present hole with a No. 28 ‘drill. This will clear out a few chips thereby giving you the perfect size to receive the 8x32 tap. The threads are then ap-plied to the body by using an 8x32 bottom tap. The bottom tap will cut threads with an extremely short lead thereby allowing you to have threads in the body as far down as possible. Once the body is prepared, the post must be prepared to receive the same type of thread.

To prepare the post to receive an 8x32 thread, it is necessary to build the post up to a point where the base of the post is a .164 of an inch. This is done by chucking the post up in the lathe and removing all of the threads of the post so that the bottom of the post is merely a small pin. The post bushing is a small piece of brass with an 8x32 thread on the outside diameter through the center of which a hole is drilled the size of the end of the post. The post bushing is then placed over



Needle and flat springs in cabinet.

the end pin of the post and silver soldered in place. This will then give you a post with an 8x32 thread which will be a perfect fit to the new threads in the body. When the post is replaced in the body it should be lined up in its proper position. If at this point the post moves too far, shim the post so as to keep perfect alignment (see article on Post Tightening). If the post already has an 8x32 bushing and requires a new bushing, the new bushing should be a 10x32 bushing. This will then give you a diameter of .190 which is smaller than the shoulder of the average post.

NEEDLE SPRINGS

Needle springs are purchased in all sizes and dimensions; however, they must be properly prepared before they can be used as springs on a musical instrument. To measure the length of the spring, we must pick out the spring that fits the hole in the post. Put the spring through the hole in the post using the key to measure the length by means of the spring hook. Always allow the spring point to just reach the spring hook.

When we have it set at that point, bend the back edge of the spring so as to properly mark the length. Remove the spring and cut to exactly that size.

To flatten the end of the spring so that it can be riveted into the post we must remove some of the temper from the steel spring. This is done by applying a small amount of heat to the back end of the spring, and as soon as the color starts to change, chill the back end in oil. This will cause some of the temper to draw thereby bringing the spring to a point whereby the end could be flattened out by light hammering so that it will have a dove tail. This heating process is quick and it takes very little time to catch the right amount. The small amount of drawing still allows the spring to maintain enough temper so that it has a proper amount of bounce. This spring is then re-inserted in the post and forced in place by placing a cutting pliers against the back of the spring and the front of the post and squeezing the two jaws together. This will force the spring into the post in a riveted fashion. The spring must, at all times, be tight in the post. To check the firmness of the spring in the post, merely pluck the spring with your fingernail. If it gives you a perfect musical tone, the spring is tight. If the spring is not tight, it will give a rattling sound. The tension of the spring is then applied by actually bending the spring into the position so desired. Closed keys obtain their spring tension by having the spring bend away from the tone hole. Open keys require the spring bent toward the tone hole. Open keys require less tension than closed keys since open keys are held closed by fingers.

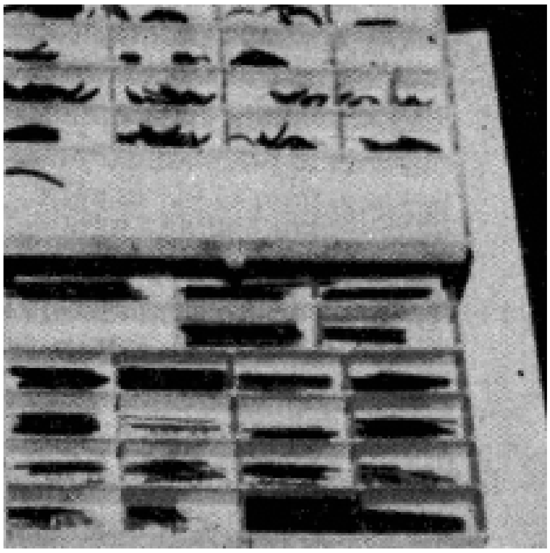
FLAT SPRING

Flat springs are held in place by means of a small screw that has an 0x80 thread. The flat spring is picked out according to its thickness so that one can derive the proper amount of spring tension for that particular key.

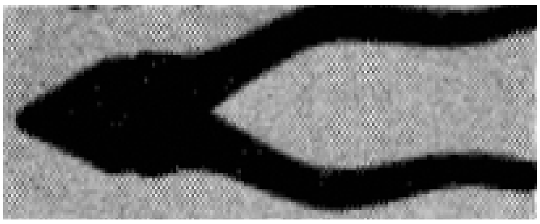
The length of the flat spring is cut to size after the flat spring is firmly affixed to the key. The end of the flat spring should be smooth and slightly upturned so as to allow for a smooth sliding action. It is also advisable to put a small spot of oil in the flat spring track. This will cause the key to work smoothly.

KEY WORK

Due to the fact that there are many small jobs which must be taken care of in the course of overhauling a clarinet, we shall take the seating of pads as our last procedure. In the proper disassembly of the clarinet we must take each joint separately and think of it in that manner. The system of disassembly used by the mechanics is optional. I personally prefer to line up my screws in the screw-block "nearest the top." When disassembling any key, swedging should be done.

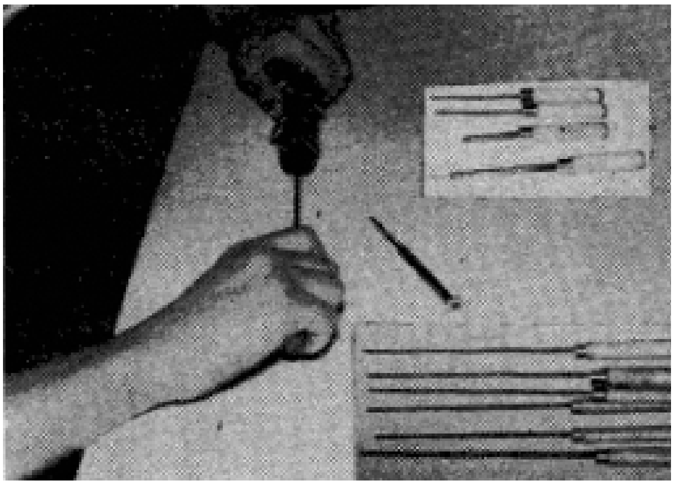


We swedge keys to remove lost motion of the key between the post. This is done in the following manner: first insert the rod in the tubing hinge. Using a swedging pliers, grasp the tubular hinge in the grooved slot firmly and move the hand in a circular motion around the tubular hinge. It is advisable to do this only a couple of times and then move the rod in the tubular hinge, since there is a shrinking tendency of the diameter of the tubular hinge to the rod. By moving the rod in the tubular hinge, it will have a tendency to keep the bore of the tubular hinge true. This may be done with either a swedging pliers, the jaws of a Jacobs chuck, a collet attachment on the lathe or a regular Universal chuck from any standard lathe. In swedging the key, we should be careful to keep our swedging marks on the tubular hinge as evenly as possible so that it will not be too noticeable to the human eye. It is advisable, in all instances, to over swedge the key and then mill the end down with a tubular hinge



Swedging pliers.

shortener to the perfect fit. This will allow you to retain a smooth bearing surface on the key. The tubular hinge should be swedged in this manner, should swedging be necessary. On the solid hinge, such as on a Bb bridge key on the upper joint, lost motion, if very slight, may be taken up by counter-sinking the pivot hole in the post to allow the pivot screw to go in further. If there is too much lost motion in such a key, it should be elongated in the following manner: using the No. 50 drill, drill a hole approximately '1/8" into the dead center of the solid hinge. Using a German silver rod of the same diameter of the solid hinge, trim it down as a male stud. Allowing for a tight fit in the No. 50 hole, place the two together and silver solder the same. Then trim the key down to the desired length.



Pivot screw counter bores and hinge shortners counterboring post to set pivot screw deeper.

On the Ab key of the upper joint the side extension of the spatula will not allow you to swedge this tubular hinge normally. You may use one of two methods to repair this: file down approximately 1/16" of the side spatula to allow us to have a tubular hinge to swedge, then merely proceed with the swedging of this key. The second procedure is to elongate this key in the same manner described for solid hinges after which, using the proper size drill, drill the complete hole through from the opposite end. The tubular hinge itself will act as the perfect pilot for your drill. After which, you may cut it to the desired length to remove the lost motion.

In the swedging of double tubular hinges, it is advisable to first swedge the male hinge so that it is a perfect fit between the post. After which, take a piece of drill rod which is the same size as the outside diameter of the male hinge of the high C trill key. Insert this in the female hinge of the high Bb trill, and repeat your swedging process. You must be extremely careful in swedging this key since the tubular hinge is so thin that too great an exertion of pressure might tear this hinge apart. The tubular hinges of the B and C# levers of the lower joint are swedged in the same manner. To finally free the key if the tubular hinge is tight on the rod, the perfect tool should be an exact size reamer for the tubular hinge. However, I will not be so foolish as to believe for one instant that the average repair shop maintains such high quality tools so as to allow themselves to have the perfect tools at all times. It is for this reason that I suggest that you use a drill. In the event the tubular hinge is too tight against the rod, contrary to other beliefs, I advise you to grind the rod to lit the tubular hinge using pumice stone and oil. To properly clean the tubular hinge after such a grind, you merely have to use a pipe cleaner wet .with kerosene. All of this work should be done prior to the polishing of the keys.

Very often, the finger rings are a little too long to allow for the perfect fit over the finger holes. To shorten the arm leading to these rings, may I suggest the following procedure. Using a small Swiss pattern file or a small saw, cut a slot on the underside of the ring extension as close to the solid hinge as possible. This slot should be half way through the extension. Using your finger, bend this closer to the solid hinge. Now silver solder this extension which will assimilate a cracked key. Upon the completion of this job, the finger ring will be much lower than it should be. Merely

Using file to cut away side of spa-tula extension to allow for key swedging.

place the finger ring in the vise and twist the rest of the key so that the finger ring will come to its normal position. This will allow the twist to take place in the solid hinge and will, in effect, shorten the extended arm of the finger ring.

To elongate a finger ring, we merely have to crimp the extension with a side cutting (diagonal) pliers. This will cause the finger ring to move forward. Of course, any marks left by the pliers should be removed to keep your work neat. Upon many occasions, we find that the key cup will extend beyond the recess of the tonehole. To cure this ailment, the following procedure is advised; using a small saw blade, saw a slot on the bottom of the key just at the edge of the key cup. This slot should be exactly the depth of the key cup, which is approximately half way through the key. Applying silver solder flux (borax) heat this part until it is red hot at which time, we can very gently move the key cup backward. If more silver solder is needed to keep this job neat, it is advisable to apply the same. Upon the completion of this procedure, there will be a very small point extending from the top of the key cup. This can easily be removed. The thickness of the saw blade will determine the amount that the key will be shortened. Elongating such a key, if it is flat stock, can be done in the following manner: use a riveting hammer, the width of the riveting edge to the width of the key. Hammer across this part. It will leave marks. However, by hammering lightly and evenly, these marks will be slight. After which, you may reverse the riveting hammer and using the flat side of the same, hammer down most of the marks. The balance of the marks can be removed through filing, emerying and polishing. You may elongate a key quite a considerable amount in such a fashion.

CLARINET NOMENCLATURE

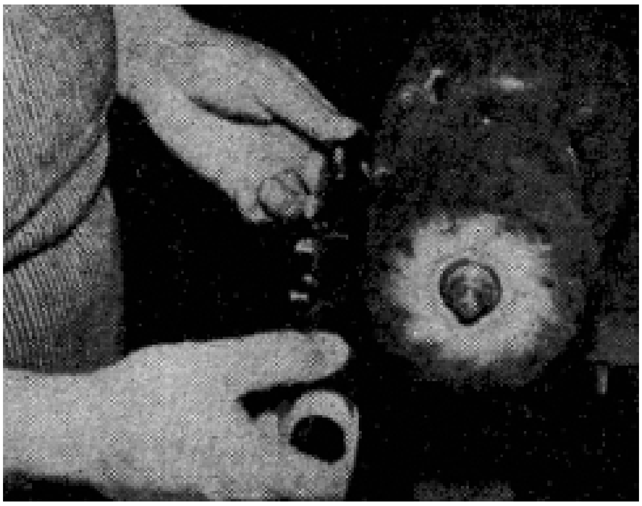
Clarinets are made up of five joints. The first joint of a clarinet is actually the clarinet mouth piece. The second joint is known as the clarinet barrel.The third point is referred to as the upper joint. The fourth joint is referred to as the lower joint. The fifth joint is referred to as the clarinet bell. The clarinet barrel has two tenon rings. These are used to protect the female sockets of the clarinet barrel. The cork tenons of the upper and lower joint are referred to as the male tenons. The lower joint also has a tenon ring at its top. The keys of the upper joint and lower joint are usually made of German silver. However, there have been occasions where pewter and brass have been used to make he fame specific keys. These keys are held in place by means of either rods or pivot screws. The tone holes of the clarinet (wood, rubber or composition) are usually recessed by means of clarinet. end mills set at approximately 3O° angle so that the open edge of the tone hole is even to the top edge of the clarinet. The finger holes on the clarinet are separate pieces that are raised above the body of the instrument. These are usually screwed and glued in place at the factory. The keys of the clarinet have specific names. However, the clarinet being a cylindrical bore instrument is built in twelfths. As a result, every key on the clarinet will have two different names (see chart).

Clarinets are made in the keys of Eb, Bb and A. The clarinet family then goes into the alto clarinet, the bass clarinet and the contra bass clarinet. Most clarinets are (ring) instruments. However, there is such an instrument known as a plateau clarinet, referred to as a closed tone hole clarinet. On the open tone hole clarinet, the musician's fingers act as keys. On the closed tone hole clarinet, there is a tremendous amount of regulation involved. As we approach the larger instruments such as the alto clarinet and bass clarinet, the size of the tone holes makes it almost impossible to use ring instruments. As a result, these instruments have plateau keys. There are many articulations that can be put on a clarinet. These are usually put on at the factory in accordance with the different models of the instruments. These articulations are: the articulated G# or C#, the articulated Bb, or Eb; the articulated D# or G#; and the low Eb. If a clarinet has all of these articulations on it, it is referred to as a full Boehm.

CLARINET DISASSEMBLY

Before a clarinet can be worked on, it must be completely disassembled so that the polishing, corking, padding, etc., can be completed. The disassembly of a clarinet entails placement of the screws in a block of wood in such a manner as to allow the repairman to replace them in their proper positions. There are many orders of setting up these screw blocks. This depends upon the actual system desired by the average men. When these instruments are disassembled. the necessary key work should be completed at that time. (See Article on Key Work.)

Keys that are loose fitting should be swedged. Solid hinge rods may require exten-



Polishing wood body

sions. In removing a spring from a post, it is advisable to use a regular spring pliers. These springs must be put in the proper order so that they can be replaced properly. In replacing these springs, it is wise to remember two rules; rule No. 1, a spring faces toward the tone hole for which it operates; rule No. 2, the tension of the spring is applied according to the action of the key. (See Article on Needle Spring.) It is at this point that the post should be re-tightened and all other type of work that will tend to hinder the polish of the instrument must be accomplished. When the instrument is completely disassembled, the bore should be polished by strenuous swabbing with any white lime polish. The outside surface of the wood is polished in the following manner: those places that are easily accessible with the buffing wheel are so polished. The buffing wheel will tend to apply a fine finish to the grenadilla wood. Those places that are not easily accessible with the buffing wheel must be polished by hand in a stropping fashion. However, when the buffing wheel is being used, it is advisable to lightly touch all of the posts on the clarinet. This will tend to apply the polish to the bulky part of the post and the hand stropping will polish the base of same. The tone holes should be clean and the average tone hole can be cleaned by means of a small brush. The top edge of the tone hole is easily cleaned by using circular cup brushes on a slow speed motor. The bore of the tone hole is usually cleaned with either small pipe cleaners or brushes. However, in some instances, the saliva and dust cause a heavy packing in the tone hole which is more easily cleaned out by using circular files such as the

Circular burrs can clean out
hardened crust in holes.

circular burr put out by any jeweller's supply house.

We must be careful when using these to choose the exact size burrs so as not to increase the size of the tone hole.

SPRING REMOVAL

It is necessary, such as on the metal clarinet, to remove the springs for polishing. In the past, the only approved method for this particular job involved the use of side-cutting (diagonal) pliers, together with round-nose, pliers. You would clip the spring in the jaws of the side-cutters and, by applying pressure with the round-nose pliers to the side-cutters and

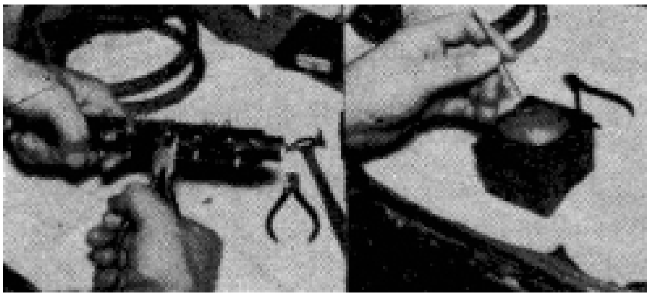
Spring removing pliers work easily on
bronze as well as steel springs.

the post at the same time, you would un-rivet the spring. This method is still being used by most repairmen. It is the belief of your writer, however,that this method is becoming obsolete. It was always a poor method because the side-cutting pliers left a mark and nicked the spring; this had a tendency to weaken the spring and possibly cause it to snap later on.

To eliminate the hazard of making marks

with the pliers, get a pair of 4 1/2-inch round-nose pliers with a box joint. Cut the nose off the pliers, leaving only the box joint. Then use these pliers in preference to the side-cutters in removing springs from both saxophones and clarinets. These pliers are also ideal for removing springs from flutes, piccolos, oboes, etc. They will work as well on the smallest spring of an oboe and piccolo as they do on the largest spring of a saxophone. You will find that these pliers permit you to use a tremendous amount of pressure because of the leverage.

These pliers will not slip on the spring or mar it. In fact, the bite of the pliers is so powerful that you won't have to use the second pair of pliers in most cases. To remove a

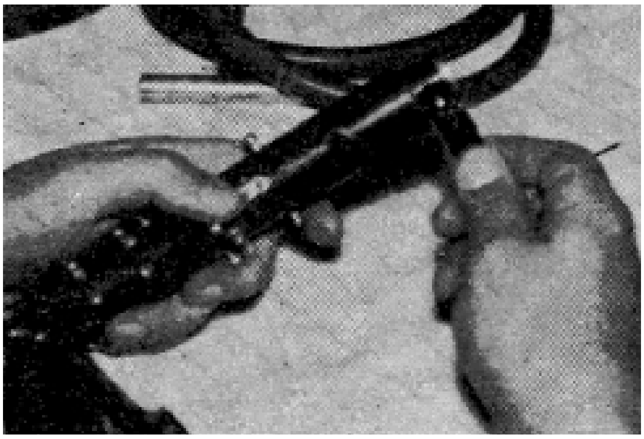


Removing broken springs with special pivot point pliers. Punching out broken piece of spring in lead block.

spring with these pliers, merely grip the spring in the box joint approximately 1/32-inch from the post and, with a slight turn of the wrist, press the spring back firmly toward the post. In most cases this will remove the spring. If the spring is exceptionally tight, you may revert to the pressure of the second pair of pliers. Since there is very little danger of marring springs with these pliers they can be used to good advantage on the gold springs of flutes or piccolos. We feel certain that this procedure will eliminate one of the mechanic's biggest headaches.

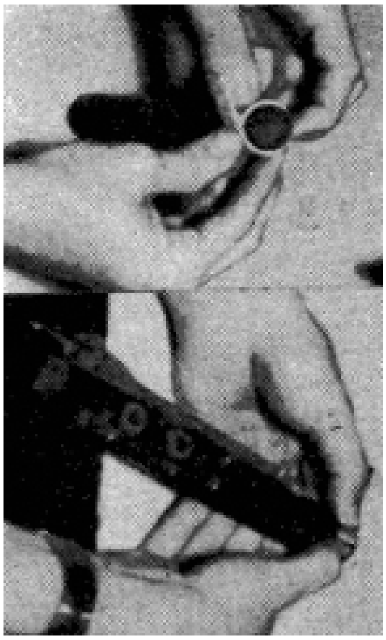
If the spring is broken so close to the post that it cannot be pushed out by un-riveting, then remove the post from the clarinet, place it in a lead block and, using a center punch directly on the hole post of the spring, tap the center punch lightly. This will drive the old spring out, causing it to imbed itself in the block of lead. Or, you can use, in most cases, a pair of special spring punching pliers. Should the pivot point of these spring punching pliers become defective, you can replace it with a hardened Martin pivot screw since this screw has the same thread and also has a fine point.

Springs should be replaced in the following manner: first, locate a spring of the proper



Applying shellac to cork track

diameter; it should fit smoothly in the spring hole. Insert this spring in the hole, extending it so that the point of the spring comes exactly to the far edge of the spring hook on the key. At the back end of the post, bend this spring sharply; this will determine the proper length. Remove the spring and cut it at the bend. The spring must then be pounded out to a head. Since the spring is tempered steel, it is necessary to draw the temper slightly at the head of the spring so that the head can be properly hammered. You can draw out the temper by heating the head very slightly over a Bunsen burner flame. As soon as you detect



Top: Overlapping seam. Bottom: Butting edge seam.

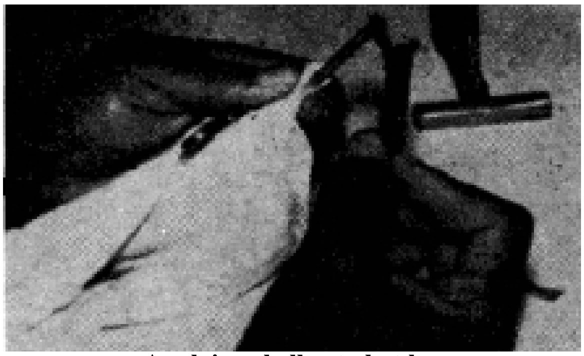
a color change taking place on the spring (it should happen almost immediately), immerse the spring in oil. This will halt the drawing of the temper, leaving enough temper in the spring so that it does not lose its life, but is soft enough to be hammered out.

With a riveting or ball-peen hammer, strike light blows on the spring while it is held in place on the anvil edge of the vise. This will allow the spring to assume a gentle dovetail effect. Then replace the spring in the post, forcing it into place with either diagonal or round-nose pliers. For cutting the steel spring, we recommend Swedish steel diagonal pliers such as are sold by band instrument repair supply houses.

Joint Corking

Joint corks are applied to two types of instruments: metal or wood (composition) clarinets. On wood clarinets the size cork used as 1/16 of an inch in thickness. Metal clarinets, the size cork used is 1/32 of an inch. Since they are applied in different manners, we must take them as separate procedures. To apply a joint cork to the wood clarinet, there are two methods used. The first method is to measure the size of the width of the cork to match the track of the tenons. If it is not to be a butt seam, the exact length of the cork is not too important. But rather, one edge of the cork must be beveled to allow for the overlap. Hard shellac is applied evenly in the track. The cork can then be applied to the track by means of either a hot slick, melting the shellac as the cork is applied or a more rapid procedure would be to spin the clarinet quickly through the flame whereby the clarinet will not be damaged and yet it will draw a sufficient amount of heat to melt the shellac. In this method, the cork must be applied quickly in one motion while the shellac is still hot. The overlap seam is sealed together by using the hot slick. Any excess shellac must be then chipped away prior to cutting the cork to the desired size. The second method of application of this cork is t6 cut the cork wider than the track, and after the cork is wrapped around the clarinet, it must be tied down with twine, after which the twine is heated through the flame quickly, which will allow the heat to melt the shellac under the cork. The width of the cork is then cut to size on a lathe by using a cork turning knife after which the cork is cut to size (diameter) in the same fashion as the first method; that is, using emery cloth (size 2/0 or fine) while the clarinet is being turned at high speed in the lathe.

Metal clarinets differ from the wood clarinets insofar as the joint cork is concerned, in this manner. While we heat the shellac on the wood clarinet, on metal clarinets, the heat application is directly against the metal joint whereby we allow the heat of the metal joint to melt the shellac rather than the flame. It is also advisable to make a butt seam on a metal clarinet in preference to the overlap. On metal clarinets, we must also cut the width of the cork exactly to fit the track. This 1/32 inch cork is then applied while the tenon is hot



Applying shellac to hot key.

enough to keep the shellac soft. This is held in position with fingers for the few seconds that it takes for the shellac to cool off. A smart trick on metal clarinets is to paint the cork with shellac, usually 2 coats. When this is dry, use only a small amount of heat to melt the shellac and you will have exactly the right amount of shellac whereby no excess will be visible, thereby disallowing the necessity for chipping. Cork applied in this manner will have a tendency to give a finer seam. When applying joint corks to rubber or plastic, we must be extremely careful concerning the heat application, since heat will have a tendency to melt the rubber thereby causing it to lose its proper shape, and heat application to plastic materials will cause the plastic to shrink. However, a little care, properly exercised, will eliminate all problems of this nature.

Key Corking

Corking of keys can be done in one of two fashions. The first method is to heat the key allowing the key to melt the shellac and then applying the cork. In using this method, we use hard stick shellac. However, there is an even more simplified method.

This method entails our painting the cork with 2 coats of shellac (liquid orange shellac). When this shellac is dry, it requires a lot less heat and eliminates the possibility of sloppy workmanship. To apply this type of cork, one merely has to lightly heat the key and press a piece of cork against it. The key can then either be held until cooled sufficiently or it can be held against a wet rag to speed up production. Corking of the keys cannot be set down in a set amount of rules insofar as the sizes of the corks are concerned. However, there is a basic set of rules to follow that will meet the average requirements with a small amount of exceptions. This set of rules is as follows:

Bb fork key	1/64 cork
C# or G# key	1/16 cork
Top ring F key	1/64 cork
Bb Bridge key	1/64 cork
A key	1/16 cork
Ab key	3/32 cork (trim to fit body)
Slide Bb key	1/16 cork
High C trill key	1/16 cork
High Bb trill key	1/16 cork
F# trill key	1/16 cork
Back thumb ring key	1/64 cork
Register key	1/64 cork
Low F4# trill key	1/64 cork
Three ring F key	1/16 cork
C lever key	1/64 cork
C# key	No cork
B key	1/64 cork
D# key	1/32 cork
C crow foot key	1/64 cork (2 places)
B lever	No cork
C# lever	No cork

Padding

Bladder

Bladder pads are made of the same material as any other type pad with one exception. The covering of these pads known as bladder skin is made from the lining of cattles' stomach. This skin is quite airtight. As a result, when these pads are to be applied, a small hole, usually made with a needle spring, must be punctured on the side of the pad, not the top. This will allow the air to escape when the key is heated. Otherwise, the pad would swell or expand. Therefore, after the proper size pad is picked out, prior to' shellacking in place, the important rule is the puncturing of this pad. Bladder pads come in 3 sizes; thick, medium or thin. The preference of the writer is the thick pad. However, certain instruments such as Selmer clarinets actually demand the use of medium size pads and in this instance, the thin pad can also be used to good advantage. However, the difference between these three is the amount of shellac used with each individual pad. The thick pad merely has to be shellacked in place. The medium pad requires a small amount more of shellac to a point where it half fills the keys. The thin pad must be completely floated in the keys by filling the key cup entirely with shellac and letting the pads rest on top of the shellac in the same manner as piccolo pads are applied. (See chapter on Piccolo Repair.)

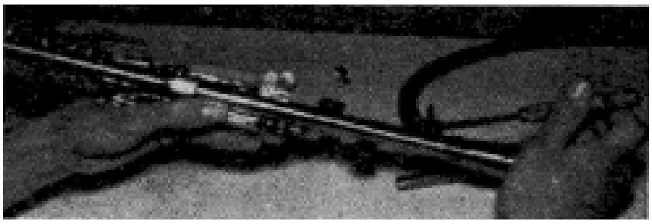
Kid Pads

Kid pads, sometimes referred to as skiver skin pads are applied in the same way and manner on clarinets as they are on saxophones. These pads are not floated in place but rather are merely held in the key cup with hard shellac. The seating of these pads is quite simplified in view of the fact that they take an impression quite easily. If it is necessary, due to deep cups, to float these pads, it is done in the same way and manner as the floating of the thin bladder pad.

It is most advisable to use these pads on metal clarinets or on those types of instruments for anyone other than professional men. It is further advisable to cut a small piece of cardboard away from the large pads so that the small portion of the felt is visible. This will eliminate the possibility of the pad bulging in the center. It is unnecessary to puncture a hole in these pads in view of the fact that skiver skins are slightly porous and will not swell such as the bladder pads.

Pad Seating

The seating of the pad is the most im-important bit of work in the actual over-hauling of the clarinet. No instrument can be properly regulated unless the pad is actually seated perfectly. To properly seat a pad, we must soften the shellac in the key cup by applying heat from the flame directly to the key cup. The pad is then moved to a point of perfect coverage with the aid of a pad slick which is nothing more than any flat piece of steel. To apply heat to a key cup without burning the pad, it is advisable to use the bottom of the flame since this portion of the flame is a controllable area. After the pad has been moved to cover the pad seat perfectly, allow the key cup to cool slightly to a point where it is merely lukewarm. At this point, apply a little bit more than normal finger tension. This will cause an impression to take place in the pad. Allowing the key to cool will prohibit the pad from shifting while the seating is being



Seating pad with slick.

applied. A smart trick on bladder pads is to moisten the pad prior to seating since bladder pads are quite similar in nature to raw-hide. The moisture has a tendency to soften the skin of the bladder pad there-by allowing the pad to accept a seating easier. In rare instances, where the brown kid covering on brown clarinet pads is extremely heavy, this kid can be softened by applying a small amount of denatured alcohol to the pad. This will allow the pad to accept an impression easily. However, to eliminate staining of the pad, the pad must be wet uniformly. Before the pad can be perfectly seated, it is extremely important to achieve the perfect feel in the operation of the key.

Adjustment and Regulation

There is very little actual regulation involved insofar as a clarinet is concerned. Most of the adjustment on a clarinet is actually the removal of lost motion in the operation of each individual key and the height adjustment necessary on each key to give clarity of tone to each individual note. In view of this fact, we shall first discuss all of those keys that are considered to be individual working keys and the two points of actual regulation of the clarinet, we shall save for last.

Upper Joint

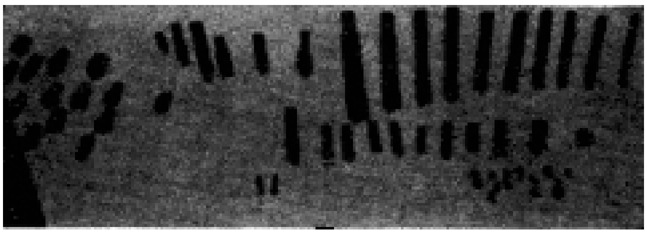
The height of the register key should give the maximum opening still allowing the spatula of the key not to exceed the height of the back ring key. The A and Ab keys must be set so that there is a hairline of lost motion between them. However, when the A key is applied, it should open the Ab, key to its full extent and it must not hit the open F ring key.

The side trill keys must be set in a level plateau. The high C trill and high Bb, trill must not hit one another but the spatulas of these keys must be set at an equal height. The F# trill key must be set at the same height as the side Bb, key. However, these must not strike one another and there must be a very definite step down from the plateau level of the high Bb and C trill. The Bb fork key must be, set so as to give the maximum opening. However, the spatula of this key must be set so as not to interfere with the fingering of the C tonehole and the Bb bridge key. The C# or G# key should have its maximum opening, yet have a sufficient amount of clearance from the spatula of the G# or C# to the C tonehole. The top ring F key must be set at its absolute maximum insofar as height is concerned. This maximum is determined by the position of the A key when the A key is applied. The top ring F key must be raised to a height just below the spatula of the A key. This height is maintained by the thickness of the cork on the foot of the back ring key. Fingertip rings must be set a hairline above level to the finger holes so that the individual playing on the instrument can cover the key and the tonehole at the same time with the ball of the fingertip.

Lower Joint

The F# trill should maintain its maximum height with the assurance that the top of its spatula has clearance under the three ring F key. The three ring F key must be set so that the height of this key is equivalent to the actual diameter of the tonehole. This will allow the C or G to give a full tone. The regulation point between the F ring key and the Bb, bridge key of the upper joint determines the actual height of the Bb, bridge key of the upper joint. The C lever key is a constant key on the lower joint of the instrument and is basically the determining factor for the height of the B and C keys of the lower joints.

The actual regulation between the three adjustment points (C, B, and C# keys) is coupled together with the removal of lost motion from these keys. This is completed in the following manner: It is important to remember that we must always regulate first and remove lost motion last. As a result, the first job is to regulate the B and C keys so that they cover perfectly together by raising or lowering the spatula of the C key. When this is completed, the removal of lost motion between these keys is performed by allowing the C key to open to a height whereby there is no lost motion between the C lever and C key foot. This must be done since the C lever key is our constant key. If it is necessary, at this point, to achieve a higher opening on the C key, we must then trim the cork on the foot of the C lever key. When the C key is set at its proper height (this is done without bending any key) the C# key is then bent to a point where it exactly touches the C key at its crow foot without causing any lost motion between the C lever key and the C key or between itself and the C key. The B key is then brought down to the exact same



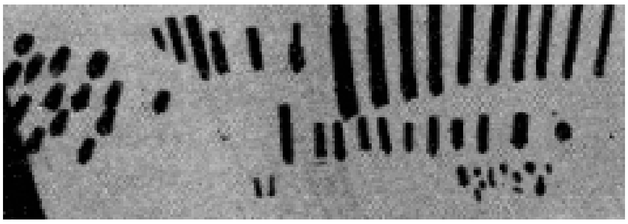
Various types of end mills (tone hole cutters)

point by raising or lowering the foot of the B key. This can be done through either the application or removal of cork to the foot of the B key or by bending the foot of the B key in this manner. If the B key is too far open, hold the heel of the left hand against the key cup with the thumb of the left hand against the spatula of the B key. Hold these two points with an equal pressure. With a dent hammer strike a light blow on the foot extension of the B key. This will cause the foot to drop without changing the regulation point of the B key itself. The B key, when brought to the exact point of the C crow foot, will then eliminate all lost motion from the entire lower section of the clarinet. In some instances, the B lever and C# lever of the clarinet receive cork in view of the fact that on this type of clarinet, there is no bladder skin used at the connection points between the levers and the keys.

On this type of instrument, it is necessary to put on the C# and B levers before final regulation takes place. Final application of the C# and B levers on the average clarinet requires the application of a small piece of bladder skin in the small hole of the C# and B keys' at the connection point of the levers. A simple way to apply this bladder skin is to touch the tip of the levers to your oil so that a small speck of oil is picked up by the lever keys. If the lever key is then placed against the bladder skin, it will pick up and hold it so that it can be properly applied. Excess bladder skin is removed by merely touching it slightly to the flame. This skin will not ignite but rather it will shrink to a point where it is' unnoticeable. However, there will always be a sufficient amount to do the job. If this bladder skin should tear, it will not effect the playing of the instrument. However, it will cause the instrument to be quite noisy. It is extremely important to remove all the lost motion between the post of the B key so that the B key is firm and solid in place. If the B' key is loose fitting, it will disallow perfect regulation from both sides of the instrument. This, in effect, will cause the mechanic to get good regulation when' fingering the spatula of the B key itself, whereas an improper adjustment will show itself when the B is fingered from the B lever key. To eliminate this possibility, the pivot points that hold the B key in place must be sent further into the post by means of counter boring the pivot hole in the post. (See Chapter on Key Work.) The height of the B and C keys determines the clarity of the low G or middle D. It is important to remember that the position of the B lever should be slightly above that of the C4 lever since the musician s hand has a natural tendency to curl and this will eliminate the musician striking both keys when reach-ing for the B lever.

Tone Hole Repair

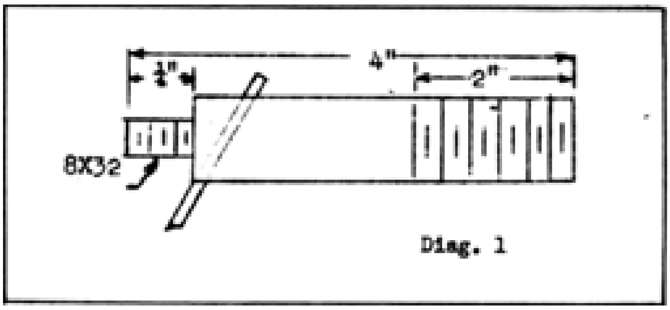
There are two types of tone holes on the clarinet. The first type are pad holes which are cut into the actual outside diameter of the body so that the actual pad can be slightly smaller than the outer diameter of the cut in body itself. These tone holes are cut in place by using clarinet end mills which consist of 2 cutting edges and a pilot. Therefore, in order to cut these tone holes, the hole itself must be drilled prior to the application of the end mill itself. The end mill used for this particular type of work may have either 2 or 3 cutting edges. The important thing to remember when using end mills is that chatter of the tool will have a tendency to tear the instrument apart.



Various types of end mills (tone hole cutters).

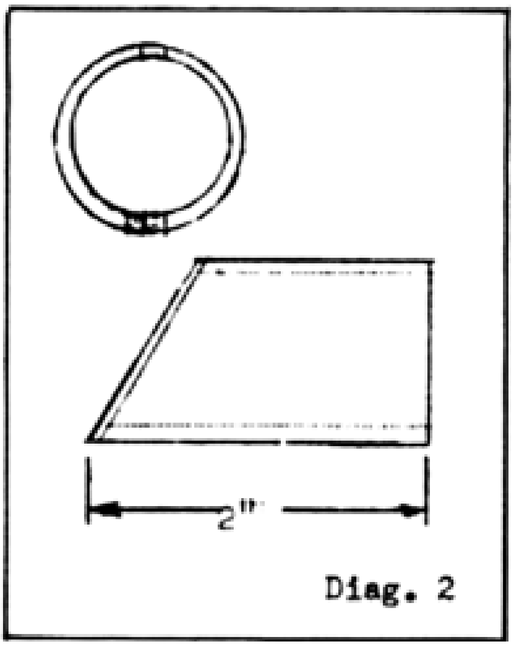
However, chatter can only take place if there is an improper fit on the pilot. A perfectly smooth fitting pilot will allow a sharp tool to take an extremely neat cut without the use of any special jigs. When cutting these holes, the depth of the cut is determined by the size of the tone hole being cut. The curvature of the body will cause the end mill to cut the side (width) before the opposite direction will be touched by the cutting face of the tool. When the lowest part of the instrument shows its full shape, this is the point at which we must stop the cut. The usual angle on the rise of the. tone hole is actually a 300 included angle, or a 150 rate of taper on the face. In most cases, we are not called upon to use one tool for the complete cut of the tone hole since this is used basically in either manufacturing or when a section of a clarinet has been replaced such as tenon repairing on broken clarinets. The usual repair of these tone holes is caused by a chip, a crack or something that will hinder the pad seat of the tone hole. In such a case, we merely have to shave the tone hole slightly to allow a new pad seat to show itself. Small chips are easily dressed away with the use of pad seat reamers, which are actually circular files. This has a tendency to widen the mouth of the tone hole. However, if the cut is slight, it will not vary the intonation. If a crack in any clarinet intercepts a tone hole, not only must the crack be glued and closed but it is wise to replace this tone hole and it is done in the following manner: using the correct end mill and pilot for that hole, cut the tone hole to a point where there is a thin shell left just short of the bore of the instrument. At this point, cut a piece of either grenadilla wood or hard rubber whichever the case may require so that the outside diameter is identical to the cut. The inside face of this piece of material must have the same angle as the tool applied when making the cut in the clarinet. The same diameter hole is drilled dead center to this piece. This piece is then glued in place in the clarinet. When the glue is hard, the same end mill that made the original cut, will make the final cut to bring the tone hole to its exact proper position. When this job is completed, a pad can be seated perfectly on such a tone hole. The second type of tone hole is the raised finger type. This tone hole is a separate unit when the instrument is built at the factory. These tone holes are replaceable. However, when these tone holes are applied at the factory, they are usually threaded and glued into position. The taps used for this type of work are special backed off taps. These taps cannot be readily purchased by the average mechanic. As a result, we, in the repair of these tone holes which in practice consists of the replacement of the same, do not have to thread them if we cut the recess for them and fit the new pieces perfectly.

This is done in this manner: using an end mill with a perfect pilot, cut the depth in the same way and manner as replacement of a tone hole. The outside diameter of the end mill should match the outside diameter of its own recess. The new finger tip hole must be cut separately and apart from the instrument on the lathe so that replacement of the part in the body allows only the height of the replaced portion to be cut to size. This is easily done either by the use of a flat mill or a file. The final cutting to size is done after the glue is completely hard. We recommend Plastic Steel as the glue for this type of work. The Charles Miller set of end mills allows one to perform this job in a different fashion. If use of these tools is preferred, then the recess is cut disregarding the full width of the outside diameter of the original recess. When the new piece is replaced, this set of tools has special end mills that cut the outside diameter or the shape of the fingertip tone hole. However, if this tool is used, it is extremely important to



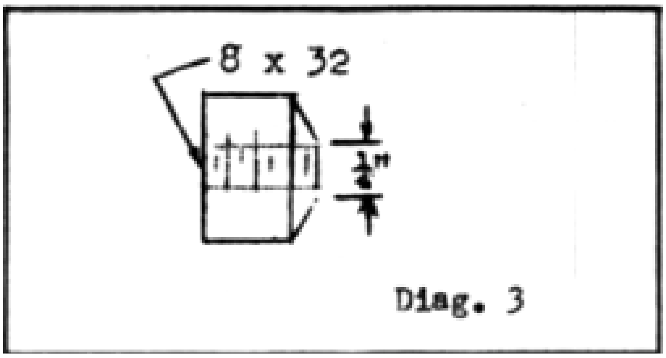
<u>Diagram 1</u>- Tone Hole cutter-Material used 1/4" drill rod-1/4x20 thread 2" long on back end. Front end 6x32 thread 1/4" length. Tool hole 1/8" diameter. Tool bit 1/8" drill rod. Hole drilled at 15 degree angle.

cut the height of the fingertip tone hole prior to using the outside end mills. A third method is to use the end mill that is the exact outside diameter of the fingertip hole required. The replacement part would then have the exact outside diameter so that merely the height would have to be cut and there would be no shaping necessary to the replacement part. If the replacement of the fingertip tone holes is on a rubber clarinet, the broken tone hole can be removed from its thread by warming a tool



<u>Diagram 2</u>- Drill 1/2" hole in 1/2" brass rod 2" overall length. Drill 1/8" hole at 15 degree angle to furthest end. Cut away excess stock to allow half of hole to show as recess on both ends. Similar type tube made with .025 wall. Any nut with 1/4 x 20 threads to act as lock.

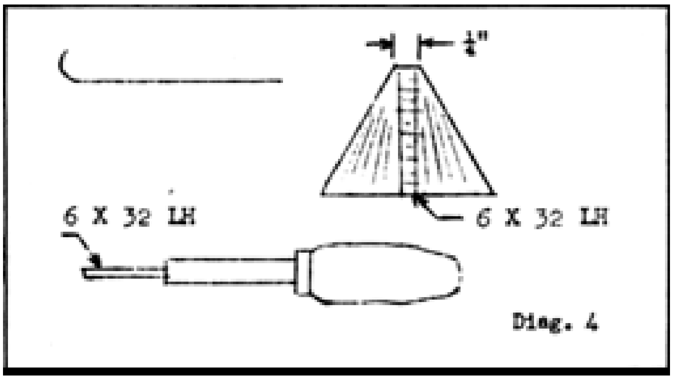
and actually burning out a small portion of the rubber finer hole. This in turn will allow you to break loose the balance of the broken part since it will come away from its own threads with very little effort. If this can be achieved, it is wise to thread the new replacement so that



<u>Diagram 3</u>—Pilot length 1/4". Thread hole 6 x 32. 15 degree angle on one end to 1/4" face on same end.

they can be put back in the same way and manner as if it was made at the factory.

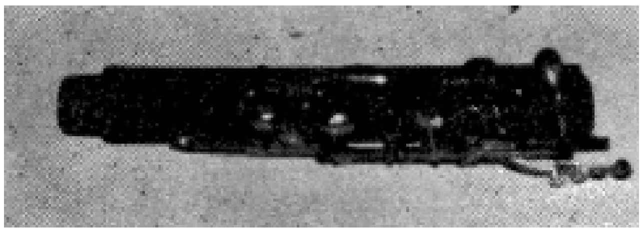
The usual thread on this type of work is a number 40. Some factories have on occasion used a number 38. Thread chases can then be used to good advantage. (see Thread



<u>Diagram 4</u>—(Tone Hole Undercutting Tool)
Circular file or deburring tool. 1/2" diameter at large end. Soften or anneal. Remove back stud. Drill hole with No. 36 drill. Thread 6 x 32. Face off small end to 3/16". Thread must be left hand. Screw driver holder threaded on end 6 x 32 left hand. Small hookbent approximate right angle hook end ~46. Wire to be 1/8" drill rod. Hook circular file on wire, large end down. Insert in clarinet to desired tone hole. Screw in from face of tone hole and revolve handle left hand. Upon completion of cutting, reverse handle and remove same.

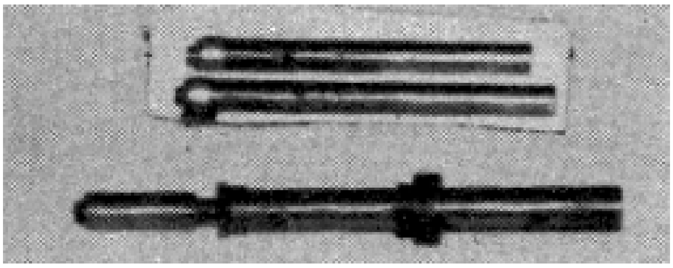
Chasing).

TENON REPLACEMENT



Male center tenon broken.

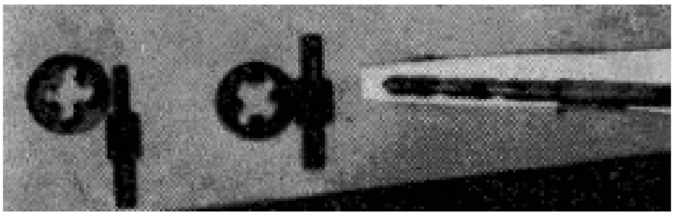
REPAIR #1



Tenon repair tools

There are many clarinets that seem to break more readily than others. This is especially true of the plastic variety and the hard rubber or Ebonite. Although wood clarinets do crack, they are rarely broken but this statement does not mean that it cannot happen.

There are three tenons that we are usually confronted with. They are the following:
Male Tenon on the lower joint (to fit the bell)
Male tenon on the upper joint (to fit lower joint) Female tenon on the lower joint to fit male tenon on the upper joint.



Tap and die for upper tenon 27/32" x 20" for bell tenon - 1" x 20" bore drill

There may be many methods of doing these specific types of repair jobs. However, we shall describe the two types of methods that are most commonly used. This does not mean that if any repairman has another method, that we frown upon it. In fact, we are always open to new suggestions from anyone. It merely means that we know that these two methods do work to good advantage.

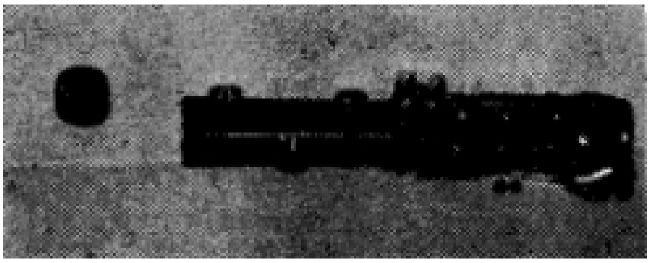
The first method is that which calls for boring out the body, and the tenon is inserted and glued in place, with or without safety pins to lock it.

The second method is that which calls for the threading of the parts, gluing and allowing the posts to act as the pins. The boring tool, consists of a 6" length of drill rod, 1/2" diameter, with a 1/4" hole through the side of the rod. The front edge of the rod is cut down to 3/8" for 1/2" from the end. This under cut is for the pilot which is made of brass. To hold this pilot in place, a 1/2" washer and an Allen screw (8x32 thread) are used. The front end of the boring rod is: drilled out to 1/2" depth with a 28 drill and' the hole 'is threaded with an 8x32 tap. The cutting, tool is 1/4" drill rod, sharpened and hardened so that the .tool has the cutting edge. This tool bit is inserted in the 1/4" hole -and locked in place by means of a headless Allen- screw. The resulting tool is' a pedect fly cutter. The pilot used on this tool' must 'have its outside diameter a perfect fit to the bore of the body of the clarinet. The length of the cutting bit is dependent upon the size of the cut desired. If the method of repair used is 'that of threading the tenon and the body, we recommend the use of 27/32x20 tap and die. To bore the body out the bit should be set .152" extended from the boring bar. This will the bore out the clarinet to a diameter .804". Since the decimal equivalent of 27/32" is .84375 or .844", this will allow .040" for threads, This procedure is used to repair the male tenon on the upper joint. The depth of the cut should be past the open C tone hole. Thread the body, making certain that the threads are cut true and straight and using a cutting oil with a sulphur base. To cut these threads true to the center, the tap should have a pilot end. Replacement tenons can be purchased. If you prefer making the tenon, the outside length should be the length of the prepared bore plus the length of the tenon. The diameter of the end to be threaded should be .844". If this repair is performed on a wood joint, we recommend the use of plastic steel for the gluing agent. Cut the diameter of the tenon to fit the female socket of the lower joint, then cut the recess for the cork. Since even a bottom tap has a lead on its starting thread, we must allow for that lead on the threaded tenon by under-cutting the first thread on the tenon. This will assure you of the fact that the tenon will screw in to match the opposite end. By the same token, a die has a lead as well. Therefore we must understand the last thread.

If this tenon is not to be threaded in place, we must bear in mind that we need more length to the gluing service. Therefore, the internal cut should be made past the Bb or Eb tone hole.

After the tenon is set in place, the tone holes must be rebored and the post holes redrilled slightly, since the boring out of the body interferes with the post hole. It is for this reson that all the posts must be removed from the body if they are in the length of the cut. In both methods of repair, the posts upon resetting, will act as pins for the tenon.

If the tenon is made on a rubber clarinet, we must use plastic steel. Rubber cements will seal any leak, but they never fully



Male tenon lower joint (bell section).

harden. The best glue I have found for this purpose is plastic-steel. It comes in wet powder form with a small bottle of liquid. After mixing, it does a terrific job of holding.

On clarinets made with plastic materials such as Resonite (Bundy, etc.,) I suggest that you do not attempt to use the threaded method.

If the tenon is threaded and glued in place, we can proceed with the finish cutting immediately since the threads, being right hand, will hold the part firmly. If the tenon is merely glued in place without the use of threads, it is wise to let the glue set for twenty-four (24) hours before making the finish cut.

The above description is merely for the replacement or repair of broken male tenons on the upper joint that fit the female tenon of the lower joint.

MALE TENON LOWER JOINT
Tooling Up

For bell tenon replacement the Continental Tool Division brought forth a tool that did the job excellently. However, they are no longer in the tool business. Our suggestion is to reverse the tool bit on the Charles Miller boring tool. This will allow you to use the back end of the tool as a pilot. The main stock of the boring bar is 1/2". The bit is set to cut away half of the wall of the body.To use this tool in boring out the body to receive the tenon replacement, it is necessary to change the tapered bore of the instrument to a straight bore with a 1/2" hole. This is done by cutting a piece of brass 3/4" in diameter 1" long. Cut the outside diameter to a 7 degree taper so that it will fit snugly in the bore of the lower joint in the middle of the low E tone hole. Drill out this piece with a 1/2" drill. Insert this brass piece in the lower joint from the bell side. Jam it in place. This insert will now give you a straight bore with a 1/2" diameter. If the tenon replacement is to be threaded in place, the tool bit in the boring bar must be set more exact than if there are to be no threads. If threads are preferred, the thread size recommended is 1"x20. Since we have to allow .040" for the threads, we must bore out the clarinet to .960 to receive the 1"x20 tap. The tool bit cuts twice its own length since it cuts the same amount off each side while turning. Therefore, the bit must extend from the bar only 1/2 of the difference between the size of the bar (.500) and the desired bore (.960). The bit must, therefore, extend .230 from the bar. At this point, you are ready to prepare the body to receive the new tenon.

Preparing the Body

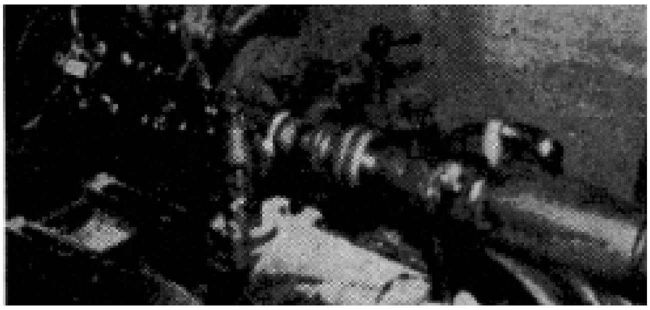
After reversing the tool bit in the boring bar so that the 1/2" stock is extended as a pilot, lock the small end in the chuck or headstock of the lathe. The body of the clarinet will be guided on to the boring bar correctly because of the tapered inserted sleeve. Hold the body firmly against the dead center of the tailstock while feeding the tailstock forward slowly. Cut up to but not into the low E tone hole. This will give you a distance of nearly 1/2".

Making the Tenon

The length of the inserted tenon will include the insertion and the extension. Drill out the inserted tenon with a drill. Bore out this piece with the boring tool of your lathe inserted in the compound rest, to the diameter at the end of the remaining tapered bore of the lower joint. Continuance of this taper to match the original taper of the instrument is obtained by using the angular feed of the compound rest. When setting this feed, remember that six to eight degrees is the average size taper in the average clarinet. This is an included angle. Therefore, set the tapered feed for half that amount. The outside diameter of the tenon is cut to size and the cork, recess cut in only after there is definite assurance that the tenon is firmly in place.

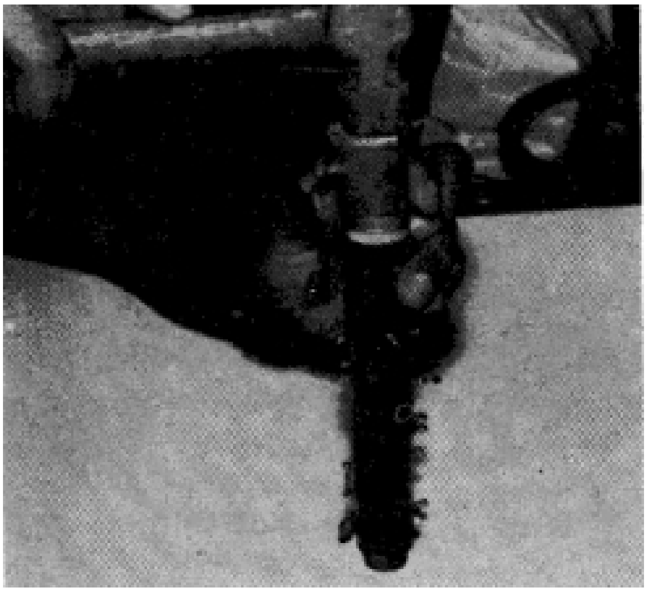
Female Tenon Lower Joint

The usual break of the female socket of the lower joint is such that a tenon will break just at the point of the main bore of the body. If the break is such, it is repairable in this manner. Chuck up the clarinet in a lathe so that the dead center of the lathe is placed against the actual bore of the body. Cut the outside of the body to a diameter of .843 of an inch. This will give you the perfect size diameter to receive a 27/32x20 die. The length of this cut should be to the very edge of the recess of the finger hole. This will give you complete clearance over the three ring F key tone hole. The replacement part must be a sleeve that fits over this extended end of the body so that the extension of the sleeve becomes the replaced female socket. After the body is cut to the diameter of .844 of an inch, the mechanic may elect to either thread this part with the aforementioned die or the replacement piece can be made as a slip fit over this section of the body. If the part is threaded and the replacement part equally the same, the job can be immediately worked on since the thread will hold the part in place while it is being cut to fit. If it is not to be threaded, the job must then be held up until such time as the glue is completely dry. To obtain a perfect seam, it is wise to knife edge the cut of the body so that a straight cut on the replacement part will give an absolutely snug fit. When the part is properly glued in place, the outside diameter of the replacement part is then cut to match the outside diameter of the body. The instrument is then removed from the lathe and if the part is rubber, imitation graining of the rubber is accomplished with emery cloth in a vertical direction and light buffing thereafter so as not to remove all of the emery marks thereby simulating the actual grain of the material. When this is completed the instrument is once again placed in the lathe. However, when cutting the recess for the ring on the female tenon, it is wise to place the dead center of the lathe against the outer center of the female so that even on a warped instrument, it will have the appearance of being perfectly true after the ring is laced on its recess. When this portion of the job is completed, the relocation of the three ring tone hole is the next operation. The actual key itself will show the approximate position of the hole. A smaller hole is drilled at that point and with the use of circular files, the hole is then brought to match the old hole which is still in the body of the clarinet so that upon the completion of this operation, the recess of the tone hole can be replaced in perfect position by the use of an end mill. (See chapter on Tone Hole Repair.) Relocation of the post for the three ring key must then be completed and the key itself will show the position of the post. Final relocation of the post hole for the C lever key must take place. Post hole drills are selected for the outside diameter of the drill since the drill not only drills a hole but counterbores a shoulder as well. It is this shoulder which is the most important part in a selection of these tools since the actual drill point on all post drills is approximately the same size. Most clarinets use a special wood thread, the



Makes cut on body to receive end band.

post tap for which can be purchased from musical instrument supply houses. It is quite similar to a 6x28 thread. Some clarinets such as the Prueffer have a post with an 8x32 thread. In this case, the post drill is still used. However, after drilling the hole, redrill on to the top section of the clarinet extremely tight fitting so that it has a tendency to pull the crack in the clarinet together. It is wise to force a little glue into the crack before driving the ring in place. To prepare the body to receive this end band is a simple procedure. Cut the edge of the body on the lathe just past the tenon. The width of the cut should be a .002" or .003" smaller than the width of the ring to allow for dress off. The depth of the cut should be. approximately .003 to .004 larger than the inside diameter of the end band. When this is accomplished, bevel the edge of the clarinet so that the ring can be driven home. To drive this ring home, a piece of brass tubing that fits loosely against the ring should be placed in such a manner and with light blows of the hammer, the ring can then be forced on. After the ring is forced in place, replace the clarinet body in the lathe and dress the length of the ring so that it is a perfect match to the end of the wood. Cut the top face of the ring so that it is a perfect match to the woo In view of the



Hammering end band on body

fact that a cracked clarinet has a tendency to pull the body of the instrument out of round, it is sometimes necessary to do final dressing by hand with a file, fine emery cloth and buffing.

Flush Banding

If the crack in the upper joint of a clarinet or oboe passes far enough down the length of the body so that an end band is insufficient to do the necessary repair, the application of a flush band is required, it is shrunk into a recess in the middle of the body and tightened to a point that will, in most cases, close the crack. It is done in the following manner:

The cutting tool should be ground in the same way and manner as a cut off tool. That is, a straight face tool with side clearance edges. The groove in the body is cut so that it does not intercept or interfere with any tone holes or post holes. The selection of the spot is usually optional depending upon the severity of the crack. The width of this groove should be cut one-half of one millimeter wider than the ring to allow for side expansion of the ring as the diameter of the ring shrinks to fit the body. The depth of the cut should be slightly smaller than the thickness of the ring. The flush band should be annealed prior to the shrinking process. When the ring is cooled, place it over the body so that it fits in the groove prepared for. Squeeze the ring easily in a vise so that it retains an oval shape and is set in the recess cut in the body. Place the ring in the flush band die of the shrinking press, assuring yourself of the fact that the ring is placed evenly in the die; the ring is not placed evenly in the die, the shrinkage would take place in an off center manner which will have a tendency to not only ruin the job but may possibly ruin the instrument as well. When the ring is placed evenly in the die, steady turns on a shrinking arm will shrink the ring back into round as well as shrink the diameter. It is wise to turn the body before you reach the bottom of the shrink. This will allow the ring to settle in its own prepared space perfectly. We must be careful not to over-shrink the ring or we will have a tendency to damage the bore. When the ring is fully set in the groove so that it is tight fitting, there will be marks left on the ring from the shrinking press. It is for this reason we allow the depth of the cut in the body to be less than the thickness of the ring. This gives us a small amount for dress off. The dress off is completed in the lathe with a normal cutting tool to a point where it is flush to the body. We must remember, however, that when an instrument cracks, it throws the instrument out of round. Therefore, final finishing must be done by hand, with filing, emerying, and finally buffing. There is another method of flush banding put out by the Linton Manufacturing Company. This method consists of cutting the groove in the body any way whatsoever. In the kit they prepare for this job, they supply a small piece of aluminum that fits around the body and is held in place with binding wire. The type of metal used for this ring is a form of lead. However, this lead has an extremely low fusion point and will melt at approximately the temperature of boiling water. This flushband is applied by heating some of this metal in a small retainer they supply with the kit and pouring this metal into the grove through the opening allowed by the aluminum band. If this metal does not completely fill the groove after the band has been removed more of the same type material can be added in the same way and manner as any crack filler. After the band has been applied in this manner, its final completion is arrived at by hand dressing with light filing and easy emerying. However, this type of material should not be buffed as the friction of the buffing wheel can be sufficient to melt the material. Hand buffing in this particular case is recommended. This method of flush banding does not pull a crack together but merely holds the instrument in its already set position so that the crack will have very little chance of expanding further. This method works extremely well on oboes since it eliminates the problem of the extremely large shrinkage necessary to clear the crown of the oboe. Furthermore, in view of the fact that there is no required width to a groove, this flush handing can be applied in any position whatsoever.

Rubber Rings

In many instances the rubber ring is preferred to the application of an end band. To apply this rubber ring, the following procedure is recommended:

We prepare the body in the same way and manner as if an end ring were to be applied. However, in the application of a rubber ring, the body is not cut to fit the rubber ring but rather the rubber ring is cut to fit the body. It is further advisable to cut the body much deeper so that the rubber ring being thicker has more strength. It is also wise to cut the body to the depth that will match the tenon end. The rubber ring is bored out so that it is approximately twenty thousandths smaller than the diameter of the body at the cut. It is wise to cut a slight knifed edge on the body and a straight edge on the rubber so that you can obtain a perfect seam. To apply this rubber ring, the rubber must be stretched so that it can be forced over the end of the clarinet. Stretching of this rubber is accomplished by heating the rubber over the torch to a point where the rubber ring becomes softened. At this point, the rubber ring is driven in place.

No glue is necessary. When it is driven home tight, it must be allowed to cool slowly. This causes the rubber ring to shrink and it is this shrinking that will cause the rubber ring to hold extremely tight, to the wood. When it is fully cooled, the length and diameter of the rubber ring are cut to fit the body. Final dressing of the rubber ring should be done by hand. However, imitation graining can be easily accomplished across the rubber ring into the wood so that it becomes extremely difficult to ascertain that there is such a ring applied. This is strictly for the purpose of disguising.

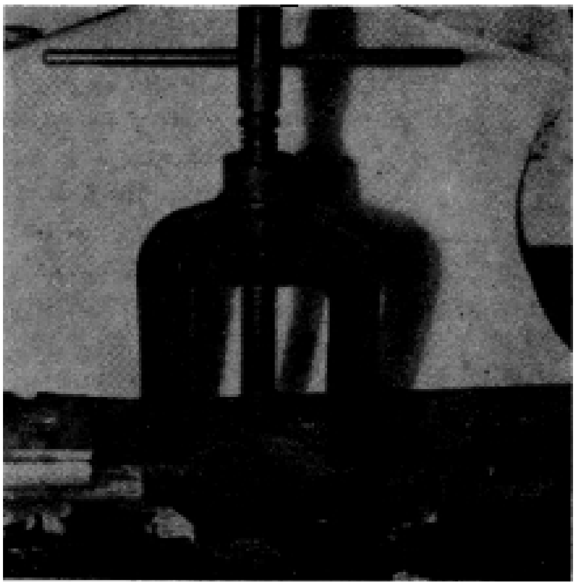
Body Polishing

Grenadilla wood can receive a very fine luster by polishing this wood on a slow speed buffing wheel (preferably a bench motor) using any white lime compound. Naturally, we must stay clear of the tone holes when polishing this body. There will be enough polish left on the body by the buffing wheel so that polishing between the posts and around the tone holes can be easily accomplished with a small strip of cotton flannel. While polishing the body on the wheel, it is wise to polish the side of the post. Final hand stropping will give us the necessary luster in the smaller spaces. The cleaning of dirt around the tone holes is easily accomplished with the use of small cup brushes placed on a slow speed motor. This should be done prior to final hand stropping. The bore of any instrument is easily cleaned by wrapping a small strip of cotton flannel around a trumpet valve cleaning rod. Apply some buffing compound to this rod and vigorous strokes in the inside of the bore will bring a fine luster, to same. In this manner, we will be putting a shine on the inside as well as the outside. The bell and barrel of a clarinet should be completely polished on the buffing wheel. We must remember never to use a red rouge compound in the polishing on Grenadilla wood or rubber as the red rouge will imbed itself in the pores of the wood and rubber.

The polishing of a rubber or plastic body is accomplished in the same way and manner as the wood clarinet. However, we must be careful while polishing either plastics or rubber to keep the pressure against the buffing wheel very slight since the buffing wheel, through friction, will generate heat. Metal bodies are polished in the same way and manner as described in the chapter on polishing depending upon the finish of the instrument.

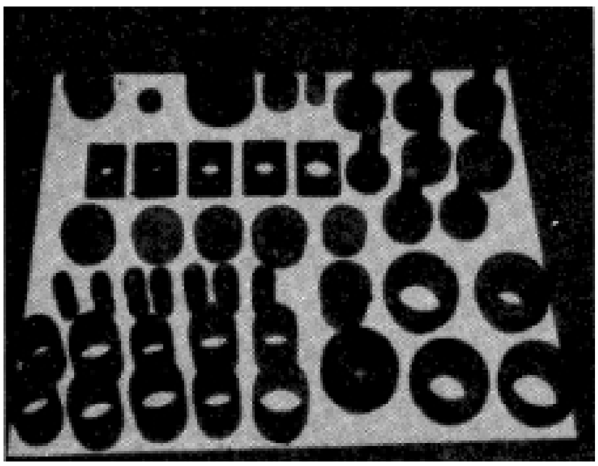
Silver Soldering (keys, etc.)

Silver soldering is a process used when the parts to be soldered will have insufficient strength if lead were used as the binding agent. To silver solder, we must bear in mind two important facts. First, that silver will take the road of least resistance. Therefore, the part must be thoroughly cleaned. This can be accomplished either by filing or brushing with a steel wire wheel prior to silver soldering. Do not touch these parts with your fingers as your fingers will leave oil spots at this point. The flux used in silver soldering has a borax base. There are many types on the market that are much better than borax itself since the formulae for these different types of flux are such that it will eliminate quite a bit of the expansion that usually takes place when borax is heated. It is also important to remember that silver solder will only flow when the part is



Ring machine or press.

clean and flux has been applied to that point. Tremendous quantities of flux are not needed. Keeping the flux to a minimum will have a tendency to give you neater work. The part should then be heated slowly to a point where it is red hot. The silver solder is then applied. Silver solder should never be applied until the part is red hot. The piece to be silver soldered should be held in place with a silver soldering jig. There are many of these on the market. Application of the heat should take place until such time as the silver flows like water. If the silver cannot be seen flowing as heretofore described, there will be very little holding power. When silver soldering two thin pieces of material such as brass, one must be careful not to keep too forceful a flame and not to concentrate the flame in one particular position but rather to dance the flame lightly so that the material that is to be silver soldered does not reach its own fusion point and melt. If small pieces are to be silver soldered, there is a material known as Perma-Jig, which will help you do a very fine job on those items where a soldering jig is too clumsy. The im-important feature to be remembered in silver soldering is the control of the heat, bearing in mind the fact that we must always heat the heaviest part first. Furthermore, control of all of the heat is important and many times we lose half of the heat as the flame passes the part. This only prolongs the silver soldering process. To utilize this lost heat, it is smart to place a sheet of either asbestos or magnesium pad behind the part as the heat is being applied. These materials do not absorb but rather reflect any excess heat. As a result, your job can be accomplished more easily and better. After the part has been silver soldered, it must be removed from the jig and the scale on that part must be removed. This is removed by immersing the still warm part in a solution of nine parts of water to one part of sulphuric acid. This is known as a pickle. Pickling of the part will remove all of the scale, after which final dressing of the broken pieces should be done so that the part has the appearance of never having been broken. This dressing is accomplished with the use of Swiss pattern files, emery cloth and fine light buffing. When buffing silver soldered parts, it is wise to remember that silver solder is much softer than brass or German silver. Therefore, do not apply too much pressure to the buffing wheel at the soldered joint or it will remove silver solder faster than the other materials.



Complete set of dies of ring machine for clarinet, oboe, English horn and sub press for flush banding.

Using the Ring Machine

The ring machine is an instrument used for the purpose of shrinking rings so that they are tight fitting on the tenons and the bells of the various musical instruments such as clarinets, etc., that require these rings. The small tenon rings should be removed. The proper die, that is the die that fits inside the ring loosely so that the ring rests on its shoulders, is inserted in the machine with the ring face down. Set the lead screw of the ring machine firmly against the die so that the ring is going in the shrinking die straight. A sudden quarter turn of the lead screw usually gets the best results. However, we must remember that the shrinking press is nothing more than an oversized draw plate. As a result, it only shrinks the one end facing in the shrinking die. Therefore, the ring must be turned around and this process repeated in this manner so that the ring shrinks evenly. The ring should then be tight enough so that it must be driven on to the part. If it is still not tight enough, this process can be repeated. After the rings have been driven back on the part, they may have a tendency to shrink the end of the female socket. Dressing of these sockets may be necessary with tenon reamers. The bell ring is not removed but rather, the bell is placed in its proper die so that the small end faces down. The top die should be such that its diameter is slightly smaller than the outer diameter of the bell ring, yet large enough so that its edges rest upon the bell ring, and do not hit the wood. Leveling of the bell in the ring die is accomplished by moving the bell from the bottom end so that the die will seat itself close to the center of the ring machine as the part fits directly under the lead screw. Bring the lead screw firmly in place and with a sudden motion of a quarter torn of the screw, you will shrink the ring. If this is insufficient, repeat the procedure. Some bell rings have a tendency to want to turn while shrinking. Should-this hap. pen, the bell is then inverted in the same shrinking die and with a small plate placed over the female socket and the lead screw applied to this plate, a slight amount of pressure with a large part of the bell facing down will reverse the turn of such a ring. Tightening of this ring can then be accomplished by repetition of the first procedure.

The ring machine is also used for application of flush bands as described in the article on Flush Bands.

Shrinking of oboe bell rings is also accomplished by use of the ring machine and the oboe dies. The entire procedure is the same except that the oboe die must be picked out so that the diameter of the tube or die does not hit the wood of the oboe bell but rather, rests upon the round ring of the bell. The bell is placed in the shrinking die, tenon side down. A large tube is placed against the bell ring and the large plate used with the oboe die is placed on top of the large tube or die. The lead screw is then turned down so that there is a firm fit against the top die. A quarter turn of the lead screw in a quick motion is usually sufficient to tighten this ring; if a quarter turn is insufficient, repeat the procedure. If the bell of any instrument stays too firm in the lower die after the shrinking process has been completed, a light tap with a rawhide mallet to the protruding part of the bell will remove same. If a ring is held too firmly after the shrinking process in the shrinking die, this is removed by placing a softer piece of material than the ring itself is made of against the ring, (preferably copper) and a light tap in this lower die with the die removed will drop the ring out of place.

Clarinet Assembly (Order)

This order of clarinet assembly is not to be considered the only possible order. However, it is the recommended order of assembly of your writer. It is as follows:

Upper Joint

1. Bb, fork key
2. C#, or G# key
3. Top ring key
4. Bb bridge key
5. A key
6. Ab key
7. High C trill, High Bb trill & F# trill (these 3 keys are put on at the same time)
8. Side Bb key
9. Back thumb key
10. Register key

Lower Joint

1. F# trill key

2. 3 ring F key
3. Side C lever key
4. Low C# or F# key
5. B orE key
6. C crow foot and D# keys
7. B and C# levers

Checking for Leaks

Leaks on a clarinet should be checked for as each pad is seated. Since pads are made of translucent skin, it is difficult to use a leak light and the use of such tool requires a tremendous amount of practice to truly ascertain whether or not there is a leak. However, this is one method that can be used. The more widely used method is that of using a testing feeler. This consists of a very narrow slip of tissue paper or cigarette paper. This paper is inserted between the key and the tone hole and the key is held lightly in place while the paper is removed. If there is a slight tug against the paper, it will usually assure us of the fact that pad is covering at that point. If the paper slips out easily, it is a sure sign of the fact that the pad is not hitting the tone hole at that point, thereby causing a leak. When an instrument is completely repaired, testing of the entire joint is accomplished by holding the fingers over the upper holes of each joint individually, the heel of the hand at the bottom of the joint and sucking the air out of the joint with your mouth. If the instrument is completely covered, you will create a partial vacuum in the instrument which you can readily feel. In the lower joint, if you create this partial vacuum, you may release the pressure of your pinky from the low E key. Normal air pressure at 14.7 lbs. per sq. in. will be more than sufficient to hold the low E and F keys closed allowing you to make a complete popping sound when the instrument is drawn away from your mouth. If there is a leakage, you will not be able to create such a partial vacuum. It is extremely unwise to use cigarette smoke to test for leaks because while you are blowing the cigarette smoke into the instrument you build up pressure in the instrument which may sometimes be sufficient to offset some of the spring tension on some of the closed keys. They will, in effect, give you a false idea of leakage and will leave nicotine stains on the bladder skins. It is also advisable to change the pad should there ever be a nicotine stain since this only deteriorates the pad and causes the key to stick to the body. It is for this reason that we never test an instrument for leaks by trying to blow air through it but rather test it by sucking air out of it. If brown clarinet pads are used, small inspection lights are the smartest checks for leaks in such a case since the material covering the brown pad is opaque.

Correcting Buzzy Tones on Clarinets

Occasionally, certain tones give a buzzing effect. This is due to the fact that the bladder skin used on the pads has a tendency to be in sympathetic vibration with the note being played. This will occur very commonly on what we term the throat tones which are the middle A and middle B flat. Also referred to in the same grouping is the open G. To eliminate this buzzing sound, it is necessary to replace the bladder pad with another made of a different material so as to eliminate the vibration of the skin. The register key pad is the cause of the buzzy tone on the middle Bb. Therefore, if this pad is changed so that the new pad is either a kid pad or a cork, clarity on this note will be achieved. Of course, we must remember that the fingering of B flat using the A key and the register key is actually a false fingering. The true fingering for this note for the perfect sound is the A key and the B flat trill key. The open G can have its buzz removed by changing the top ring F pad to a cork or kid pad. The buzz on the A can be removed by changing the A pad to a kid pad. If there is a buzz on the low C#, this can be eliminated by changing the G# pad to a cork pad. In many cases, buzzing tones or dead notes are sometimes caused by too close an action on the 3 ring key. To eliminate this, opening of the action is advisable. On the low G, it would require the opening of the low E and F keys. However, these cannot be opened unless the height of the F# key is also brought to a point where there would be no lost motion between the F# and F keys as well as the E and F keys. This also takes into consideration the adjustment between the C and F lever and the F or C key. Very often the register key hole will become clogged with dirt or lint from a clarinet swab. This must be removed prior to trying the instrument out. Likewise the thumb insert on the upper joint of the clarinet must be kept clean or it would affect the F#. On clarinets where there is an articulated G#, grease from the joint cork may sometimes collect in the G# tone hole. This should be kept clean or it will have a tendency to change the intonation of that particular note.

Finger Ring Replacement and Repair

Finger rings on a clarinet may have to be replaced or repaired. We do not repair worn finger rings. They are merely replaced by silver soldering on a new ring. However, very often we are faced with finger rings that are too snug fitting around the raised finger hole. To correct this, we may either grind out a small amount from the ring itself or slightly stretch the ring by forcing the same over a tapered mandrel and lightly hammering the sides of the ring with a dent hammer while doing so. This stretches quite easily. If finger rings have to he bent into position, we must be careful to keep the ring flat while so bending. Therefore, it is advisable to bend these rings by placing the entire ring in the jaws of the vise so that when the balance of the key is bent forward or backward, it does not change the complete lay of the ring. For simple adjustment or regulation of the ring keys, it is advisable to place a flat slick between the ring and the finger hole and press the key cup down. If the ring is to be reversed, the slick is placed underneath the pad and the ring pressed down. These rings should be set so that they are very slightly above the finger hole since the musician plays the instrument by covering the holes with the ball end of each finger; the perfect feel can, in this way, be achieved. After the rings are set on the three ring key as well as the Bb bridge key, the final adjustment between these two keys is made by raising or lowering the bridge of the Bb bridge key. It is advisable to keep a fairly decent size opening on the three ring key so that it does not impair the intonation or sound of the three finger C or upper G.

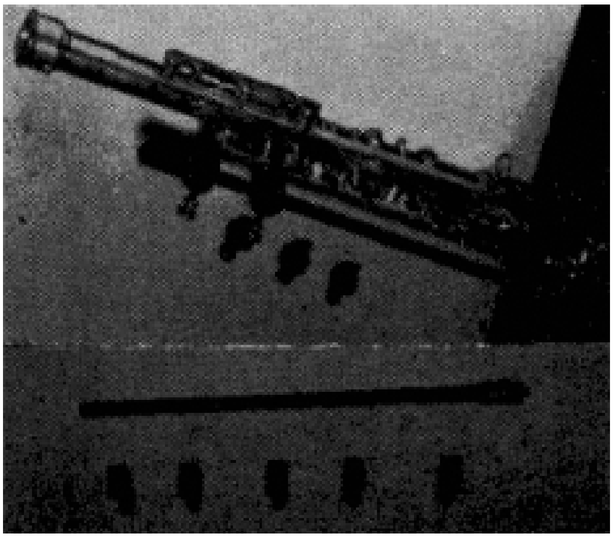
If a finger ring is bent out of shape, it must be straightened two ways. Firstly, so that it is perfectly round and secondly, so that it is perfectly flat. This is done by forcing the ring gently over a tapered mandrel so as to bring it back into a true round. If light hammering is necessary, the use of a rawhide mallet is advisable so as to eliminate any possibility of stretching. To be sure that the ring is flat, place it against any flat piece of steel and lightly tap it into position with the rawhide mallet. This will eliminate any possible hammer or stretch marks on the part. If, in the repair of these rings, marks are left on these rings, we must remember that appearance is extremely essential in the proper repair of any instrument. Therefore, these marks must be removed by light filing, scraping, emerying and buffing. To eliminate any marks coming on the keys, through the use of the vise, it is advisable to either use brass jaws in your vise or make brass sleeves to fit over your vise jaws. These rings, although replaceable, do not have to be made since they can be readily purchased from any supply house. They are purchased in either rough cast form or as finished casting.

**Register Key
and Back Thumb Inserts**

Too many people believe that the register key and back thumb insert must be a force fit in the body of the instrument. This will work on rubber instruments. However, it is not advisable to have these parts too tight on either wood or plastic instruments. However, to seal a leak around these parts, it is advisable to heat them and apply hard shellac to these parts and while they are still hot, push them into place so that the shellac acts as a seal against any leakage. If these parts are too tight on wood clarinets, they do not allow for either shrinking or expanding of the wood and as a result, may' be one of the causes for the cracking of the upper joints of clarinets. The register key insert should not be tampered with insofar as the size of the hole is concerned, lest it have a tendency to change the entire intonation of the extreme register. If the hole in the register key insert is too small, it will have a tendency to throw the extreme register flat. The back thumb insert is curved at the bottom to match the bore of the clarinet. This curvature should be set in its proper position when the insert is replaced in the body of the instrument.

Removing Broken Lyre screws

The removal of broken lyre screws is a common occurrence on metal clarinets since' the musician has a tendency to try and over-tighten the lyre in its socket. As long as the lyre is made of brass or German silver, it would have a tendency, when it is being forced, to snap at its weakest point. This is usually flush to the end of the lyre socket, at which point, it is quite tight and should be removed in the following manner: Using a Number 50 drill, drill a hole as close to dead center of the broken part as possible. The hole should be drilled to a depth of the body itself but not into the body. Place a Number 1 E-Z Out extractor (which has a left hand thread on a taper) in a tap wrench. Set this extractor in the already drilled hole, turn it to the left and as it starts to engage its own threads in the hole, it will take a firm bite on the broken part and unscrew it easily from the socket. Removal of the broken pieces from the E-Z Out extractor is performed by using a small pliers and turning the part to the right. If the hole drilled in the broken part is close to dead center, the broken piece will removed without any damage to the threads. The lyre can then be threaded further down its end so that the same lyre is still usable. On small lyre sockets on the brass instruments or on saxophones, the same procedure is followed.



Post drilling jig.

However, upon the removal of the broken part, the lyre screw would have to be replaced.

Rusted Rod Removal

Very often, through lack of oil, a rod becomes rusted in place. Before we can remove this rusted rod, we must ascertain whether or not the rusted portion so holding the rod and key is in the post that is threaded, the post that has a clear hole or in the tubular hinge of the key itself. If the rusted portion is in either one of the posts and not affecting the key, this becomes discernible due to the fact that although the rod would seem frozen, the key would move freely on the rod. If, however, when the key is being operated, we can see the ears of the screw or rod moving with the key, this is positive assurance of the fact that although the rod is free in both posts, it is frozen to the key. Since there are two different methods for the removal of these two types of frozen rods, we must take them individually in discussion. Removing or breaking the rust in either of the posts is quite simplified. The lubricant used to dissolve the rust can be a penetrating oil or “Liquid Wrench” works to best advantage in dissolving rust due to the fact that this is nothing more than the moisture taken from gas mains and it will dissolve oxidation. Rust is nothing more than oxidation of iron referred to as ferrous oxide. However, application of this material alone, although advisable, is insufficient. Light tapping with a dent hammer on the side of the post around the threads or the rod, while the post is placed against a flat piece of steel so as to eliminate any shock against the body, will cause the rust or corrosion to crack so that the liquid wrench can then dissolve it, after which the rod can easily be removed.

If the rod is rusted in the key, it is necessary to break the rust allowing the liquid wrench to dissolve the same before using a screw driver to remove the rod. To accomplish this, we can lightly tap the side of the key so that it moves slightly, along the rod between the posts moving it back and forth until such time as the key frees itself on the rod. Slight heat application in many instances is advisable. When the key is completely free, on the rod, the use of a screw driver will remove same. However, it is advisable not to use the screw driver until such time as you are completely sure that there is freedom of movement between the key and rod. In rare instances, the rod is so rusted that it is advisable to drill out this rod in preference to attempting to save it and the cost of the repairing, in time, is much cheaper by replacement of same. To drill out this rod, we must use a post drilling jig which allows us to drill a hole smaller than the diameter of the rod itself through the dead center of the end of the rod to a depth that passes the end of the post. Two different drill sizes are used in view of the fact that the threaded end of the rod has a smaller diameter than the head of the rod. This rod must be drilled from both sides so that the remaining portion in the post is nothing more than a mere shell. This operation is completed by placing a screw driver under the tubular hinge of the key and with a light prying motion, raise the screw driver. The thin shell left in the post will snap so that the key will lift out of the position. The broken piece in the key can be driven loose. The remaining shell in the front post can also be easily pushed out. However, the thread post should be rethreaded to the same size thread as on the remaining screws. This will either be a 1x64 or 1x72 on clarinet screws or a 2x56, 2x64 or 3x48 on saxophone screws. (For Rod Replacement, see the following article.)

Rod Replacement

In the event that rusted rods must be drilled out or rods be damaged to a point where they should be replaced, it must be done in the following manner: The size drill rod to be used should be a snug, smooth fit in the tubular hinge of the key. To determine the size thread to be used on this rod, we must measure the old thread with a micrometer and use our formula in reverse to determine the code number for the diameter of the thread. The formula is the number multiplied by 13, add .060 to give the diameter in thousandths of an inch. In reversing this formula, we take the micrometer measurement of the thread, subtract .060, and divide by 13. For example, assuming that a rod at the threaded end measures to .099 of an inch, subtracting .060, this leaves the balance of .039, dividing by 13 gives us a code number of 3. This tells us the diameter of the thread in code number. The number of threads per inch is determined by the use of a thread gauge. In the event that one is not available, your set of taps and dies would serve the same purpose. Most instrument repairmen have use for 2 sizes of the Number 3 tap, namely, the 3x48 and the 3x56. To determine which of the two is to be used, select either one and place it against the old threads so as to try and mesh the threads of the tap against the threads of the rod. The perfect number of threads per inch will mesh perfectly. The incorrect size would show itself by not allowing the threads to mesh. (See article on tap and die threading.') After we have determined the size thread to be used, the rod must be prepared to receive this size die. For instance, assume that the rod measures to .112 of an inch and the thread to be used is a 3x48 (this is usually the perfect size) To receive this 3x48 die the rod should be .099 of an inch. Therefore, we must not attempt to apply the 3x48 die over the end of the rod as long as that rod has a diameter of .112 since this will cause a tremendous amount of strain and would result in either breaking the end of the rod or hurting the die. Therefore, we must place the rod in either a bench motor or lathe and trim the end of the rod, usually by light filing, to a point whereby the diameter of the part to be threaded is reduced to .099 of an inch. The threads are then cut with the 3x48 die up to a point that has been trimmed to receive the same allowing the threaded end to be a little longer than necessary. Upon the completion of the threading process, we must remember to remove the final burr that is kicked up by the cutting teeth of the die in the final cut. This is done by drawing a file against the last thread lightly while the rod is being turned in the bench motor or the lathe. This is sometimes referred to as cutting a back lead. When this is completed, the rod is removed from the lathe and screwed in place in the post so that the final thread is completely engaged in the post. At this point, the front of the rod is marked as well as the threaded portion that will protrude from the back post. Remove the rod and cut off the excess at the points of marking. This may be cut with a diagonal pliers and finally the two ends of the rod are dressed smooth with a file. The final process in the completion of making this rod is the cutting of the ears of the screw. This can be done by means of a midget hacksaw or by using the screw slotting tool such as the one sold by many tool manufacturers in this country.

Clarinet Pad Charts

Not all clarinets take the same exact size pad. Therefore, we list for you a few of the more standard set sizes that you will encounter in overhauling clarinets. The average clarinet takes 17 pads in each individual set. However, a few of the sizes vary in accordance with the size of that particular key cup. This actually is one of the peculiarities used as a determining factor in ascertaining the make of the average instrument despite the many different names engraved there on. For instance, the Pedlar clarinet has 3 small size pads and these are: the C# G# key; the top ring F key; and the Bb bridge key. These sizes are 8 1/2mm. There are eight Number 10mm for the balance of the smaller keys on the upper joint. The three ring F key and F# trill key are larger than normal on this make instrument and they use a Number 13mm pad. The four larger pads are one Number 15 1/2mm and 3 Number 17mm. The peculiarities of this instrument to help you determine the make is based upon two factors; firstly, the 3 small pads on those 3 aforementioned keys and the larger size pads on the three ring F and F# trill key. Being able to tell the make of the instrument from the pads can be helpful because this also tells us the size of the pivot screws (2x56) such as described in tap and die threading article, and the fact that you have German silver keys to work with. This is true in either the wood, metal or rubber clarinets.

The Bettoney clarinet has its pad peculiarities in the fact that the register key accepts a number 8 1/2mm such as the top ring key. The C# G# key accepts the same size pad as the three ring F and F# trill key, namely, 12mm. The balance of the keys on the upper joint use 10 1/2mm sizes. Of the four big keys on the lower joint, the C and B keys use a No. 18mm pad. While the C# key takes the odd size of 16mm and the D# key a 151/2mm. The Bettoney clarinet is easily recognizable through these pad sizes.

The French type clarinet has the most simplified of all sets of pads in the fact that the only small pad on the instrument is on the top ring F key whereby it uses an 8mm pad. There are ten Number 10mm pads for the balance of the keys on the upper joint. There are two Number 12 mm for the three ring F and F# trill key. There is one Number 15 1/2 mm for the D# key and three Number 17 for the balance of the keys in the lower stack. When pads are bought in sets, these are the standard sizes of the average sets of pads. There are many brands of clarinets on the market. However, they will fall into one of these three categories. Your better brands such as Selmer, Buffet, and LeBlanc utilize the more standard set such as listed on the French type. However, many Italian imported clarinets have proven that they do not adhere to anything. The Czechoslovakian clarinet utilizes a half mm larger on the upper joint than the French type. The Rampone clarinet (one of the better Italian makes) uses pads approximately 1 1mm in size on the upper joint while the B and C keys of the lower joint run to the weird size of 20mm.

If the clarinet in question has an articulated B# of the modern variety, the pad size for the articulated key (such as on Buffet and Selmer, etc.) is 7 mm. It is sometimes wise to use a cork pad on these keys to eliminate any buzzy tones. If there is an articulated G#, the pad size of the average instrument is approximately IO 1/2 mm (such as on Buffet). Selmer's use an 11mm pad.

Clarinet pads (bladder) come in three varieties; namely, thick, medium and thin. The thin variety, sometimes referred to as Piccolo pads, must be completely floated in the keys; by this we mean filling the key cup with shellac and letting the pad lay on top of the shellac in such a manner as to make it appear as if the pad were filling the key cup without any shellac visible. The medium size pad must be half floated. The thick pads merely have to be shellacked in the key cup. To eliminate the swelling of such a pad, upon heat application, it is imperative to puncture a slight hole at the side of the pad so as to allow an escape hatch for the air under the bladder skin. If this is not done when the key is heated, the pad will have a tendency to blow up so that application of an impression in the pad will not be feasible. Very often, the center of the pad will tend to belly up. This happens due to the fact that the shellac does not actually come in contact with the felt of the pad but rather, it is usually glued to the cardboard back. On the small pads, this item is negligible.

However, on the larger size pad of the lower joint, this belly can cause us a tremendous amount of trouble and prohibits us from attaining perfect coverage and a solid feel in the seating of the pad. To correct this situation, it is sometimes wise to cut away a small portion of the cardboard back so that the felt of the pad is visible, thereby allowing the shellac to adhere to the felt. The LeBlanc Corporation of Kenosha, Wisconsin, has manufactured the Noblet pad which has a cut out in the cardboard for exactly this purpose. Clarinet pads are often made with single bladder skins. These pads usually leak directly through the skins since the single skin is quite thin and is porous. The better type of pad consists of a double skin wherein the two skins are actually glued together there-by bringing to a minimum the possibility of the leakage through the porosity of the material.

Brown clarinet pads can be applied without puncturing the skin since the kid pad is porous enough to eliminate the aforementioned troubles. However on the larger pads, removal of the portion of the cardboard to allow the shellac to hit the felt is also advisable. Pad sizes remain the same in either brown or bladder pads.

On many clarinets, the size of the tone hole may seem to be quite large in com-parison to the key cup such as usually found on the articulated G# and on the three ring F key of Selmer clarinets. To facilitate the seating of such a pad, it is wise to use a thin clarinet pad and float same in place. The difference between the brown and the bladder pad consists of good and bad points on both sides. For instance, if brown pads are used on a clarinet, they will have a tendency to give slightly muffled tone by comparison to the bladder pad. However, they not only last longer than the bladder pad since the covering is that much stronger but they eliminate all possibility of buzzy tones. Bladder pads give a more professional sound to a clarinet but do not last as long and may cause certain notes to have a buzzy effect. It is for this reason that if bladder pads are used in the overhaul of a clarinet, it is wise to apply a cork pad in the register key and sometimes on the top ring F key. (See chapter on correcting buzzy tones on clarinets.)

Cutting Clarinet Barrels

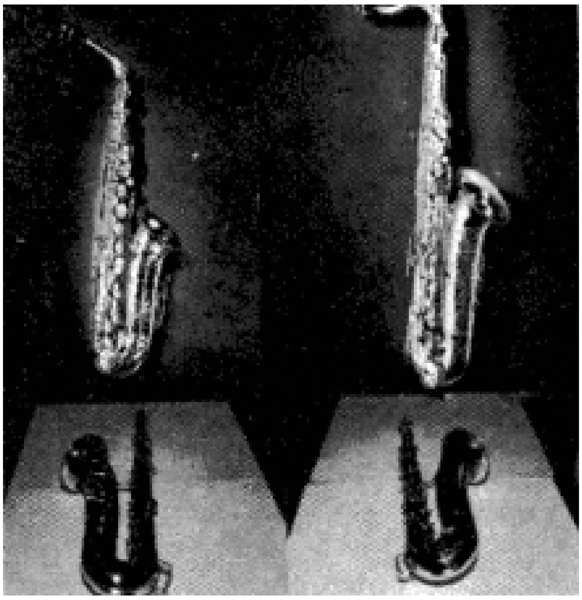
The average clarinet when manufactured, comes through with a barrel supposedly capable of setting the instrument at a pitch the equivalent of A-440. However, this is usually too long a barrel for the average musician and may sometimes have to be cut to allow the musician to tune slightly sharper. In cutting a clarinet barrel, we must remember that we must always cut from the mouth-piece side since this will allow the barrel to still retain its proper appearance. If the barrel were cut from the upper joint side, it would definitely show due to the fact that we would be cutting into the larger diameter of the barrel leaving an edge. To properly cut a barrel we must first remove the ring of the mouthpiece side, then placing the barrel in the lathe and centering the same with the dead center of the tail stock and while the tail stock is so engaged, cut the recess for the ring for as much as you wish to cut off the length of the barrel. Remove the barrel from the lathe and replace the ring driving the ring home to its new seat. Replace the barrel in the lathe with the tail stock engaged. Cut off the end of the barrel to a point where it is a perfect match to the edge of the replaced ring. The final process is to bore out the barrel to the perfect depth to receive the mouthpiece. To accomplish this purpose there are mouthpiece socket reamers which are more easily used than the boring tool on the lathe due to the fact that we do not have to worry about centering the barrel when using the mouthpiece socket reamer or whereas the only positive way to truly center the barrel for boring with a boring tool would be with the use of a four jaw independent chuck. If the mouthpiece socket reamer is used, the mouthpiece socket reamer is fastened in the chuck, and the barrel is held in the hand while the female tenon is so bored. The mouthpiece socket reamer cuts the perfect depth and diameter for the average mouthpiece. This tool can be purchased from any one of the tool companies. The final procedure is to dress off the burr at the very edge of the mouthpiece socket.

CHAPTER 4

SAXOPHONE REPAIR

Saxophone Explanation and Description

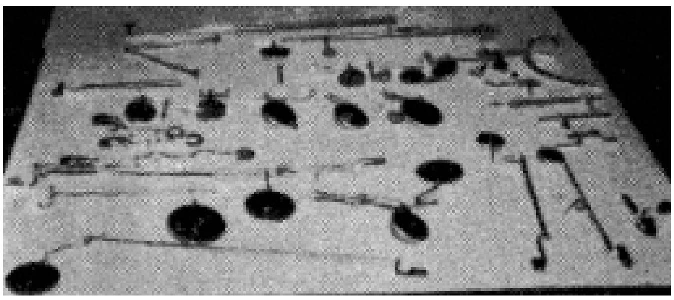
The saxophone is a comparatively new instrument in the musical instrument field. It is the youngest of all modern musical instruments. It is a conical bore instrument. In view of this fact, the saxophone is built in octaves as compared to the clarinet, which as a cylindrical bore instrument, is built in many keys or pitches to accomplish the needs of the composers for different sounds in various arrangements. The smallest saxophone is the Eb soprano. This instrument does not, as a rule,



Saxophone assembled and disas-sembled bodies.

go to high F as other saxophones would but rather the highest note is Eb in its own particular pitch. The next larger saxophone is the C soprano. Next, the Bb soprano. As we step into the alto line, an instrument that is very rare is the F mezzo alto. One of the more common instruments is the normal Eb alto. The next instrument in line is the C melody saxo-phone which is followed by the Bb tenor saxophone, the Eb baritone saxophone, and the Bb bass saxophone. There is a contra bass. However, this instrument is so rare that it can be called extinct. Of the afore mentioned instruments, the three most popular are the Eb alto, the Bb tenor and the Eb baritone.

There are peculiar instruments in the saxophone line such as the saxella which was put out by the King Company and is actually a Bb soprano saxophone. However, it was shaped differently from the normal saxophone so that it actually had a stand of its own with practically no curvature except on the bell flare and a curved neck so that it could be differentiated from the normal straight soprano saxophone. The soprano saxophone comes in either straight or curved forms. The difference between the two is not only in the appearance but rather in the sound. The straight soprano will have a much bigger sound in view of the fact that the curvature of the curved soprano has a tendency to be slightly muffled by comparison to the straight soprano since this curvature is responsible for disallowing the sound waves complete freedom of exit from the horn. There are such instruments as the straight alto saxophone. However, these are extremely rare. They were made by the Buescher Company. On today's modern saxophones, we find that many items have been added to facilitate the musician's articulation. For instance, the extra high F key which actually consists of a high F lever and a pearl tip lever allows an extra fingering of a note that is already there. The articulated G# allows the musician to easily make the change from either low B, low Bb or to G# without hesitation. To accomplish this end it needs merely a small extension under the spatula of the G# key that fits under the low B and C# keys so



Set of saxophone keys

that when either of these notes is ap-plied, the G# key is brought into play. More recently, some baritones have come forth with a low A key. This key is operated by the musician with the right hand thumb. The Mark VI Selmer

Saxophone has come forth with an extra high F# key. This key arrangement consists of a lever running parallel to the keys on the lower stack which operates a long key with its tone hole slightly above the high F tone hole. The saxo-phone is an instrument made of brass. It has, aside from its mouthpiece, a good goose neck or mouthpipe, separated and detached from the main body of the instrument. It is a single reed instrument and in effect is built along the lines of all of the reed instruments. There are many different makes of saxophones on the market. To properly discuss these different makes, we must take them individually.

Selmer

Many years ago, the Selmer Saxophone (Model 12) was actually an ad-vent for the musicians in this country. The Model 22 was the first improvement on this instrument since they eliminated the key arrangement of the side Bb key, modernizing it to match the present day system. The Model 12 utilized the A pad as a side Bb key allowing the spring tension of this key to keep the key closed whereas the spring tension on the A lever was strong enough to offset this key so that when the A key was applied, the A pad fell closed of its own spring tension and then could be operated manually by the finger top lever of the side Bb key. This allowed the Bb key to vibrate since its spring tension as a closed key had to be quite light, and allowed too much opportunity for lost motion due to improper cork adjustment, thereby giving the musician a terrible feel. With the advent of Selmer Super Saxophone, the fine quality of tone achieved by the Selmer Saxophone made it one of the finest instruments of our day.

The Cigar Cutter model gave the musician the Selmer quality of tone and eliminated the poor working octave key of the average Selmer Saxophone since at that time the Selmer saxophone had as its one fault the octave arrangement. This unquestionably made this horn the best horn on the market. However, the Selmer Balanced action and the latest Mark VI Saxophones are so far superior to anything put out in the past by the Selmer Company that it is not worth discussing.

Buescher

The Buescher Saxophone has made a few improvements from the old round G# model. Today's model still has the finest working octave assembly. The Buescher snap on pad was the first and original tone booster pad of all saxophones and anything thereafter has merely been a copy. The Buescher Company, at the present time, puts forth two saxophone lines with their name on them. They are the Buescher 400 and the Buescher Aristocrat. The Buescher 400 gives a different type of key arrangement which uses steel angles in grooved slots for the purpose of eliminating action of metal keys against cork. The low B and Bb keys are on the stack side of the bell, unprotected by guards. It is much more complicated in key arrange-ment than the Aristocrat model. It has a much larger bell than the Aristocrat and all the long rods are made of nickel silver to give more strength than brass which is a much softer material. It is the opinion of the writer that the Buescher Aristocrat Saxophone is an extremely well built horn insofar as sturdiness is concerned and this horn is to be considered as one of the top American brands.

The Conn Saxophone

The Conn Saxophone has long been one of the forerunners of achievement in the American music industry. Conn was the first to apply the extra high F key to a saxophone. The Conn Company will long be remembered for having the first tenor saxophone with a clear middle D and it was for this reason that the Conn tenor gained a worldwide reputation. The Conn Company, on its older horns, had reinforced tone holes by virtue of rolling the edge of the hole. However, on today's market, this point is eliminated. The octave assembly of the Conn Saxophone, modern as it may seem, uses the same principle as the Buescher octave in reverse. It is a well built horn and, at the present time, one of the top American brands.

Martin Saxophone

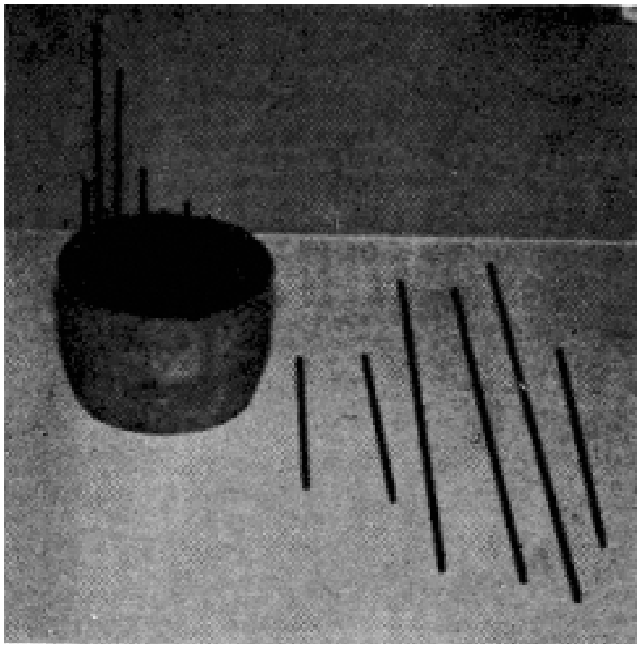
For many years the Martin Saxophone was nothing more than a student line instrument. By comparison to other instruments, it was old fashioned and out-dated. In recent years, when the Martin Company made its first major change in its saxophone styling, by bringing forth the Martin Committee Model Saxophone, the Martin Company took its place as one of the leaders in the field. This instrument had solid nickel silver keys on a brass body. It was completely modernized. However, the one old fashioned feature was its octave assembly. This instrument was an extremely fine horn. However, the tenor saxophone had a slightly muffled middle D. Today's Martin is practically a copy of the older model with a modern octave assembly and clarity has been achieved on the middle D of the tenors.

If ever there were changes made on saxophones, the Holton Company made them. What would normally seem to be changes for the better. made this saxophone in the past seem like a farce. The high Eb trill key put out by the Holton Company with the advent of their Rudy Weidoft Model was a museum piece. Their attempt of clarification of the middle D by the insertion of the C auxiliary tone hole was. without question, the worst key arrangement that could possibly be conceived by the minds of men.

Their G# trill lever was, without any doubt, one of the biggest mistakes ever made by any saxophone company. The insertion of an extremely long rod to hold the Eb trill lever and the high E key was undoubtedly a horrible mistake in saxophone planning. However, the more recent Holton instrument, although it cannot be considered among the finest in the professional field, has made such fine improvements that it ranges as one of the top instruments for the amateur student lines.

King Saxophone

The King Saxophone for many years had a reputation of being a soft sounding sweet tone instrument that no professional would use. It is what we considered to be a confidential horn. That is to say, only the person playing it could hear it. However, it has a arrangement with a hook system of engagement between the G# key and the G# lever with the trill lever built on the lower stack in such a manner that it was a virtual impossibility to keep the key in proper adjustment. It called for an extremely large cork on the G# lever in an attempt to remove the lost motion in the G# key. Evidently, this was one of the poorest examples of engineering that could be imagined. To try and clarify some of the octaves, tone holes in both the G octave and the A octave were drilled on an angle. Mechanically, this was supposed to allow clearance for the sound waves. Actually, it only allowed extra reason for improper appearance and leakage. For many years, the King Saxophone was not even considered by musicians. However, on today's market the King Super 20 is, in the opinion of the writer,


Screw block with sax rods and springs in order.

the only saxophone that can compare to the Selmer and it does this rather easily. It has full body and clarity and almost flawless intonation on every note. It is the most completely changed instrument on the market. Its design allows it being compared to any other instrument.

Some models come through with a sterling silver neck and bell. It uses small nuts to act as lock screws. It has rollers wherever there is sliding action on the horn to allow for better fingering. It is completely different in design, all of which is for the better. This makes it one of the finest saxophones of our time. The King Saxophone is equipped with tone domes or boosters built in each individual pad with a very similar appearance to the resonators on the Conn Reso pad except for the fact that some of them run slightly larger.

Other Makes

There are many other makes on the market such as the second rate horns or student line put out by the American companies heretofore mentioned. There is also the Buffet Saxophone which is, in effect, a complete innovation in the old Buffet which in simple description was a mess. The tone domes on the Buffet are built so high that it has the same effect as closing the action on a saxophone which can do very little good. The imported instruments such as the Kohlert, made good student line horns but they are in no manner comparable to the better' American makes. The SML put out by Strasser Marigaux LeMa ire is one of the heaviest saxophones that was ever built, and its tone and make up are certainly not in comparison with the price of the horn. We do not place this instrument in a comparative category of either of the better American brands or the Selmer.

Order of Disassembly

The disassembly process involves removing all the rods, pivot screws, springs, pads and felts so that the instrument can be properly polished. Most repairmen use a small block of wood (Screw Block) to hold the rods, pivot screws and springs. The only thing we can offer for your benefit is to use some kind of system so you will be able to find the proper rods easily when assembling. All key rollers should be removed prior to polishing.

The recommended order of disassembly is a simple system of "nearest to the top". In this manner, one can easily be able to pick out the proper rod from the screw block and replace it in its proper hole. A saxophone is two sided. The lower stack rod and all of the assembly immediately around it make up one side of the saxophone and the balance of the instrument is its opposite side. In this manner, replacement of all parts is facilitated. In disassembling a horn, all extra work on the instrument other than the normal overhauling should be done. For instance, swedging of keys, removal of rusted rods or removal of broken springs from posts; dent work and soldering should take place in the disassembly process so that upon completion of the disassembly the saxophone is immediately prepared for polishing and lacquering process.

Tone Hole Refacing and Soldering

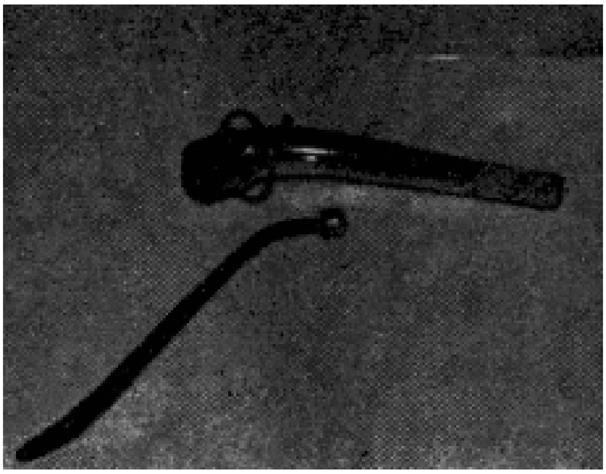
Tone holes in saxophones can either be damaged through dropping, denting, or in most cases, buffing by an over-zealous polisher. Tone holes that are damaged insofar as dents are concerned are usually brought back into round by driving the proper dent plug through the open hole so that it falls into the bore of the body. Nicks or marks on these tone holes are removed by letting the dent plug rest firmly in place in the tone hole and light tapping against the side wall of the tone hole would remove same. Sharp cuts on top of the tone hole have to be removed by hammering against such a plug, the tone hole resting between the plug and the dent hammer so that the metal stretches at that point to close up the sharp cut. However, these procedures, simple as they may be, do not constitute the bulk of the work for the musical instrument repairman insofar as tone hole repairing on the average saxophone is concerned. Musical instrument repairmen have always been plagued with cockeyed tone holes. The bulk of these are not caused by the musician, but rather by former repairmen and especially polishers who forget themselves. High speed buffing cuts down the instrument; a portion of the tone hole is cut away leaving us an extremely crude edge that can be called anything but level. To properly seat a pad on a saxophone tone hole, we have to have either a level tone hole or suffer through a deep impression in the pad. A new tool for leveling these tone holes has finally come forth on the market. In the past, repairmen have had to use their eyes, their hands and their imaginations to try and set these tone holes to a point whereby their work of seating was at least partly reasonable. Hand filing may bring us close to the truth but can in no measure whatsoever, give us complete accuracy. As a result, these small deviations cause small pinpoint leaks which will, in turn, hamper any decent musician in the performance of his job on this instrument.

The industry has been crying for many years for a design of a tool that would enable us to quickly and efficiently level the tone holes of a saxophone body so that easy pad seating of same could take place. Your writer has in his possession such a set of tools, completely and effectively designed so that leveling of all of the tone holes of a saxophone body regardless of how bad, becomes a ten-minute operation. It is important that we describe these tools so that the procedure involved in the use of these tools can be properly described. The tools consist of a set of circular files; this tool comes in four sizes. They have adjust pilots that allow them to hold their level in the tone hole socket. Mere overall description of the tool would be to call it a lollypop. The adjustable pilots are set up on a left hand and right hand thread arrangement so that these adjustable pilots can be set to match the tone hole merely by turning the handle of the tool. The perfect set of these pilots is to turn such a handle to such time as a pilot holds firm in the tone hole at which point, we release the handle slightly so as to allow for the fact that all tone holes are not a true concentric. The thumb is placed firmly against the top of the file which, incidentally, is a leveling plate to check the level of the tone hole after it is cut. With the thumb in this position, the handle is moved in quarter turns back and forth. The file teeth set on these tools are milled slots or edges on angles so that no chips can clog a file; as a result, you have no cleaning involved insofar as the use of this tool is concerned. The movement of the hand in this procedure is kept until such time as the tone hole is completely levelled. Checking for the level of this tone hole is done by reversing the file, the back of which is your leveling plate. Since these files come in four sizes, it is necessary to pick the proper size prior to performing the job. The hardness of these tools is 58-62 Rockwell. This, in effect, is to state that these files are so hard that cutting the brass would make it almost impossible for these tools to go dull; therefore, one can simply state that these tools are a lifetime proposition.

Many of the older instruments, such as the Buffet, the Holton and the Martin saxophones had soft soldered tone holes which had a tendency as the solder grew old and pitted to leak at the soldered joint. Dirt that would collect in these tone holes at its soldered seam. had a tendency to make it pretty rough to resolder these parts. In these cases, it is advisable to remove the entire tone hole and after leveling out the top edge, clean the parts and resolder as a complete job. However, small leaks do not require the removal of the entire hole but rather, clean the part that is to be soldered by scraping the inside edge and in some cases, dig between the tone hole and the body with a small tool so as to clean any dirt out. If there is still some dirt that might prohibit the solder from flowing smoothly, this could be burned clean with the application of heat and soldering acid. However, please remember in soldering these tone holes that solder will take its road of least resistance. Therefore, after the part is properly cleaned and prepared to receive the solder, the edge of the body on which the tone hole rests should be fitted as close as possible to the tone hole so that the solder can flow quickly and easily along the seams. It is advisable to apply the solder from the inside of the tone hole. This will enable one to get the best soldering job and allow for easy scraping of any excess solder. It is completely advisable, upon the disassembly of any horn that has soldered tone holes, to check for leaks prior to polishing and lacquering since any leaks that would show themselves after the horn is lacquered would put the mechanic in a bad spot for soldering up the same. The easiest way to check for this open tone hole is to hold the body of the instrument in front of any light and any leak would show itself by allowing the light to come through its opening. In the event that you have an open tone hole in a newly lacquered instrument and you do not wish to hurt the lacquer on this horn, it is sometimes possible to secure a small pinhole leak with the application of a material known as plastic aluminum. This only takes a short while to harden and it will secure any opening. This is only used in an emergency and should not be considered the perfect repair job in view of the fact that soldering of the tone holes is the proper method.

Dent Removal

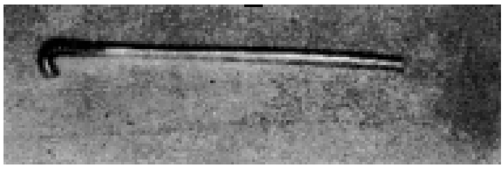
Prior to polishing and lacquering, the dent should be removed from a saxophone so that upon the completion of the polishing and lacquering job, the instrument can have its best appearance. Actually, large dents would impair the tone since they do change the bore of the instrument. There are four sections of the instrument that can be dented. They are: the goose neck, the stack section. the bottom bow and the bell section. In each case, the type of rod used for this dent removal is the basic determining factor. The dents on the neck are removed with a dent rod curved in the same shape as the neck. If it is a major dent so that the neck will have to be burnished, the rod



Dent rod for use on goose necks.

should be completely smooth for the burnishing process. If it is a singular dent, a raised ball end on the end of the rod works to best advantage. The neck has three sides insofar as dent removal is concerned. If the rod is placed in the vise so that its curvature faces to the right, one whole side of the neck can easily be straightened with the tool. (See chapter on Dent Removal with Rods.) By reversing the rod so that its curvature faces in the opposite side, the dent in the opposite side of the neck can be removed by setting the rod in the vise so it stands straight up from the jaws of the vise. The dents in the top curvature of the neck are easily removed in this manner.

One of the usual damages to a saxophone neck is caused by the musician bending the neck in a downward motion while putting the neck in the saxophone. This causes the bore of the neck to go into an oval shape with a large part of the oval being the two sides of the neck. To straighten this, we merely have to place a tight fitting rod in the bottom of the male tenon of the neck. Holding this rod in the vise, pull back very gently on the mouthpiece side of the neck with a slight jerking motion until the neck goes back into a true round. Absolute perfection is not always achieved even though it will return to its original shape. The neck may then have to be slightly burnished on the neck rod. The stack section of the body has its dents removed by using a rod of either 5/8 or 3/4in. diameter, the end of which is slightly raised by curving of the tip of the rod. It is important to remember that when using this rod to remove a dent, it is never used in a pulling motion but rather the dent is located above the rod and removed by a gentle rolling motion of the rod from side to side, never across the length of the body. Very often, dents can be pushed up even though they are under a soldered post on the stack section. However, when pushing up such a dent, it should be pushed by a steady application of pressure on the rod directly under the dent. Final rolling out of this dent should take place by rolling toward the post. Rolling away from the post will have a tendency to make the rod bounce there-by stretching the metal alongside the post. Very often the rod will not fit down the stack section of the horn due to the fact that the G octave tone hole protrudes into the bore of the body. It is advisable to unsolder the small tone hole and resolder it

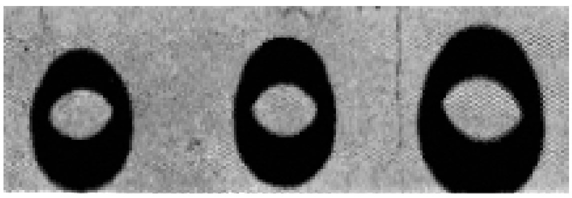


Dent rod for bottom bow of sax bodies.

upon completion of the dent removal.

If an instrument is extremely dented, it might be advisable to unsolder the stack section so that we can use larger mandrels from the bottom bore of the stack section. In most cases, however, under normal conditions this is not necessary.

The bottom bow of the saxophone has its dents removed by application of the dent rod through the D# tone hole. The end of the rod



Tone hole protectors when using rod.

should give as wide a curvature as possible and still be slightly raised above the balance of the rod so as to have the tip of the rod, Which is curved in the opposite direction, the foremost part so that the dents are removed at that end. It is with this rod that the dents are gently pulled up and with the use of a dent hammer, the metal lightly tapped into perfect position. We must bear in mind that the saxophone repairman has no chance of burnishing on this bottom bow. Therefore, this dent work must be done with gentleness so as not to stretch the metal and he must remember that patience is one of his finest tools. Sharp cuts can be removed by direct hammering on the cut while the dent rod is directly beneath same. When the dents are brought up and the shape of the horn kept by use of the dent hammer, the final finishing of this portion of the instrument is achieved by extremely light filing, emerying and buffing, bearing in mind the fact that the filing must take place following the contour of the part on which the dents are removed. A dent rod so applied as herein described will remove the dents up to that portion of the bell section so that the balance of the dents are removed through the opening of the bell. There have been many tools put forth for use on the bottom bow of the saxophone. Some of these tools have tone hole protectors for the D# tone hole.

The dents are removed from the bell section of a saxophone by using a rod long enough to reach the bottom of the bell and still have clearance of stack section against the vise. The end of this rod should be a large curve so that the best surface is achieved. This will continue the removal of dents at the back end of the bottom bow into the bell section. The curvature of the rod will allow you to shape the curvature at the bottom bow. In using this rod, it is wise to remember that these dents must be removed by rolling the instrument over the dent rod using the hammer to merely shape the instrument. Do not pull along the length of the bell. These dents must be removed by merely rolling each dent as an individual item. Do not try to remove more than one dent at a time regardless of how many dents there are in that portion. They must be taken individually. As soon as the dents are removed from the bottom curvature, it is then Wise to use a rod with a ball on the end of it, such as the ball holding rods described in all tool catalogs bearing in mind the fact that the larger the dent removal surface on a dent rod, the finer the dent removal. This rod can be used up to the outer flare of the bell. The outer flare of the bell is a burnishing job in the same way and manner as any other instrument.

Soldering Posts, etc.

Soldering on the different posts of a saxophone, as well as the flat spring tracks, differs from the soldering that is usually performed on other instruments, such as trumpets, trombones, etc. In this respect, when braces are soldered on brass instruments, it is not unusual to apply a little extra solder and remove the same by means of a scraper. However, the important thing to remember when it comes to soldering the different component parts of a saxophone is that the minimum amount of solder should be used in order to eliminate the possibility of scraping upon the completion of the soldering job. Furthermore, a particular point must be chosen at which the solder is applied, assuring ourselves of the fact that the exact amount of solder is used so that we eliminate the scraping procedures. This is done because of the fact that many posts are soldered so close together that if scraping were necessary, it would be virtually impossible to keep the soldering neat and clean. For instance, the posts that make up that area of the instrument which involves the high F, Eb, and D keys are so close together that it eliminates the possibility of clean work if the work has to be scraped. To accomplish proper soldering in places such as this, perfect control of the torch is necessary; in other words, while the heat is being applied to the part that is to be soldered, we must be certain that the overflow of heat does not heat any other part and we must also apply the solder from that point where-by any excess is most easily removed. When applying the solder, the part should be heated and the flame slightly moved so that the heat of the part will melt off a slight speck of solder. The flame is then moved back into position to allow the slight amount of solder to flow out evenly. If this is an insufficient amount of solder, the process should be repeated with particular care in watching the opposite side of the part that is being soldered so that we allow the solder to perfectly flow to exactly the point that is desired. If there is any excess solder, it would then be left at the point of application. To remove this excess, we barely heat the soldered part to a point whereby the solder just begins to soften and with a light flick of a scraper, we remove the excess. This will easily come off. When this excess has been removed, apply another drop of soldering acid to the soldered part and gently reheat the part. This soldering acid will cause the solder to flow smoothly. The minute it does flow, the torch should be removed. This will give the type of soldering job that eliminates the need for cold scraping. Before the second post is soldered in place, the area, surrounding the soldering job should be completely polished either by hand or on the buffing wheel since, when the next post is put on, we will not be able to properly clean between them.

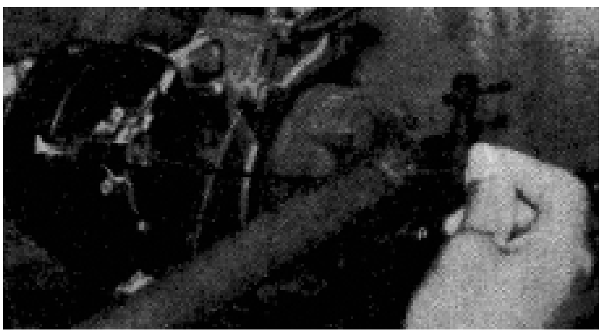
If a post is to be soldered on in the middle of many posts, the smart trick is not to heat the body hut rather to heat the top of the post until such time as the solder at the bottom could melt. This will concentrate your heat in that area surrounding the post itself, thereby not allowing the other parts to come loose. In the event that soldering is done on an item such as a post on a lacquered instrument, it is wise to buff the lacquer off the post thereby eliminating the possibility of burnt lacquer on the post. Now by following the procedure as previously described, we can solder this post to the body without burning the lacquer on the body. Touch up lacquer on the post is easily accomplished with a small brush. Lacquer in such a place can be touched up without being visible due to the fact that there is a definite break of contour from the post to the body. Warm scraping is a complete help when soldering where the elimination of regular scraping is desired and this can be useful not only on the posts of the saxophone but on extremely large braces as well, such as the bell brass of a saxophone, Sousaphone, etc. The whole idea of warm scraping is to actually apply a little too much solder to the point that is to be soldered and as this solder flows into place to remove the excess, by , reheating the part to a point whereby the solder is barely warm, yet soft enough to be removed with a straight scraper. A little practice can make one quite proficient at this. However, we must remember that after the part has been warm scraped, a drop of soldering acid must then be applied and the part reheated to allow the solder to flow out smoothly.

It is a smart trick to use the different rods on the' saxophone to hold the post in the proper position and, if at all possible, eliminate the use of binding wire since binding wire tends to pull the post out of alignment whereas the use of the rod itself will have a tendency to hold the post in the proper position. The easiest solder to work with while performing the job of warm scraping is made up of 50 percent tin and 50 percent lead. It is commonly referred to as 50/50. The first number always refers to the tin content. In other words, if we have solder that is 60/40, it means that 60 percent of the solder is pure tin and 40 percent lead. There are many fluxes on the market; however, the best type of flux for our type of work is made up of 60 percent glycerine and 40 percent muriatic or hydrochloric acid. The muriatic acid is actually deadened by the association of glycerine. However, it retains a sufficient potency to allow it to work as mere soldering acid. Many mechanics prefer muriatic acid killed with zinc. If this is to be used, it is prepared in the following manner: For as much acid as you wish to make, you merely have to add zinc metal to it. This will release the hydrogen gas from the hydrochloric acid. The zinc will be eaten up in the process. Continually add zinc until you see no more reaction taking place in the solution. Upon the release of the hydrogen gas, it will leave us a solution known chemically as zinc chloride. This solution is a perfect soldering flux. However, it will be quite dirty upon the completion of the release of the hydrogen gas.

To clean the solution so that it can be used as a solder flux, we must strain it through a piece of cheesecloth. This flux then works equally as well as the mixture of muriatic acid and glycerine. There are many solder pastes on the market, such as Kester solder paste or Nokorode. This paste should be used only where chrome plating is involved since muriatic acid is a perfect strip for chrome plating. We must remember that we never use solder acid on chrome. As a result, we must definitely use the paste and even though it makes for a greasy job, the greasiness is easily removed without damage to the chrome plating.

Very often, we may find, when disassembling a saxophone, that the stack posts are not in perfect alignment and it is sometimes easier to resolder such a post in preference to hammering it into alignment. This does not require the complete removal of the post for remounting. Instead, push the rod through the post and apply a small amount of soldering acid around the complete base of the post. Gently heat the post to a point whereby the solder melts. You will hear a slight snap as the post pushes itself into its proper position. This allows the spring tension of the rod to accomplish the alignment of the post for you. (See Post Alignment.)

In the event that the saxophone is so damaged that it becomes necessary to dismantle the body for the purpose of removing dents, it is wise to remove all traces of solder from both sections of the body. This allows us to more easily fit the parts back together. Upon the completion of the dent removal when the body is placed in its proper position for remounting, the soldering flux should be placed completely around the joint that is to be soldered. When applying the heat to this joint to remount the body, we must be careful not to allow the overflow of heat from the torch to heat any portion of the instrument other than the part that is to be soldered. In this way, we eliminate the possibility of any of the other parts falling off. Please bear in mind when soldering a body joint that the force of gravity can be used to good advantage. In other words, do not try to make solder run uphill but it will easily flow in any joint if you hold the instrument in such a position as to allow the solder to flow downhill. In this fashion we can achieve a much neater job.



Using a lathe to spin a long rod thereby causing centrifugal force to straighten any bends.

Heat alone does not cause the solder to flow. When solder at a certain point seems stubborn and refuses to flow out, it is wise to remove the torch and put another drop of soldering acid on the part and reheat. We must bear in mind that the solder flux serves a dual purpose. Firstly, it keeps the part clean and secondly, it causes the solder to flow. Heat alone is insufficient.

Post Alignment

Proper alignment of the post is a necessity insofar as having a smooth or easy feel on the assorted keys of a saxophone. To bring the post into proper alignment, we must lightly tap it to the position desired. However, in many instances, it might be necessary to use a dent rod to roll the post in an upward fashion from the inside of the body. This is done by using the stack rod that we will normally use for removal of dents. (See Dent Removal, Stack Section.) In some cases, it becomes necessary to re-solder the post in its proper position. (See soldering posts, etc.) We must remember that two points determine a straight line so when the rod goes through the first two posts and leans slightly to the left side of the third post, it is not always the third post that must be tapped into position, but it might be the first post that might have to be tapped in that same direction, thereby allowing the rod to straighten itself insofar as the third post is concerned. It might also be the second post that will have to be tapped in the opposite direction to properly align the rod to the third post. If the rod is a good deal out of the way, it might possibly require a little tapping of each post. This is taken from the standpoint that the posts are out of line side to side direction. However, if the post would seem to be perfectly in line and the rod tight fitting in the post, this is usually a sign of the fact that the post that is causing the bind is out of line by either being bent forward or backward. A light tap-ping in either direction will show you which way said post is bent. If the post is tapped in one direction and it seems to bind even more, merely reverse the tapping procedure. This must be done by trial and, error since it is virtually impossible to discern with normal eyesight.

The proper alignment of the post is an absolute necessity since posts that are out of line have a tendency to cause the rod to take a bend while going through them. Should this happen, it disallows a smooth feel on the keys affected by this post so that even though the keys and the rods are perfectly straight, they would not work perfectly, thereby giving the mechanic and the musician a completely bad feel.

Straightening Bent Rods

Drill a hole in a block of wood the same size as the diameter of the rod. Chuck the rod up in the lathe or a slow speed motor. Insert the rod in the hole in the block of wood. Hold the wood at the extreme end of the rod away from the chuck. Turn, on the lathe. Move the wood block up to the chuck but hold the far end of the rod between your fingertips. Twist the block slightly and draw it gently away from the chuck. When the block has travelled to the far end of the rod, turn off the lathe or motor while still holding the end of the rod in the block. Centrifugal force will spin the rod straight. Sometimes it is necessary to reverse the rod and repeat this procedure. The important thing to remember is: Never let go of the end of the rod while the lathe or motor is turning. This is dangerous since centrifugal force will cause the rod to whiplash and it will come twisting around like a knife blade. However, there is no danger if you hold the end of the rod at all times.

Smaller rods can be tapped straight while lying on a level steel block by rolling the rod against the steel block to a point whereby we can see light beneath the rod and the level block so that the high spot of its bend is on top. A light tap at the apex of the bend will tend to straighten the rod. If this is insufficient, repeat the procedure.

Rusted Rod Removal

Unlike the rusted rods on clarinets, the saxophone presents a much easier problem in removal of these rods, in view of the fact that it is sometimes much easier to unsolder a post and thereby easily remove the rusted rod.

The post is resoldered using the rod to hold the proper alignment of the post. (See Post Alignment and Soldering.) It is wise to attempt to remove the rod in the same way and manner as described in rusted rod removal on clarinets. However, if the rod does not come out easily with this procedure, do not waste time but rather unsolder the post; it is much simpler.

Rod Replacement

Rod replacement on saxophones is completed in the same way and manner as on clarinets. However, the average saxophone uses two sizes of thread. The larger rods use a 3x48 thread. The diameter of this thread is .099. The small size keys use a 2x56 thread. The diameter of this thread is .086. The Selmer, Buffet and other imported makes of instruments use foreign threads and it is sometimes wise, in rod replacement on these instruments, to change the metric thread to our American sizes to facilitate your work. This will not hurt the instrument in any manner, shape or form, but it will allow you to perform your job easily. If these threads are to be changed, it is wise to change them to these thread sizes: on the large rods, 4x48; on the small rods, 1x72, the diameters of which are .112 and .073 respectively.

Spring Removal

(See chapter on spring removal on clarinets.)

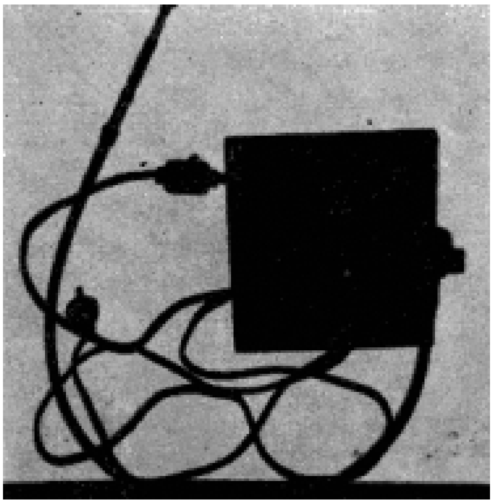
Key Swedging

(Removing Lost Motion)

(See key work, clarinet swedging and key extension.)

Very often when disassembling a saxophone the removal of lost motion is easily accomplished by movement of the post. If there is a rod that holds a key to these posts, the elimination of key swedging may be accomplished by moving the post forward in the following manner: With the key in place and the rod engaged, heat the post to a point where the solder melts and gently tap the post into position. This will maintain the alignment and eliminate the lost motion. When there are pivot screws involved, the posts merely have to be tapped together. The Conn saxophone utilizes the patented lock screws so that in most cases the lost motion can easily be removed by sending a pivot screw in a little deeper and locking it in the proper position. This is accomplished by sending the pivot screw into a point whereby it actually binds the key. Release the pivot screw gently to a point where the key is free moving without lost motion. At this point, tighten the lock screw. The King Saxophone (Super 20 Model) uses small nuts to accomplish the same end. Removal of lost motion on solid hinge rods can also be accomplished by counter boring the post so that the pivot point screw can go deeper. (See page on Clarinet Key Work.)

Norton Springs



Norton flexible shaft drill.

The Norton spring is, in the opinion of the writer, the finest spring ever made for saxophone or clarinet. It is a rare occasion when these springs are used on clarinets. In the past, many years ago, the Norton springs could be applied to any instrument. At the present time, they are only found on the Buescher Saxophone. These springs consist of two types. One type is made of piano wire that is gold plated. The second type is blue steel. Of the two, the piano wire is the preference of the writer. The purpose of these springs is to allow the mechanic the privilege of using any diameter spring he wishes for any given key to allow him to receive the most even spring tension in any post. This is accomplished because of the fact that these springs do not fit in different size holes but rather each spring hole is the same size and these springs are screwed in place by virtue of the fact that each spring hole is a threaded hole, with a 3x48 thread. Clarinets use a 2x56 thread. To apply these springs, we merely choose the size we desire for the particular key. Screw the, spring in place so that it is firmly in the post. Set the key against the spring and cut the proper length. It is for this reason that we do not prefer the blue steel spring since in applying the blue steel spring, we might have to cut off the needle point. Since it is this needle point on a blue steel spring that gives us the perfect feel in a spring tension of the key, we would thereby be defeating the spring's own purpose. To Nortonize a saxophone, we must use what is referred to as the Norton drill. This consists of a small motor with a flexible shaft and a drill handle shaped as a number 7. This allows us to get between the posts so that the old hole can be drilled out with a Number 47 drill. However, in view of the fact that there is already a spring hole in the post. We cannot use a twist drill. For this purpose, the Norton Company sells special drills to fit its machine. This special drill not only fits and can be locked in the drill handle of the aforementioned drill but more important, it has straight flutes so that it is actually a drill reamer combination. If a twist drill was utilized to do this job, it would have a tendency to rip, thereby causing too serious a strain both against the drill bit and the drill holder and would undoubtedly break the small gear into the head of the drill. When the post has been drilled to receive the thread, it is necessary to use a ratchet tap holder in order to eliminate the necessity of a complete turn on a tap holder. To allow us to get between the different posts in the smaller spaces, the Norton Company sells its 3x48 taps in long and short sizes. Likewise the drills come in long and short sizes. The Norton spring is so flexible in view of the fact that it is made of piano wire, that it could easily be called indestructible.

Belly band at neck unsoldered

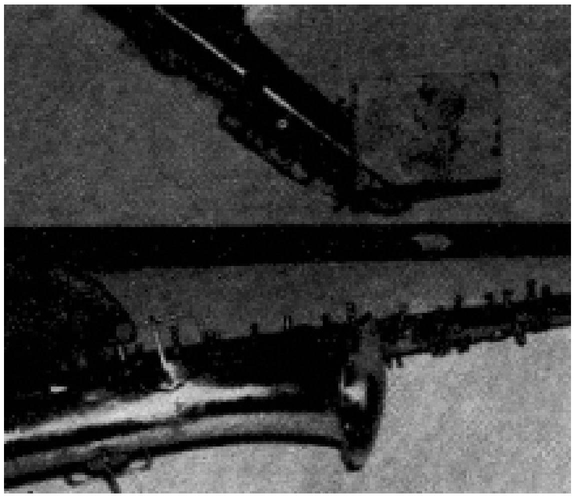
Neck Fitting

Very often the male tenon of the saxophone neck becomes loose fitting in its female tenon socket. This neck can be tightened with either the saxophone tenon expander or by use of the Thompson tenon expander. The old fashioned method for accomplishing this job was to hammer the neck tenon lightly while it was placed over a steel mandrel, thereby causing the metal to stretch to a point whereby upon the elimination of any hammer marks, it would be tight fitting in its socket. The old fashioned method was doing it the hard way. If a neck is not tight fitting, it could cause a serious leak on a saxophone. In many cases, however, it is merely a question of the fact that the neck screw does not tighten the neck. In such cases, it is sometimes smart to cut the slot in the female socket so that there is more room for tightening the neck. However, on instruments such as a Buescher, Martin, Holton, Selmer, etc., where the female neck socket has its tightening screw built on a separate band, it is wise to remove the screw and check the soldering of this band. This band has a tendency to become unsoldered due to the continual force that is applied against it by the neck screw. It is virtually impossible to tighten the neck in its socket if this band is Un-soldered. This is a common occurrence. These bands should always be checked on every saxophone that is to be over-hauled, prior to polishing and lacquering. If the band is loose, remove the screw and bend the band away from the body of the instrument. Properly clean the parts to prepare it for soldering. When these parts are clean enough to receive the solder, put the band back in place holding the band in position with the neck screw so as to allow a small opening between the two ends of the band. At this point, resolder the band. This will usually allow you a sufficient amount of room for tightening of the neck screw.

In many cases, the screw will actually bind in its own thread to a point where-by one cannot tighten the screw sufficiently even though the ends of the band are not sufficiently close together to warrant your being unable to tighten the neck. This is simply cured by removing the neck screw. Apply a little grease to the screw and replace it. When the neck screw is retightened, hold same with a pair of pliers and, in a gentle motion, gradually force the screw a little tighter, working it back and forth. This will ease up the tension in the threads so that the screw can then be tightened easily by hand. Remember this procedure is only used when the ends of the neck band show us that there is still room for more tightening. The average neck screw on the modern instrument uses an 8x32 thread. On the older Buescher instruments, a 6x40 thread was utilized.

Guard Repair

Very often the saxophone guards which surround or enclose the D#, low C, low B and low B b keys become either damaged or broken at the silver solder joint through dropping, bumping, etc. The particular damage displays for us the type of repair necessary. To facilitate the explanation of these different repairs, we must take them individually. For instance, if a guard is bent, it merely has to be straightened without being unsoldered from the body. In straightening this guard, properly brace the

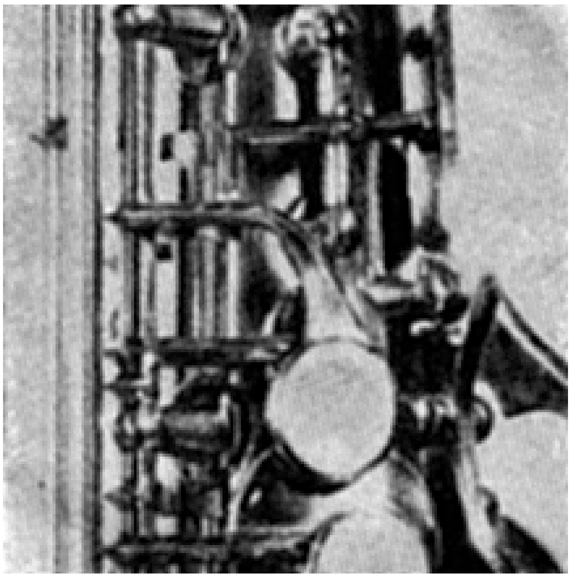


Top: Using asbestos to reflect head so that guard can be silver soldered without removing it from the body.
Bottom: Fitting guard plates.

guard prior to hammering same so that it comes back into its proper position. To brace such a guard, we merely have to hold a heavy piece of steel at the base of the guard in the opposite direction of which the guard is to be struck. The opposite side of the guard is then hammered with a rawhide mallet until the guard assumes its normal position. If the center of the guard is bent down, this is brought back into position with a heavy flat nose pliers applied in such a manner as to bend the guard back to its normal position. In the event that a guard is broken from the body at its soft soldered joint, it is sometimes wise to soft solder this guard back into position so that the plate fits the old solder joint. Straighten the guard as previously described. In some cases, straightening of the guards is done prior to soldering. However, in most cases, it is advisable to solder the guard to the body first and hammer it back into shape later. In the event that the plate of the guard accepts the break and silver soldering of the guard wire to the plate becomes necessary, it is done in one of two ways. The first way would be to remove the entire guard, silver solder the plate to the wire and replace the guard on the saxophone, soft soldering same into position. However, a simpler method would be to bend the wire of the guard approximately 14 of an inch of the body, remove the old plate and cut a new piece of brass to match the same. Place a small sheet of asbestos on the body under the guard wire. The new plate is placed against the asbestos sheet and the guard wire bent down firmly against the plate so that the guard wire acts as its own jig. In this manner, the asbestos sheet will act as a protector and not allow the heat to hit the body but rather, will reflect practically all of the heat applied to the job that is to be silver soldered. Upon completion of the silver soldering, remove the asbestos sheet and soft solder the plate to the body. If the job is done in this manner, it is not only easier and quicker but it also eliminates the job of trying to line up the three points of the guard. In many cases, the cross section of the wire of the guard breaks at its silver soldered joint. To repair this, bring the wire back to its proper position, place a piece of asbestos under the wire at the break and silver solder same. The asbestos will achieve, heat reflection and tend to speed up the operation. Finishing of this type of work requires merely ernerying and buffing. This type of repair eliminates the three soft soldering jobs necessary in mounting a guard.

Pearl and Socket Replacement

Pearls on a saxophone are usually worn out by the musician who, through sweat and constant use, actually wears down the pearl socket. In so doing, he wears away the pearl. These pearls are made of sea shell. As a result, they do burn and in the replacement of a pearl socket, it is easier to burn up this pearl and replace it with a new one that will fit the new socket, than it would be to try and save the old one. To replace the pearl socket, the key must be heated red hot since the pearl sockets are silver soldered in place. When the key is red hot, the pearl socket merely has to be pushed away. New pearl sockets are available and can be purchased from any supply house. They are merely silver soldered in place. Replacing the pearl in the new socket



Extra high F key and levers.

is definitely simplified by virtue of the fact that these pearls are set in the same way and manner as any jewel. That is to say, they use no adhesive but rather, the top of the edge of the pearl socket is burnished or hammered to fit over the beveled edge of the pearl. The fact that the new pearl socket was heated red hot in the process of silver soldering causes the pearl socket to be in an annealed state. This, in turn, facilitates the setting of the pearl. These pearls can be set with a special tool which, when placed against the top of the edge of the socket and tapped lightly, will tend to shrink the top edge of the pearl socket so that it presses firmly against the pearl, holding the pearl very solidly in place. In the absence of these tools, the same job can be accomplished with the use of a dent hammer and extremely light tapping against the edge of the pearl socket. We must be careful in the use of any method of setting the pearl not to strike the pearl since the pearl is quite brittle and will have a tendency to chip. The high luster is brought to the pearl upon the completion of the job through the use of the buffing wheel and any white lime compound. The pearls used on the keys of a saxophone are indented to fit the balls of the fingers. However, the pearl used on the left hand thumb rest under the octave key is rounded on its top to allow for the rolling of the musician's finger against the thumb octave. The replacement of the pearl socket for the left thumb is merely a soft soldering job against the body. The type of socket retainer used on Conn saxophones is that of tubing. On Buescher saxophones, etc., the back thumb socket is actually solid brass. Therefore, when soldering this type in place, it is wise to apply the heat directly to the socket so that the heavy piece of material will become warm enough to receive the solder. The Conn thumb rests are usually sent through with their pearls already in the socket. In the event that it is necessary to solder this one in place, we suggest that when the thumb rest is placed against the body a protective cap, such as a key cup, big enough to cover the entire pearl be placed over it before clamping it to the body and the heat application be against the body rather than the socket. In soldering any type of socket to the body, please bear in mind that the overflow of heat is not actually lost, but it will have a tendency to heat any part in its paths. Therefore, when applying the torch at the part, apply it in such a position as to allow the overflow of heat to completely bypass any other portion of the saxophone. The extra high F assembly is a combination of two keys whereby the finger tip key presses down the B key and C key of the upper stack and opens the High F key. This is not to be considered a true tone of the instrument. It is a false tone that comes fairly close but can never be perfectly in tune. Its finger-ing is in conjunction with the C fingering of the saxophone so that actually the musician is playing the note A and opening the High F key, thereby forcing an overtone which is the equivalent of High F. The finger tip key presses a lever which in lowering one side of the lever raises its opposite end which is placed under the high F key. This arrangement was first put on a saxophone by the Conn Company many years ago. They were the leaders in this field. It is done for the purpose of allowing better articulation in the change from a High C to a High F. However, in recent years through the use of this fingering, musicians have been able to apply other fingerings that allow them to go far beyond the actual registers of the horn. If an extra high F key is on the saxophone, it eliminates the need for a cork on the foot of the B key since the B key of the upper stack will use the felt on the pearl tip of the high F finger tip key for its stopping action. The F finger tip key not only requires the felt under its pearl tip but a 1/16" cork on its foot. The lever it presses against requires a 1/64" cork at its point of contact to the F finger tip key and a 1/64" cork at its point of contact to the high F key. In view of the fact that this entire arrangement is based upon sliding action. it is advisable to oil both places to receive a smooth feel in the operation of this key. The insertion of an extra high F assembly requires the fitting of the finger tip key in the upper stack section of the saxophone which may necessitate the shortening of the length of the tubular hinge of the B key. The auxiliary lever is merely held in place by its two posts soft soldered in its position between the C key of the upper stack and high E key. The adjustment is such as to allow a slight amount of lost motion before the high F key is actually raised. This assures us of the fact that the high F key will remain in a closed position thereby not causing a leak.

Automatic Octave Replacement from Double Octave

The double octave key assembly consists of two separate octave keys where-by the musician had to actually change his fingering as he went past high G# to high A. The automatic octave allows the musician to keep his thumb in a stationery position whereby the octaves change in conjunction with the use of the G key. Very often, we are faced with the replacement of the double octave on a baritone saxophone which would still be worth a good deal to either the musician or the dealer if the octave assembly were changed. On any other type of instrument, the application of the different octave keys by soldering the posts into proper position would be all that would be necessary. However, on a baritone saxophone, it requires a different operation. Before these keys can be applied, it becomes necessary to change over the curvature at the top bow of the neck so that it faces in a completely opposite direction thereby allowing us the necessary room for the rod removal on the upper stack. In changing this bow, it necessitates changing the turn that holds the neck socket to its opposite position thereby completing the absolute turn of the top assembly. When this portion of the job is completed, the octave is changed over by replacing the keys in this manner. Since the double octave does not require any extra use of the G key, the G key consists of merely the pad, the finger tip and foot for stopping action. It becomes necessary then to bridge an extension from the G key to the top of the horn and apply a tubular hinge at that point so that an arm can be built off this tubular hinge to contact the G octave key. In view of the fact that this arm resting against the G octave key that gives the G key its stopping action, we must eliminate the foot at the bottom of the key near the pad. One extra post is necessary on the upper stack which will allow room for a G octave key so that the G octave key becomes part of the upper stack. The arm of the G octave key should rest under the G key. The auxiliary lever or teeter key of the octave assembly is then put on by soldering two posts in position so that the lower arm of the teeter key rests on top of the arm built on the G key. The top arm of the teeter key is in such a position as to contact the A octave on the neck. The thumb octave key is applied by soldering two posts in position where-by the arm of the thumb octave key must contact the teeter key and the G octave. The thumb tip is brought into position directly above the thumb pearl socket. (For regulation of these keys see chanter on Octave Assembly and Regulation.).

Straightening Bent Keys

Remove all the oil from the key and rod so that a proper touch may be felt. Insert the rod in the tubular hinge gently until you feel the key bind. Mark the distance. Insert the rod in the opposite side of the tubular hinge until you feel the bind. Mark this distance. The two marks will overlap. The center of the overlapping is the point of the bend in the key. The direction of the bend is easily determined by pushing the rod through the hinge to the opposite end of the hinge. The side of the hinge that the rod favors is the point of contact. Using a dent hammer, strike a light blow at the point of the bend on the side or point of contact. If necessary repeat this procedure. On double hinge keys, straighten each hinge of the key in the aforementioned manner. Next, using pliers, bend the arm extension of the tubular hinge so that the rod lines up with the hole in the opposite hinge. Place the rod in the opposite hinge and repeat this procedure.

Key Corking

The first procedure in the preparation is to cork the entire set of keys. The size of the corks is definitely determined for you without guesswork. Merely follow these rules: If the key hits the body and the cork is used for a stopping action, use 1/16 inch (thick cork). This will allow you plenty of room for trim so as to remove lost motion later on. If the key requires a cork for sliding action against another key, use 1/64 inch cork (thin). This prevents one key from digging into the cork of another. Very few keys are used for both purposes at the same time. These keys require 1/32 inch cork (medium). An example of the latter is the extended arm of the F# key of the lower stack. It is used for stopping action on the G# key and it must slide over the arm of the Bb bis key of the upper stack. The fingertip Spatula of the low Bb key is another example.

To do a neat job in the corking of these keys, remember never to put the shellac in the flame. Let the heat of the key melt the shellac. This will prevent you from applying too much shellac. To prevent the shellac from sticking to the side of the key, making a sloppy job, squeeze the cork against the key as it is cooling off. To cut these corks, I advocate the use of a single edge razor blade. The cutting stroke should be toward the key in a downward motion so as to eliminate the possibility of pulling or breaking the cork off the key. It is important to try to cut the edge of the cork in a straight manner. Do not bevel the ends of the cork. Beveled corks on the feet of the stack keys tend to lose their solidity and act as smaller corks. Felts should be applied in the same manner while corking. Don't heat the pearl when applying the felt.

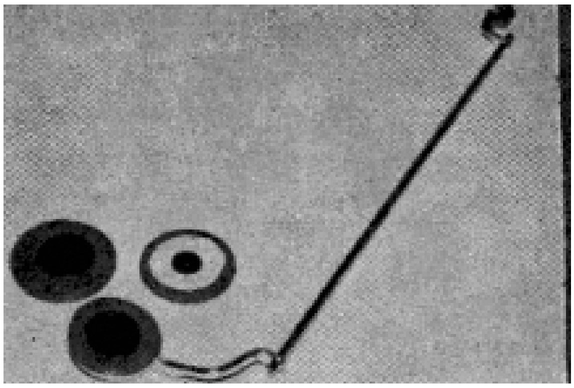
Padding with Regular Pads

Padding with regular pads is actually a simplified job which consists of heating the key over the flame until the metal is warm enough to receive the shellac which is used as the adhesive on pads. We must be careful not to burn the lacquer when applying the hot shellac. The shellac must be spread evenly in the key cup. The pad is then placed in the key cup so that all of the edges of the pad are definitely in the key cup and not resting over the top of the key edge. Turn the key cup upside down and press the pad against any flat piece of steel or jewellers anvil so that the pad sinks a little lower in the back than in the front, the sides being equal. The pad surface should be as flat as possible while maintaining the back of the pad at a lower level than the front. This allows for a better and easier pad coverage by virtue of the fact that the key is on an angular hinge and does not move straight up and down when approaching the tone hole. Therefore, we would more often than not come closer to better coverage prior to seating thereby facilitating the job of the repairman. We should remember that when picking out the pad to fit the key cup a firm snug fit is advisable since a loose fitting pad will allow room for excess shellac to run out of the key cup thereby allowing for a sloppy job. The average pads are made of woven wool felt, a thin cardboard back and tan kid skin, riveted in the center so as to hold the center of the pad firm, thereby dis-allowing the pad to accept a belly.

Padding Special Pads:
Conn Reso, Buescher Snap On, Tonex, Etc.

The Conn Reso pad does not follow the rule previously mentioned concern-ing the back of the pad being lower than the front but rather, the pad should be even all the way around the key cup. The Conn Reso pad is made as any other pad with one exception; there is a metal ring around the outer edge of the pad under the kid skin. This metal ring when fitted to the proper key cup sits on the top edge of the key cup. This pad will hold firm in a key cup without shellac, since the kid skin will hold the pad in place. However, it is advisable at all times to shellac these pads in place and when shellacking them in place, we must remember that since these pads are actually held in the key cup in a suspended state, it is advisable to hold the center of the pad down firmly against the hot shellac in the key cup to eliminate the bellying of the pad. These pads by virtue of the metal ring have a tendency to tear easily since any tool placed against the edge of this pad will act as a second jaw of a scissor and rip or cut the pad covering. At the present time, even the Conn saxophones do not use the metal ring. In seating these pads, difficulties can arise (see Pad Seating). The Buescher Snap-On pad is made of the same material except that there is a metal plate instead of a cardboard at the bottom of the pad. There is a hole in the pad allowing the room for the snap button to be engaged against the male stud of the key. This eliminates the possibility of a belly on the pad. However, it is almost impossible to move this pad to cover a tone hole when seating in the same way and manner as any other pad. Therefore, different measures have to be taken to make these pads cover (see pad seating). Although this pad can be held in place firmly by the use of a snap button, it is advisable to shellac this pad in place always, since a loose-fitting pad together with a loose-fitting button would actually cause a leak underneath the pad even though the top surface of the pad covers the tone hole perfectly.

The Tonex pad is a pad made up of a series of layers of material consisting of cardboard, paper, rubber and leather. All of these materials are glued together to form one solid



Selmer tone boosters applied to pad.

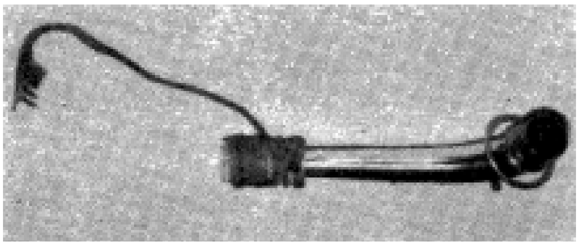
sheet. The pad is then punched out and application of these pads is done in the same way and manner as regular pads. However, these pads have a tendency to receive a very deep impression; nevertheless, their covering is such heavy leather that they will unquestionably outlast any pad on the market. They are of the same material as the ring that is made for the padless saxophones put out by the Selmer Company in the early forties. These are pads such as the Acoustivex pads put out by the Micro Company. Despite the fact that they have tone-domes built in the center of the pad, they are applied in the same way and manner as regular pads except that we must press the edges of the pad into the key cup with our fingers rather than pressing the entire pad against the steel block.

Inserting Selmer Tone Booster

Since the innovation of the Buescher snap-on pad which proved beyond the shadow of a doubt that a metal disk in the center of the pad will have a tendency to increase the tone power by virtue of sound reflection rather than absorption, every company has been striving to build resonator disks in their key cups or pads. The Selmer tone booster is a simple plate that is attached to each pad individually by means of a screw and washer through the back of the pad. To apply this, it is necessary to remove the rivet in the center. of a regular pad and punch a small hole directly over the old rivet hole (assuming that the rivet was in the center). The tone booster is picked out according to the size of the tone hole and not the pad so as to allow for complete clearance of the tone booster in the tone hole when seating the pad. They are applied to the pads prior to insertion of the pad in the key cup. The pads are then put in the keys in the same way and manner as described on the Acoustivex pads. (See Padding— Special Pads.)

Spring Alignment

When replacing the spring in a saxophone or for that matter, in any instrument, there are a few simple rules, to remember: Rule Number 1; the spring faces toward the tone hole for which it operates. For example, the spring for the G key must face toward the G tone hole. The determination of whether the spring 'is toward the top of the saxophone or toward the bottom depends upon the placement of the post as in comparison to the tone hole. Rule Number 2; if two springs are in one post, the longest spring faces towards the tone hole furthest away from the post. Rule Number 3; spring tension is determined by whether or not the key is either in an open position or closed. If the key is a closed key, the tension of the spring is applied so that the spring is bent away from the tone hole; for example, high E key. If the spring is for an open key, the tension of the spring is applied so that the spring is bent toward the tone hole. It is important to remember that in the use of needle springs, the point of the needle spring gives the most even tension. Therefore, when cutting the spring to size, the spring should be measured so that the very point of the spring rests directly on the spring hook. In applying the spring, we must remember that no spring can give its proper feel unless it is riveted firmly into the post. To assure ourselves of the fact that this situation holds true, merely pluck the spring .with your fingernail and if it is firmly

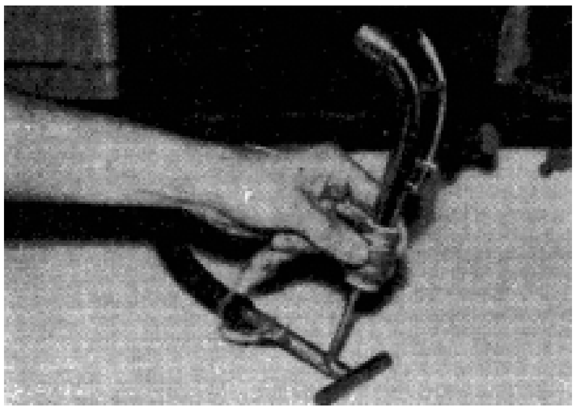


Cork tied on neck for heating.

in the post, it will give a musical sound. If it is loose in the post, it will give a metallic rattle in preference to a clear tone. If necessary, remove the spring and rehammer the end. (Described in page on needle springs clarinet repair.)

Corking of Necks

Saxophone neck corks are best put on in the following manner:



Applying flame inside neck to melt shellac to cause cork to adhere.

1. Apply stick shellac to the neck approximately 1/16 " short of the length of the neck cork

tube.
2. Fit the inside diameter of the cork tube to the neck by filing with a rat-tail file so that the cork is as snug a fit as possible.
3. When the shellac on the neck is cold, insert the neck in the cork tube as far as the shellac has been put on.
4. Tie the neck cork on with regular brown twine tightly making the winding of twine close. Make certain that the hack of the cork is tight to the neck.
5. Apply heat with your bunsen burner in the small opening of the neck.
6. When the neck is hot enough, the shellac will start to ooze out the back. Wipe off the excess shellac while it is hot and with a twisting motion, move the neck backward enough to cover any lacquer damage.
7. When the neck has cooled off, remove the twine and trim the cork to size.
There is a machine sold by all of the tool companies referred to as a cork turning machine. The use of this machine is simply explained in the fact that the saxophone neck is held on an arbor and while a sanding wheel is turn-ing with the aid of a motor, the neck can be turned up close to the sanding wheel and then easily revolved so that it cuts the neck cork perfectly true and even. This machine is quite expensive and it is only advisable in such instances where many neck corks are being ap-plied. The cork can be cut to size with a file and finished with emery cloth.

Pad Seating

Apply heat to the key cup allowing the shellac to soften. This will enable you to move the pad to a point of perfect coverage. This point of coverage is set with the help of a leak light. Do not squeeze the impression in the pad when the key is too hot since this may cause the pad to shift off at this point. If a pad is lumpy, it can be ironed out by dampening the pad and applying a warm piece of flat steel to the moist pad. After seating the pad, cork it up with a cork or wedge as long as possible. The longer it remains closed, the better the seating will be.

On some of the special pads such as Conn Reso and Buescher Snap-on pads, it is sometimes hard to receive a proper seating in the pad. In rare instances, to soften the pad to a point where it will accept an impression, a trick can be used. This trick consists of applying denatured alcohol to the pad by dampening a rag wrapped around your pad slick so as not to touch any portion of the lacquered instrument while wetting the pad. Moisten this pad evenly, then press the key firmly closed and cork it up with a cork or wedge until such time as the alcohol evaporates. If the pad is wet evenly, it will not show any discoloration lines or stains but it will return to its natural color. However, it will receive an excellent seating. This is sometimes used to very good advantage on the Conn Reso pad where heat application would tend to loosen the center of the pad from the key cup thereby creating a belly in the pad.

Saxophone Assembly (Order)

I recommend a specific order of assembly as follows:
1. G# key (Lower stack)
2. Bb bis key (Upper stack)
3. Low Bb key
4. Side C lever key
5. Entire upper stack
6. Entire lower stack (before seating the pads on the lower stack, put on the G# lever key and attach the spring. This holds the G# key closed and does not allow it to interfere with the feel of the F# key of the lower stack.)

All other keys may be put on as you. see fit. When we say put a key on, we mean to have you seat the pad at that time. When the instrument is completely put together, uncork the keys and proceed with the regulation as follows:

Upper Stack Regulations

1. Regulate the back bar of the C key to the B key by raising or lowering it, (on Conn Saxes, reverse this procedure).
2. Regulate the A key to the C key by raising or lowering the entire arm of the A key.
3. Regulate the A key to the Bb bis by tilting the pearl tip up or down.

Lower Stack Regulations

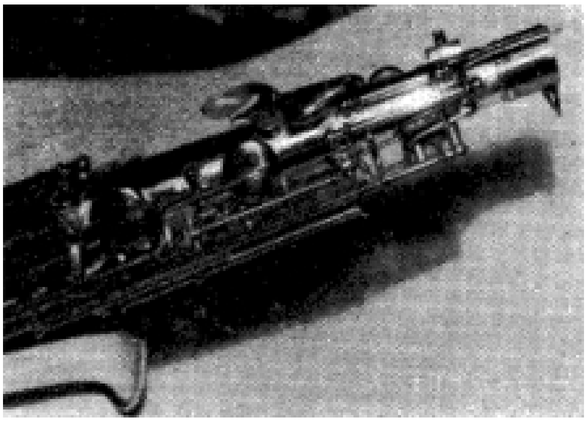
1. Adjust the arm of the F# key to the G# key.
2. Adjust the arm of the Bb bis key to the arm of the F# key.
3. Adjust the back bar of the F# key to the F key by raising or lowering it.

4. Adjust the E key to the back bar of the F# key by bending the foot of the E key up or key or as the case may require.

5. Adjust the D and the E keys. In the adjustment of late models where there is no back Eb key, the D key is adjusted to the back bar of the F# key in the same manner as the E key.

Removal of Lost Motion

The first thing to remember is that we cut or add corks to remove lost motion. We bend keys to regulate. All the lost motion on a saxophone may be removed by cutting four corks. First, cut the cork on the foot of the F key to bring its opening to the desired height. Next, cut the cork on the foot of the D key to eliminate the lost motion between the F and F# keys. (On late models, the E key cork must be trimmed in the same manner.) Trim the cork on the A key to eliminate the lost motion



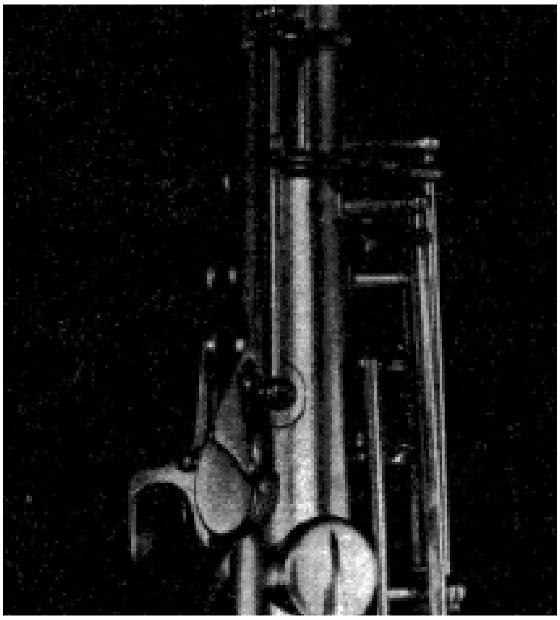
Old style octave assembly.

between the Bb bis key and the F# key. Trim the cork on the B key to eliminate the lost motion between the A key and the C key. On late models, there is no need for a cork on the foot of the B key since the cork on the extra high F fingertip lever takes its place. It is important to follow this sequence.

Octave Spring Regulation

There are two important points of regulation of the octave assembly. They are Spring Tension and Octave Regulation. Since there are separate rules to follow in each specific instance, we are listing the rules in that manner. Regulation of Spring Tension must come first.

1. G octave key—as light as practical
2. G key—Heavy enough to close the G octave key without hesitation
3. Octave lever key—Same tension as the G key
4. Thumli Octave lever—Heavy enough to operate the octave lever without delay



New style octave assembly.

5. A or neck octave key—Light enough to be operated by the octave lever.

Octave Key Regulation

1. The G octave key must cover the tone hole but not hit the body in any other place.
2. The G key must use the G octave for its stop and not hit the body.
3. There must be a hairline of lost motion between the octave lever and the body. The octave lever must not touch the body.
4. When the G key is closed, its far end must come up to touch, not move, the octave lever.
5. When the thumb octave key is applied, the octave lever must come down to touch the G key without any lost motion in the feel of the thumb octave key.
6. There must be a small amount of lost motion between the octave lever and the A octave key on the neck.

Late model octave assemblies require very little regulation. The spring of the G key must be heavy enough to offset the spring of the A octave key. The regulation is also simplified. Holding the G key closed, apply the thumb octave key, while holding the octave lever with the right hand. The G octave key should come up to touch the G key without lost motion in the thumb octave key. There must be some lost motion between the octave lever and the A octave key.

Saxophone Bumper Application

On most saxophones, the saxophone bumper can be easily held in place by means of soft shellac. However, on the later Conn models, no shellac is used but rather the bumper is applied by pressing the edges of the bumper retainer so that they firmly clip the bumper and hold the same in place. This, likewise, holds true on the old handcraft model of the Martin saxophone. The latest model Martin requires the bumper to be held in place in the guard rather than on the key by means of hard shellac. The bumper retainers on the Selmer saxophone are removable and should be removed before applying the bumper which is held in place with hard shellac. The bumper retainers make the height of the bumper adjustable by virtue of its threads. However, we must bear in mind that when putting the retainer back in place or removing same, be sure that the screwdriver used is fitted into the solid section of the retainer and not into the spit section of same. If these retainers are loose fitting, they will cause a buzz or a rattle. To eliminate this before returning the retainer to its original position, spread same by lightly forcing the screwdriver into the split section. The old type Buffet saxophone requires for its bumper a piece of cork placed around the key guard. In many cases, in preference to putting a piece on the guard, it is easier to merely shellac the bumper to the key. It actually looks neater, is easier to apply and works better. The height of the bumpers on the B and Bb keys should be such as to eliminate any lost motion between the B key and the G# lever. Likewise, through the use of the bumpers, we eliminate the lost motion between the low Bb and low B keys. In many instances, the height of the bumper may cause imperfect intonation. This can usually happen when the bumpers are so big as to hold the key too close to the tone hole. It is extremely rare that an imperfection in intonation will take place if the bumper is too small. Bumpers come in three sizes, large, medium and small. The small type is used on the old Holton and Martin saxophones. The large type fits the Selmer saxophone perfectly. The medium size is the average bumper that is used. It is advisable to maintain the same color scheme on the bumpers as on the felts.

Improving the Middle D on Tenor Saxes

Many tenor saxophones in the past have had a muffled tone on the Middle D. This is caused by the lack of escape hatches for the sound waves; that is to say that when the sound waves come to the bottom of the horn, not all of them could get out of the C tone hole and bell. Therefore, many of the sound waves, upon striking the bottom bow of the saxophone, were reflected back through the body of the horn, thereby killing some of those which might have been free. This results in a dead tone which very often sounds flat to the human ear. To clarify this tone, it becomes necessary to add another opening at this section of the horn to allow more sound waves to free themselves. The closest key to the C key that can be opened to allow this to take place, is the C# key. Therefore, if the middle D is to be a sustained note, it is sometimes advisable to open the low C# key. This will suddenly make the tone jump and become twice as full. However, on some saxophones, it may have a tendency to make the notes sound slightly sharp. On your later models, this is not necessary since the middle D has a sufficient amount of clarity. This is extremely advisable, however, on the older tenors.

A key arrangement can be put on this type of instrument to cause this to happen automatically so that the musician will have to do nothing more than merely play his horn. This calls for utilizing the spring tension of the C key in a heavier action to offset the spring tension of the C# key so that the C key when opened, by virtue of its own spring would hold the C# key in an open position and when the C key is pressed down, it will release the C# key so that the C# key falls closed of its own spring tension. The connecting bar between the two keys must be built so that there is an extension off the C key that rests under this connection bar and an extension off the C# key that will rest under the opposite end of the aforementioned extension bar. The post setup for this extension will consist of the head of a post placed at the inside base of the C guard and the post built on the stack section of the body to match the height alongside of the low D key. The height of the opening on the C# key can then easily be adjusted by bending the extension key. The height is set so as not to impair the intonation of the middle D. This key will not only tend to clarify the middle D but will also give added resonance to the middle D as well as the low D and E.

General Information on Specific Makes and Models of the Saxophone Buffet

The Buffet saxophone (old model) had no bumper retainers (see chapter on saxophone bumpers). It had three extensions built from the low Bb and low C# keys. These extensions are fitted over and above the lower stack keys so that these fingerings can be manipulated from the stack section. The back Eb key was built over the low D key so that the tone hole for the back Eb key make the D pad look like a doughnut. The fingering for the Eb in this particular case was such that it allowed for a faster trill from E to Eb, than could be had with a conventional fingering. This key is obsolete and has not been used for years. The extra high F key on this particular instrument consisted of one rather than two keys. It was so poorly working by virtue of the fact that it did not lift the high F key a sufficient amount that it was discarded by the factory. The tone holes on this particular instrument were all soft soldered in place and as a result, were positive causes for leakage. The side rods consisted of screws with heads. This was primarily for the purpose of elimination of lost motion in the keys by forcing the posts together through tightening of the screws. The tone holes of this particular saxophone were thick-walled and it made the instrument a tough job insofar as seating the pad was concerned. The key cups were extremely thin and when picking a set of pads for this type of instrument, it is necessary to pick a pad one size too small and then hammer the pad so that in becoming thin, it becomes a perfect fit in the key cup.

Holton

The Holton saxophone originally had soft soldered tone holes on its older models; a poor extra high F arrangement very similar to that of the Buffet. The high. E key rather than being on pivot screws had a rod through a split tubular hinge and the split section consisted of a high Eb lever key which operated a high Eb trill key fitted directly over the high C key of the upper stack.

To try and clarify the low D and middle D of their instruments, the Rudy Wiedeoft model of the Holton saxophone had a C auxiliary key (see saxophone explanations and descriptions). The Holton saxophone on the old model had an adjustable neck receiver which eliminated the need of a neck cork when using that model mouth-piece put out for that horn. It has a metal lined mouth-piece with a tightening assembly such as on the neck socket. The sleeve it fits on tightens down on the neck in the same way and manner. The G# trill key was split in two parts to allow for a G# trill lever which rested alongside the lower stack and raised the G# key.

Buescher Saxophone

The Buescher round G# alto saxophone had a tendency to bubble or waver the tone quality on the low B. This only happened when the instrument was not turned to a perfect A-440. This is, of course, assuming that the instrument was covering perfectly. The later model Aristocrat alto or tenor has two points that must be taken into consideration. The bumper on the low C key must be cut to its absolute minimum to eliminate the dead wavering tone on the low D. If the bumper is left too high, the tone will break despite the fact that the instrument covers correctly. The action of the instrument must be sufficiently open or the middle C, high C and high C# will have a tendency to sound flat. Actually, to clear this up, the high B key will have to be more open. In so doing, it will cause lost motion between the B and C keys. To eliminate this lost motion, the action of the entire instrument will have to be opened. Therefore, it is wise to remember that we cannot hurt the tone quality of an instrument with an open action but we can impair the intonation with too close an action. The Buescher octave key (late model) has for its extension point to the A octave, a small screw with a 3x48 thread. Rather than the use of cork, we advise the use of spaghetti (wire covering). The Buescher 400 utilizes steel angles for circular side motion in preference to sliding action of cork against brass. These angles are center undercut steel bent at right angles. They must be completely oiled to eliminate noises. The Buescher saxophone requires the use of Norton springs. The tone holes of this instrument are drawn and therefore can never leak. The Buescher 400 model uses German silver solid hinge rods for more tensile strength.

Conn

Most popular of the Conn saxophones is the Coun Tenor on today's market, since on this instrument, there is practically nothing that can go wrong. Their octave arrangement is similar to the reverse working of the Buescher octave assembly. It is extremely wise to remove all rollers from this instrument prior to corking keys near same since the rollers are not made of pearl but rather are celluloid. On the old Conn saxophone, the rollers were pearl and if a rust mark became visible through the rollers, the easiest way out was to crack the rollers since although we may remove the rod, the rollers will crack anyway. Replacement of such rollers is advisable. The side C and side Bb keys have a tendency to have lost motion between the levers and the keys. This is eliminated by pressing the fork ends of the said keys to a close fit to the levers. The Conn saxophone has lock screws which are used to set the pivot screws into perfect position and hold them firmly in this position so that it eliminates the lost motion that can occur between the posts on solid rods. These small lock screws are a 1 x 64 thread. The old steel Conn pivot screw used in conjunction with these lock screws had a straight stud whereas the later models have a pointed stud. The regulation points on the old style saxo-phone correspond to the regulation points of others. However, in view of the fact that the small C key on the Conn Alto has a one-piece rod from the back bar to the key cup, it is important to remember that any attempt in bending the back bar will have a tendency to bend the key cup so that it will eliminate true coverage. Therefore, in regulating the upper stack, the important factor to remember is that under no circumstances should the C key be bent to match any other key. The Conn saxophone in recent years has come forth with one model that is completely adjustable. That is, the regulation points are set without bending of any keys. The bending of these keys is eliminated by virtue of the fact that there are adjusting dials which are turned to the proper position and locked in place by means of the aforementioned lock screws. The height of the keys of this model is also set and the lost motion removed by means of the same type of dial set up. The octave assembly is of the modern variety and works on the same principle as the Buescher octave key. (See Octave key regulations.) The low B and Bb keys are separated from the low B and Bb, levers and the adjust-ment between them is also set by virtue of the same type of dials. These models had rolled tone holes. Later models have eliminated the rolled tone holes in preference to the straight edge. Although not strong, these tone holes are easier to work with from a mechanical standpoint. Side posts of the Conn are separated and its individual posts have simplified removal of rusted rods since a single post can be unsoldered, unlike the Buescher and Martin saxophones, which have both side posts silver soldered to the same band. On the later models, the right hand G# lever key is a separate attachment, the set of which must have a slight amount of lost motion. There was one model of the Conn saxophone that had a double tube at the neck socket with the tightening screw placed on the neck in preference to the body. This model had the octave key on the neck working in reverse, that is, the octave key was placed on the bottom side of the neck in preference to the top. As a result, the arrangement of the octave assembly was like-wise reversed so that the octave lever pressed the key down to open it rather than lifting it up. The actual regulation is the same. On the more expensive models of the Conn saxophone, the finger tips of all the keys are sterling silver plates which were silver soldered to the brass keys. The pants guard is a four pointed removable item held in place by lock screws. The bumper retainers merely clip the bumpers to hold it in place and no adhesive is necessary.

Martin

The most important feature to remember about the Martin saxophone is the fact that the tone holes are not drawn but rather they are individual pieces soft soldered in place.

The edges of the toneholes are beveled. In the event of damages to this instrument, the repair job becomes much more simplified due to the fact that the tone hole can be removed. The present octave assembly of the Martin saxophone is regulated as any other modern octave key (See Octave Regulations) The A octave on the neck utilizes a double spring since the spring that operates the key is so long that it will have a tendency to bend in the middle thereby leaning against the neck. To eliminate this bend, the second spring is put in place over the first. The second spring is much shorter and its sole purpose is to hold the first spring in its proper position. The spring screw that holds this spring in place is a 1 x 64 thread, which is 13 thousandths larger than the normal spring screw which has an 0 x 80 thread. Therefore, should this spring screw break, the average spring in your spring assortment would not fit over the same type screw since the hole would be too small and it is sometimes advisable to drill a new spring hole in the key with a Number 56 drill and rethread this hole with a 0 x 80 tap after which we can use standard equipment. The neck on the Martin saxophone does not have a neck screw similar to other makes but rather, the neck itself must be extremely firm fitting in its socket and the screw used by the Martin Company is merely for the purpose of holding the neck in one position but does not, in any way, tighten the socket around the neck. It is extremely important on the later models of Martin saxophones to use cork in preference to pads on the two octave keys since the opening of both of these keys does not allow for a deep impression such as may sometimes occur on regular pads. One of the models of the Martin saxophone had a pants guard that slipped around a post on the stack section of the body and was held over the lower guard with two screws each set through the bumper retainers. It is important to assure ourselves that this clip is held firmly in place so there can be no lost motion between the posts and the pants guard so as to eliminate any buzzy sound that might come from it. The G# lever key on the later models utilizes a reversed spring tension where-by a thin spring is placed on top of the lever so that the end of the spring rests on the G# key. Actually, the spring is only put into use when the G# lever is applied. This, in effect, allows for a slight tension of the G# key which is easily offset by the spring tension of the G# lever. However, when the G# lever is applied so that the G# key is completely released, it has the effect of doubling the tension of the G# key so that it helps to eliminate the possibility of the G# pad sticking to the tone hole. It uses the same principle of spring tension as the Selmer Company uses on its C# key. The rollers of the Martin saxophone are celluloid. Therefore, it is important to remember to remove these prior to corking the keys. The Martin pivot screw is a pointed screw with a 3 x 48 thread. However, the latest model Martin saxophone now uses straight studs similar to the Buescher pivot screw except that the head of the screw is the same size as the old Martin screws. The old Committee model Martin had German silver keys on a brass body thereby giving us a two-tone job. Your present models are all brass with some German silver solid hinge rods for strength. One of the danger points to watch out for is that on your later models, the instrument is virtually weakened by the height of some of the posts which extend much further from the body than the older models.These posts are rather thin insofar as the diameter is concerned. Polishing can easily cause such a post to bend. The elimination of lost motion on a solid hinge key, assuming that the posts are in proper alignment, is achieved by counter boring the posts to allow the pivot screw to go in further. There is a tendency to have lost motion between the levers of the side C and side Bb keys. This is eliminated by pressing the fork ends of the side C lever and the side Bb key so as to allow for an absolute minimum of lost motion between the levers and the keys. The Martin Company puts out a pad that does have a tone booster. However, this tone booster is a sheet of brass that is riveted to the pad. Therefore, they are not replaceable in other instruments. The thumb rest of the Martin Committee model is a removable and adjustable type. To eliminate any trouble with this thumb rest, it requires three corks on its bottom. All three are 1/64” cork. A small amount on each side and some in the center eliminates the possibility of rattle or buzz when the instrument is being played. To prevent the thumb rest from falling out completely should the lock screw become loose, a 0 x 80 screw (flat spring type) is placed at the top portion. This eliminates the possibility of the thumb rest falling through its side. The later Committee model uses the same type of pivot screw to hold the pants guard in place. HOwever, one model of the Martin Saxophone had a C# so badly out of tune that it was necessary to bring the high C# back into pitch. The G octave arm of the thumb octave lever was built whereby it joined against a small extended arm of the C key of the upper stack. The adjustment is such that when the octave is applied, it lowers the small C key of the upper stack to a point whereby it is half closed. This had a tendency to flatten the high C# so as to correct the faulty intonation of this model.

There is one model of the Martin saxophone that has removable guards and these are held in place by means of small screws which are the same size as the Martin pivot screws without a pointed stud, One of the important things to remember when repairing this instrument is that thin pads are most advisable. However, these pads should be a firm fit in the key cups. If a thick pad is used, the key will have a tendency to hit in the back. Bending of these keys to eliminate this improper fit will have a tendency to bend the key cups. If thin pads are used, repair of this instrument is quite simple since the part will practically fall in place.

King

The old King saxophone had an octave key tone hole that came in from the side instead of the dead center of the stud. As a result, in order to make a pad cover, we had to put an extremely deep impression in the pad so as to allow the pad to curl around the octave stud to a point where it would close or cover the hole. The purpose of this was to allow the air passage to clear the key when the key was opened so as to eliminate the possibility of a dead tone in the use of the octave. A smart trick to eliminate the extra labor and the sloppy type of work that would have to be performed to make the pads cover these holes is to file the top of the stud. In this manner a pad can easily be seated over it with a neat appearance. The G# key on the old models worked at the hack end of the instrument and had to be such that the spring tension of the G# key was heavy enough to offset the reversed spring tension of the auxiliary lever. The G# lever key (finger tip) had to be heavy enough to offset both of the other keys. It engaged itself to the G# key by means of a hook placed against an equivalent hook of the G# key. This proved to be one of the most foolhardy arrangements of a G# assembly. On the later models, the King Company has eliminated this adjustment and at the present time, they now adhere to the more conventional method. The flat spring tracks of the old King saxophone consisted of not only a brass track but a small piece of steel rod through the track so that the flat spring rested on the small piece of steel. The C key of the upper stack was built in the same way and manner as the C key on a Conn saxophone. Therefore, in regulating the upper stack of the saxophone, we must remember not to bend this key. Although the King saxophone does not have drawn tone holes on the older models, they are not removable since they were silver soldered in place. The more recent models of the King saxophone have made complete and absolute changes so that the present model cannot even be compared with any portion of the old King saxophones. The Super 20 comes in two models, one of which has a sterling silver bell with gold inlaid in the engraving and sterling silver neck. The second model is all brass. These instruments have pearl tips which are removable on every side key that the fingers hit. These pearl tips should be removed prior to polishing this instrument. In the event that it becomes necessary to replace one of these pearl tips, it is wise to remember that we cannot use a conventional tap in threading the holes in these pearls but rather, we must have a special tap known as a hacked-off tap. This tap is such that only the cutting edge remains. The high spot on the tap and the back portion of the threads on the top are relieved so that there can be no strain or rub as this tap cuts its way through the material. If a conventional tap is used, it would undoubtedly crack the pearl. The lubricant used with these taps should be turpentine. The octave assembly, although of the modern variety, uses small metallic sleeves held in place by small screws so that these sleeves will actually roll on a key, thereby eliminating the need of sliding action. However, they have a tendency to be somewhat noisy. Other silencers used on this instrument are of the spaghetti variety, in other words, plastic tubes. To achieve lock screws on their pivot screws, they utilize a small nut as a locking nut against the post on the end of the pivot screws that extends through the back of the post. The set of these is arranged by first setting the pivot screws and then holding them in place with the screw-driver while the small wrench is used to tighten the nut at the back. The hinges of this instrument are German silver while the key cups are brass. The King saxophone uses its own tone boosters which are not replaceable into the next pads. The low B and Bb keys are on the opposite side of the bell and the major problem in the repair of this instrument consists of removal of noise by virtue of perfect fit on the keys plus sufficient lubrication and the removal of lost motion so as to eliminate a bad feel.

Selmer

The old model 12 of the Selmer alto saxophone had a completely different side Bb key. It operated by using the A key of the upper stack as a side Bb key equivalent. To operate this assembly, it required the side Bb key built as one separate key whereas the key cup was placed in the same position as normal A key on any other instrument. However, instead of having a heavy tension on its spring such as the side Bb key requires, this key had a fairly light tension on its spring whereby an A lever key on the stack section utilizes an extremely high heavy spring tension to offset the light spring tension of the side Bb key. The proper adjustment on this model is to make the adjustment between the Bb bis key of the upper stack and the small C key of the upper stack through the operation of the A key pearl. The adjustment between the side Bb key and the Bb bis key was such that when the Bb bis key hits the tone hole, it should just allow us a sufficient clearance for the side Bb, key to close by virtue of its own spring tension without the feel of lost motion. At its best, this type of adjustment was quite sloppy and was immediately changed on the next model of the Selmer saxophone. The Selmer octave key on those models followed the normal rule of regulation for octave keys of the old variety. (see Octave Regulation.) The basic change between the Model 22 and the Model 12 is the elimination of the side Bb arrangement for a more modernized set up. Both of these instruments, however, do not have an extra high F key. However, this key is easily applied on this instrument. (See Extra High F Key Insertion) The Selmer Super saxophone which was the more modern version leading to the present day, had many changes including the insertion of the extra high F. However the low B and Bb, keys were still kept on the G# lever side of the bell.

The advent of the Selmer (Cigar Cutter Model) had one basic change from the normal Super saxophone. This was in the octave assembly whereby the octave assembly was a direct copy of the modern Buescher octave assembly. The key arrangement was such that the thumb octave key at its point of contact to the octave lever took on the appearance of a cigar cutter from which this model took its name. This instrument had been highly recommended by many musicians because for the first time, it gave the already good playing Selmer a good working octave key which was something it never had before. The Selmer Balanced Action was the next model to hit the scene in which many changes were made such as the low B and Bb keys operating on the opposite side of the bell and the adjustment screws on the F# bar between the F# and G# keys and the F# and Bb bis keys. The original Balanced Action also had adjustment screws in the back bar of the F# key on the lower stack. To eliminate bending of these keys, your latest model Balanced Action also has adjustment screws at the back feet of the lower stack keys (F, E, and D). However, whereas the adjustment screws on the first model were utilized for the purpose of regulating the stack section, the adjustment screws on the latest model of the Balanced Action are for the purpose of removing lost motion and not for the purpose of regulation. Regulation points between the F, E, D and F# keys still must be taken care of by bending the feet of the F, E and D keys to match the back bar of the F# key. It was with this Balanced Action model that the adjustable bumpers and removable guards came into being on the Selmer saxophone. One important feature to

re-member about these removable guards is that any guard which has three screws is removable while those guards with only two screws are not removable by virtue of the fact that despite the two screws, the guard must still be soldered in place to eliminate the turn-ing of the guard. Therefore, if these screws are to be removed, it must be done when the part is hot enough for the solder to melt.
The Remova Bell model allows the stack sec-tion to come apart from the body and original-ly this horn was not soldered together at the stack joint but rather, it was a slip fit and the belly band held it firm. This eventually caused leakage which was immediately rectified by soldering this joint and replacing the belly band as a design. This model requires replacement of pivot screws in a low C# post that is extremely difficult to get at because of its position. It splits the C# key so that there is a key and a C# lever whereby a flat spring attached to the C# lever key is held in a dor-mant state until the C#lever is ap-plied. The pressure of the C# key against this flat spring gives a sufficient amount of tension to open the C# key and allow it to work in an inde-pendent fashion. This tends to give us a more positive feel on the C# key. This flat spring is held in place by means of a brass barrel with a lock screw attached there on. The later models allow for an adjustment arm between the low B key and the C# to eliminate the pos-sibility of the opening of the C# key with the low B or by means of an adjustment point at this arm.

The octave assembly is a complete change from the old by using a brass lever in bearing sockets. The elimination of lost motion in these bearing sockets is accomplished by spreading the split section of the bearing when it is in its socket so as to eliminate any lost space in the operation of the octave key. The points of regulation are regulated in the same way and manner as any modern octave key. (See Octave Regulation.) In preference to cork on the A octave lever it is wise to use a wire covering commonly referred to as "spaghetti."

Selmer rods vary in sizes from the American type by virtue of the fact that the larger rods are .119 in diameter as against the .112 of the Buescher and the threads are met-ric measure which are in effect very similar to a 4 x 48 American size. The small rods are very similar to clarinet rods with a thread approximately 1 x 72 American size. We give these sizes in American threads since it is quite understandable that the average shop does not maintain metric sizes. The Selmer saxophone has a small upper stack rod whereby the Bb bis key and the G keys which are normally part of the upper stack are on separate set-ups working between pivot screws.

These keys have a tendency to be noisy. The elimination of this noise is achieved by counter boring the post to allow the pivot screws to fit tighter in the key and the applica-tion of cork to line the guide posts which tends to reinforce the long solid hinges of these keys. In the assembly of the Selmer saxo-phone, it is wise to remember that the last key to be applied is the G# lever key. By making all the adjustments prior to the application of this key, it will have a tendency to simplify the regulation of this instrument. The elimination of lost motion between the side C lever and the side C key as well as the side Bb lever and the side Bb key on the late model Selmer is accomplished as on the late model Conn saxophone. (See Conn Saxophone). There is an adjustable arm on the F# key over the G# key and on the extra high F finger tip lever over the extra high F lever. These pieces are set and locked in place. They are adjustable for the purpose of changing the height of the stack sections while maintaining the proper point of regulation. The Mark VI Selmer has a left thumb rest which takes the appearance of a bottle cap from a medicine bottle. The removal of this from the body prior to polishing the instrument is easily accomplished by application of heat with your Bunsen Burner through the B tone hole to the base of the thumb rest. It only requires a small amount of heat to remove this part without damage. It is wise to remove this part before trying to remove the pivot screw from the thumb lever of the octave key lest we damage the black piece that is used as a thumb rest. The high F# key is built on an extremely long rod which sits in position on a triple post above the high E key. As a result, to eliminate give in the rod and reinforce the entire set-up, there is a lock assembly which fits over the high F# key and the high E key at the point of the high E guide post and is locked by means of a .080 screw into the side of the post. The thumb rest for the right hand on this model is an adjustable thumb rest and is removable. The Mark VI saxophone operates the octave key from the right side of the thumb rest through the manipulation of a small lever which acts as the lower bearing socket. This small lever must have a 1/64" cork wrapped around its end. The thumb lever requires no cork at the spatula but rather at the base of its extended arm. There is a 1/32" cork at the bottom of the octave lever. It is regulated as any modern octave key. (See Octave Regulation). The Mark VI saxophone was the first saxophone on the market to come forth with a high F# assembly. This is quite a simple assembly which consists of two separate keys; namely, the high F# key and the F# lever. This key requires a 1/16" cork on the spatula of the lever and a piece of spaghetti wire on its extended arm which fits into the fork of the high F# key. It is operated along-side the lower stack. It is smart to remember that a better action is achieved on the Selmer saxophone by curling the needle springs so that the springs use this curvature for more strength.

Strasser, Marigeaux and LeMaire (SML)

The S.M.L. saxophone was made as a combination instrument whereby the three aforementioned companies combined their efforts to produce this saxophone. There is nothing strange or odd about the adjustments or regulations of this instrument. To compensate and correct any different intonation it would be advisable to first open the entire action so as to clarify some of the tones as well as sharpen the middle registers to eliminate the lower registers sounding sharp by comparison. Actually, the low register is in tune and the upper register which is badly flatted by the close action is the cause of the lower register sounding sharp. The opening of the action tends to counteract this feeling. To eliminate the differences in volume on the different notes, it is advisable to apply a set of Selmer tone boosters to the pads. This will tend to give a more even sound to its entire scale. Upon the completion of these two operations, the horn would play well enough to satisfy the average professional man. This horn utilizes the rolled tone holes as on the Conn saxophone (old style). However, the main basic point of difference between this horn and all others is the belly band at the neck socket which is actually removable and acts as a clamp around the female socket which splits at four sections to allow for tightening against the neck. It is important to remember that this comes this way and should not be soldered down in place. This instrument has a tendency to be noisy and requires a great deal of oil to help silence its action. The articulated G# is a movable lever under the spatula of the G# lever key so that if so de-sired, it can be moved out of contact with the B and C# keys. It is extremely important to cut the bumpers on the low C, B and Bb keys to an absolute minimum to maintain the proper intonation on this horn. The octave assembly operates on a ball joint in the same way and manner as the modern octave keys. (See Octave Regulation.)

Kohlert

There is nothing to be said about this horn, other than the fact that it follows every one of the normal standards of any average instrument. It is basic in its fundamental principles and it copies many of the ideas of the modern saxophone. It maintains an octave assembly very similar to the Buescher octave key modern style. (See Octave Regulation.)
It utilizes the tone holes drawn in the way and manner as on the old style Conn saxophone.

SAXOPHONE PAD CHART

KEYS	BUESCHER C SOPRANO	BUESCHER B♭ SOPRANO	BUESCHER ALTO	BUESCHER C MELODY	BUESCHER TENOR	BUESCHER BARITONE
UPPER OCTAVE	11	11	12	12	12	12
LOWER OCTAVE	11	11	12	12	12	16
HIGH F		13	21	21	23	
" E♭	12	13	24	24	26	34
" E		13	24	24	23	34
" D	12	13	21	24	28	
SIDE C	21	19	31	31	35	62
SIDE B♭	18	19	31	29	36	46
SMALL B	12	13	21	25	24	40
B	21	22	29	34	39	48
B♭	15	22	29	34	39	67
A	21	22	32	38	39	52
G	23	29	39	42	48	60
G♯	21	24	34	42	42	57
F♯	25	24	34	42	42	60
F	31	32	42	52	52	62
E	29	32	42	52	52	62
D	37	39	52	57	60	73
C	42	43	52	57	57	79
LOW E♭	36	32	48	52	52	70
SIDE F♯	27	26	24	42	29	62
SIDE E♭	21	22	29	29	28	38
LOW C♯	34	39	48	47	52	79
LOW B	36	48	62	62	62	86
LOW B♭	40	48	62	62	70	98

KEYS	CONN B♭ SOPRANO	CONN ALTO	CONN C MELODY	CONN TENOR	CONN BARITONE	CONN BASS
UPPER OCTAVE	11	11½	11½	11½	12	12
LOWER OCTAVE	11	11½	11½	11½	12	12
HIGH F	12	24	24	24	29	
" E♭	12	23	24	24	36	40
" E	12	24	25	24	29	
" D	12	23	24	28	36	51
SIDE C	19	32	24	39	37	51
SIDE B♭	19	32	34	34	43	61
SMALL B	12	21	24	22	36	38
B	20	32	34	42	43	47
B♭	20	29	32	34	37	51
A	22	32	32	37	48	51
G	28	40	39	47	61	64
G♯	24	36	37	42	64	67
F♯	26	39	44	49	64	67
F	34	40	61	62	62	64
E	30	43	47	47	51	64
D	38	51	51	60	64	79
C	44	51	54	57	70	85
LOW E♭	31	61	51	51	51	67
SIDE F♯	28	39	44	64	37	64
SIDE E♭	24	29	28	30	54	67
LOW C♯	39	60	48	54	64	79
LOW B	47	60	60	64	78	79
LOW B♭	49	60	60	64	85	85

KEYS	MARTIN B♭ SOPRANO	MARTIN ALTO	MARTIN C MELODY	MARTIN TENOR	MARTIN BARITONE
UPPER OCTAVE	12	12	12	12	12
LOWER OCTAVE	12	12	12	12	12
HIGH F		20	24	24	
" E♭	12	24	24	28	
" E		24	24	24	35
" D	12	20	24	36	35
SIDE C	21	32	34	35	38
SIDE B♭	21	32	34	35	42
SMALL B	12	20	24	24	34
B	21	29	34	39	42
B♭	21	32	34	39	39
A	21	29	36	39	47
G	26	39	42	48	54
G♯	24	34	42	42	54
F♯	24	34	42	42	54
F	32	42	62	52	57
E	32	42	52	52	57
D	36	52	57	60	64
C	40	61	57	57	70
LOW E♭	32	47	61	52	54
SIDE F♯	20	24	47	29	38
SIDE E♭	20	29	29	28	54
LOW C♯	39	61	47	52	64
LOW B	48	62	63	62	78
LOW B♭	48	62	63	70	85

KEYS	YORK B♭ SOPRANO	YORK ALTO	YORK C MELODY	YORK T IOR	YORK BARITONE
UPPER OCTAVE	12	12	12	12	12
LOWER OCTAVE	12	12	12	12	12
HIGH F		21	21	24	
" E♭		24	23	23	
" E	12	24	23	23	38
" D	12	21	26	23	38
SIDE C	18	32	32	38	31
SIDE B♭	18	32	28	38	46
SMALL B	12	21	25	23	39
B	20	29	34	40	47
B♭	21	29	34	38	47
A	21	32	38	40	52
G	24	39	42	40	35
					52
G♯	24	35	43	40	60
F♯	24	35	43	42	60
F	32	43	52	52	60
E	32	43	52	52	60
D	37	53	57	64	63
C	37	53	57	63	63
LOW E♭	32	49	62	49	60
SIDE F♯	18	21	42	38	34
SIDE E♭	21	29	28	32	34
LOW C♯	38	43	46	54	62
LOW B	47	62	58	64	73
LOW B♭	49	62	58	72	73

KEYS	KING B♭ SOPRANO	KING ALTO	KING C MELODY	KING TENOR	KING BARITONE
UPPER OCTAVE	11	12	12	12	12
LOWER OCTAVE	11	12	12	12	12
HIGH F	12	22	21	21	
" E♭	12	22	23	28	
" E	12	22	23	22	31
" D	12	22	23	28	37
SIDE C	18	33	32	33	31
SIDE B♭	18	32	32	33	51
SMALL B	12	19	23	22	39
B	23	32	34	39	47
B♭	23	29	34	37	47
A	23	32	34	39	51
G	26	34	40	39	61
	24	34	40	39	61
G♯	26	26	40	39	61
F♯	26	33	40	39	56
F	32	39	52	51	60
E	32	41	48	[illegible]	60
D	38	52	53	63	60
C	2-33	48	58	57	63
LOW E♭	32	46	48	48	60
SIDE F♯	21	26	42	47	47
SIDE E♭	23	29	28	29	47
LOW C♯	42	47	46	53	62
LOW B	28	57	63	63	70
LOW B♭	28	57	63	70	76

KEYS	HOLTON C SOPRANO	HOLTON B♭ SOPRANO	HOLTON ALTO	HOLTON C MELODY	HOLTON TENOR	HOLTON BARITONE
UPPER OCTAVE	11	11	13	13	13	13
LOWER OCTAVE	11	11	13	13	13	13
HIGH F	12	12	24	24	24	34
" E♭	12	12	22	24	24	38
" E	12	12	23	24	24	34
" D	12	12	22	24	24	34
SIDE C	21	18	32	34	38	38
SIDE B♭	18	18	32	34	38	42
SMALL B	12	12	21	22	24	34
B	20	20	32	34	40	42
B♭	12	22	30	38	40	38
A	20	22	32	38	40	47
G	24	29	35	42	51	64
G♯	20	24	35	38	46	53
F♯	24	24	35	42	46	54
F	32	32	42	51	53	56
E	28	32	43	53	53	57
D	38	38	53	56	62	62
C	42	42	53	56	62	69
LOW E♭	34	32	54	53	56	54
SIDE F♯	27	27	42	46	56	38
SIDE E♭	21	22	29	30	35	54
LOW C♯	34	38	50	47	54	66
LOW B	34	46	56	62	66	78
LOW B♭	40	47	56	62	66	84

KEYS	PAN AMERICAN B♭ SOPRANO	PAN AMERICAN ALTO	PAN AMERICAN C MELODY	PAN AMERICAN TENOR	PAN AMERICAN BARITONE
UPPER OCTAVE	11	11	11	11	12
LOWER OCTAVE	11	11	11	11	12
HIGH F	12	24	24	24	
" E♭	12	22	24	24	
" E	12	24	25	22	[illegible]
" D	12	22	24	26	[illegible]
SIDE C	19	32	24	39	[illegible]
SIDE B♭	19	32	34	34	[illegible]
SMALL B	12	21	24	21	[illegible]
B	20	32	36	42	[illegible]
B♭	20	28	31	34	[illegible]
A	22	32	32	37	[illegible]
G	28	39	39	46	[illegible]
G♯	24	36	37	42	[illegible]
F♯	26	38	44	48	[illegible]
F	35	38	51	52	[illegible]
E	31	[illegible]	47	47	[illegible]
D	39	51	51	61	[illegible]
C	46	51	54	57	[illegible]
LOW E♭	32	51	61	50	[illegible]
SIDE F♯	28	38	44	54	[illegible]
SIDE E♭	24	28	28	32	[illegible]
LOW C♯	40	47	47	54	[illegible]
LOW B	48	59	60	64	[illegible]
LOW B♭	50	59	60	64	[illegible]

NUMBERS REPRESENT 32NDS OF AN INCH

Please note; in recent years some manufacturers have gone to the newer type(s) of lacquers, or in some cases, such as the Conn Company, to their own formulas. These lacquers require a “cold strip” since the caustic type does not work. You may purchase this solution from an instrument company or very often from an industrial paint and/or chemical firm. To use this type of strip, you merely immerse the instrument into the solution until the lacquer has separated from the instrument in all areas. Often it will appear “crinkled” or as “bubbles”. Rinse off with clean water, pressure is preferred in most cases, or if there are loose but stubborn spots of lacquer, you can use a brush or rag to remove these ‘during the rinse. The next step is as described in the “Bright Dipping” section. A good idea is to build a hanging fine mesh screen to install in your cold strip container. Cut a piece of screen that fits snug within the container, install two wires (a piece of coat hanger is ideal) that will allow screen to drop within two or three inches of (above) the bottom and hook these over the lip of container. Remove this screen as often as necessary, “each shop will be different”, and remove the old lacquer on it with a pressure water hose and rinse well before installing back into container. This will keep your solution from “working” when not in actual use. In turn it will keep its strength for a longer period of time and as an end result, won’t have to be replaced as often. Since cold strip is generally more costly than a caustic solution, the screen idea is very worthwhile.

CHAPTER 5

POLISHING, LACQUERING, PLATING

Before an instrument can be worked on, one of the first things that has to be done is to remove the old lacquer through the use of caustic potash, common caustic soda (lye), or very many of the stronger soaps on the market today such as Oakite, etc. For caustic soda, a good formula to use is one gallon of water to four ounces of the caustic. For Caustic Potash, the proportion is the same. The absolute proportion mentioned above is not too important since it may be strengthened or weakened, as the mechanic sees fit, by using less or more water with the material. When an instrument has the lacquer removed through this solution, which should be kept boiling, it should then be rinsed in water. There is a different procedure to follow with brass, silver, gold and nickel instruments and we will take them in this order for a complete explanation of this procedure.

Bright Dipping

A brass instrument is boiled in the caustic solution whether or not there be lacquer on the instrument for the purpose of loosening and boiling off corrosion and extra dirt and grease that will undoubtedly collect after any length of time. After boiling, we must then rinse the instrument in clear water. The next process involved is that which is known as bright dipping. This is done by immersing the instrument in a solution of nitric and sulphuric acids and water mixed together in the following formula: A normal bright dipping would be mixed in the order named. One part water, one part nitric acid and two parts of sulphuric acid. It is extremely important to mix this solution in a well ventilated place since strong fumes are given off upon mixing due to the reaction of the acids. There is a good deal of heat generated through the reaction of the two acids upon being mixed, so they must be mixed slowly, while watching the crock in which they are mixed so that it will not become too hot and crack. It is important to mix them in the order named. The materials are mixed according to their density or weight, that is, the lightest first. Hence, water, nitric acid and finally sulphuric acid. The sulphuric acid must be poured extremely slowly and the mixer should feel the crock at all times while pouring so as not to allow it to become overheated. A good procedure to follow is to surround the crock with water, there-by keeping the heat down to a point where the crock will not break. The crock may also be surrounded by wet sand to accomplish the same end.

The formula for a fast bright dip would be as follows: One part of water, one part of nitric acid and one part of sulphuric acid mixed in the order named. A slow bright dip would be one part water, four parts nitric acid and eight parts of sulphuric acid. There are many variations of these formulae, although the ones named are the most widely used.

On completion of the bright dipping of the brass instrument, which is done quickly so as to allow the acid to eat off only the dirt, showing forth the clean color of the brass to facilitate the polishing of the instrument, you must immediately rinse in clear water. The clear water cannot wash off all of the acid. There will undoubtedly always remain a slight residue of the bright dip even though you may not see any signs of it. This residue is done away with by rinsing the instrument in a sodium cyanide solution, which as a base solution, will neutralize any remaining acid However, after rinsing in cyanide solution, it should then be well rinsed again in clear water, then air dried prior to polishing. Gold and silver plated instruments are handled in the following manner: After boiling in a hot caustic or soapy solution, they should then be rinsed in water, followed by a sodium cyanide rinse and re-rinsed in water. The cyanide in this case removes the tarnish from either one of these two plated instruments thereby allowing for an easy and better scratch brushing or polishing job. The cyanide may be mixed approximately four ounces to one gallon of water, stronger or weaker as so desired by the mechanic.

On a nickel plated instrument, there is only one “don’t” to bear in mind. Do not bright dip nickel plate. Bright dipping, or the bright dip acids, are a perfect strip for removing the plating from nickel plated instruments or parts. Merely treat nickel plated instruments in the same manner as we would handle gold or silver plated instruments. Sterling silver is handled in the same way as silver plate.

Cutting

Insofar as polishing of the base materials is concerned, after the preparatory steps have been undertaken, the next step is that known as cutting. This is done by polishing the instrument with a stitched muslin wheel, using a cutting compound that is free from grease such as Acme white or White Banner which can be purchased through any plating house throughout this country. Do not be talked into other polishes. These come in air tight containers which must be used within a short period of time after opening lest deterioration of the polish take place causing it to crumble into a powder. These cans of polish usually weigh approximately two pounds. We can normally cut down approximately eight saxophones with every can of Acme. We do not, in any manner, shape or form attempt to use the buffing wheel in those places where it would prove dangerous either to the instru-ment or the worker. In other words, do not try to buff over the tone holes of a saxophone but merely around them. Do not try to polish too strenuously at the posts as it may result in the posts being pushed out of line, causing a lot of extra work for the mechanic. Do not attempt to overcut an instrument, due to the fact that we may sometimes ruin the tone of a saxophone by overcutting the material, causing soft spots. Merely polish the horn.

Washing and Ragging

Upon completion of this cutting process, the instrument is then put through a washing out process wherein we utilize our hot solution and a soft brush or swab to remove all the extra solution that was left on by the buffing wheel. Upon completion of this washing, it then goes through a process of ragging out which is accomplished in a shoe-shine fashion using the same Acme by rubbing it against a small strip of cloth approximately 2” wide and then stropping the instrument, making’ sure that we do by hand all of that which we could not reach with a buffing wheel. This may not give as ‘fine a brilliance to the inner parts of the instrument which could be had with a buffing wheel. Yet without endangering the instrument, it does bring it up extremely clean so that absence of the extreme luster will not be noticeable. This system is used in the absence of a degreasing machine.

Coloring

The last and final process in polishing this instrument is done by utilizing a jewellers’ red rouge which is dipped in kerosene and a soft flannel buffing wheel. It is with the use of this compound that the soft wheel will then bring up the gloss giving one the full brilliance necessary-- to a fine finish of an instrument. When this process is completed, there will still remain on the instrument a light coating of this red dust given off by the jewellers’ rouge. This coating should then be wiped off with a piece of soft flannel but not ragged out. No fingers should touch this instrument unless they are covered by this flannel, due to the fact that our fingers do emit a certain amount of oil which would leave finger spots. This would definitely show through the lacquer job.

Scratch Brushing

Polishing of band instruments such as silver and gold is done in the following manner: Where we have the satin finish to contend with, the instrument is scratch brushed on a very soft brass wire wheel to bring up its true silver or gold color. A decent sized wheel for this work would be a 4” wire wheel with approximately three rows of brass wire. There are other small odd-shaped wheels, which enable us to get at those places better than the normal 4” wheel. The polishing of these instruments by use of the scratch brush is not entirely sufficient since there are many places we cannot reach by machine, but in those spots, it is a wise idea to use bicarbonate of soda. This is done through a ragging out process often referred to as stropping in the same manner in which we polish a pair of shoes. On those parts that have a smooth glossy finish, this high gloss is achieved by a process of polishing wherein the coloring process is utilized. This would pertain to the smooth finish on the bodies, keys and component parts of any silver or gold plated musical instrument. At least take note that the one big difference in the polishing process of base and precious metals is the elimination of the process of cutting in the polishing of precious metals.

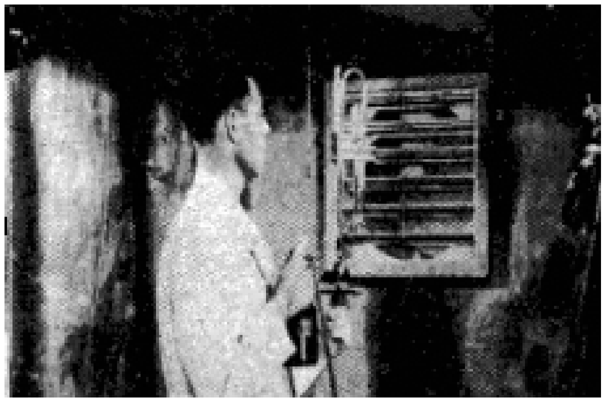
Nickel plate must be handled from the polishing process onward in the same way and manner as the base metals such as brass and German silver.

Plating Removal or Stripping

Many years ago Silver plated instruments were the rage of the day. At the present time the trend is to the brass, clear lacquered finish or gold lacquered finish. There are many models that have the two tone effect by using German or nickel silver fittings with brass. In the field of repair it is often necessary to remove the silver plating from the instrument to bring forth the brass finish. To properly achieve this end, it is necessary to understand the finish that was originally applied to the instrument. Silver plating was usually applied to the keys in a smooth finish, by burnishing the keys after the plating was applied. The bodies were sandblasted prior to the application of the silver to achieve a satin finish so that the burnished keys would stand out in contrast. As a result this sandblast finish must be removed before they would look proper.

Plating can be removed in two fashions; 1. By reversing the current in the Electro-plating tank. 2. By using hot Acid that will attack the silver plate ing quickly.

The first method is not advisable since the process of electrolysis will tend to pit the brass metal underneath. The removal of the silver plating with hot acid is the method we recommend. This hot acid is actually a mixture of two acids; namely, Sulphuric and Nitric Acids. There are many formulae for this type solution and the preference depends on the individual. Your writer prefers this formula: Four (4) parts of Sulphuric Acid, One (1) part Nitric Acid and a pinch of sodium chloride (Table salt). These acids must be mixed according to their weight or density, the lightest acid first. Therefore the nitric acid must be added first, then the sulphuric and finally the pinch of salt. These acids must be mixed in a well ventilated place as they will give off some pretty deadly fumes. It is wise to mix them in a room that has a strong exhaust fan. They must be mixed slowly so that the heat they generate will not break the crock. They should be mixed in an earthenware crock. The crock they are mixed in should be immersed in a steel barrel about the same height as the crock. The crock should be surrounded by a solution of some base material such as caus-



Trumpet held on stick for lacquering.

tic soda, so that in the event of a break in the crock the strength of the acid will be considerably reduced when the acid is partially neutralized by the base solution.

To heat this solution the steel tank is heated by direct application of a gas burner against the bottom. When the caustic soda surrounding the acid is hot it will heat the acid. This acid becomes very activated when heated. The instrument is gently placed in this solution until the silver melts off. This will be clearly visible. The instrument should be rinsed in water upon removal. This will have a tendency to turn the finish of the brass to a black color. The color is easily removed through the following process of Bright Dipping.

Upon the completion of these preparatory steps the instrument must be cut down to a smooth finish, (See Cutting) however we must be extremely careful not to injure the toneholes or passages in this process. Very close places can not be reached by the buffing wheel in this process and as a result the satin finish will remain in these places, however, this will not be too visible.

Nickel plating can easily be removed by merely Bright Dipping the part since the Bright

Dip Acids are a perfect strip for Nickel Plating.

Gold plating presents a different problem since we know of no acid that will attack gold. Gold plating must be buffed off to reach the silver plating underneath, then the process of removing the silver can be performed. This will have a tendency to remove too much from the material. To eliminate this we can achieve the same results in the following manner: Cut the satin finish as cleanly as possible, regardless of the type of plating that seems to appear. Color the instrument. Degrease the instrument. Brass plate the instrument. Brass plating will cover any finish perfectly. In this manner nothing will be detracted from the instrument. Brass plating is applied in the same manner as copper, however the finish of brass plating comes out in the same way as the finish of the instrument when it was first placed in the plating tank. To complete the polishing process to bring the instrument to a point whereby it can then be lacquered, simple coloring is then required.

Chrome plating can be removed by reversing the current in hot sulphuric Acid. Since this method is not readily available, in the average shop, we suggest that this alternate method be used. Merely immerse the part to be stripped in straight Hydrochloric (Muriatic) Acid. This method will slowly remove the chrome plating. If the acid is hot it will cause the speed up of this process.

Copper plating can easily be removed by bright dipping the part until the acid eats off the copper.

Lacquering

Musical instruments are lacquered for two reasons:

1. To add to the beauty of the instrument and retain the high finish.
2. To prevent oxidation and discoloration of the polish job.

The real secret of a fine lacquer is actually not the lacquering job but rather the polish job underneath. If we attain a high brilliant gloss on our polish finish, the lacquer will merely cover this and show forth the same effect. If our polishing job is poor, we cannot help but receive a poor lacquer job, insofar as looks are concerned. On instruments in the brass family, such as trumpets, trombones, etc. you can always maintain a high brilliant gloss and therefore an extremely fine looking lacquer job, if you have followed the coloring process as described in the previous article. On saxophones, there are two viewpoints insofar as laquering is concerned. We have one school of thought which is to lacquer the instrument prior to assembly. The other is after the instrument is assembled. There are benefits to both ways and so all we can do is point them out and let you take your choice. If an instrument is lacquered before assembly, you maintain a high colored finish, which will give you an absolute mirror gloss in your lacquer job. If a sax is assembled first and then lacquered, you cannot help but lose some of this gloss due to the fact that you leave rag marks and streaks when hand wiping this instrument prior to lacquering. Some mechanics put one or two coats of lacquer on the instrument prior to assembly and upon completion of the overhauling, relacquer the instrument with two or three more coats. I cannot definitely tell all musical instrument mechanics to use five coats of lacquer such as prescribed by all factories, baking each coat separately in an oven or hot box because actual knowledge of fact tells me that this is not done. Instead it is usually three coats of lacquer put on the average horn.

There are many different colors of lacquer used by musical instrument mechanics, the Nikolas lacquers being definitely the preference of this writer. As to the color, you may take your choice from different samples. As to the type, there is a great deal to be understood. This is a prime lacquer known as A5 which has a resin base. This lacquer has great adhering qualities, but it is not its nature to have a hard finish. There is another type of lacquer sometimes used by musical instrument mechanics known as CE 5. This has the same principal quality as the A5 lacquer. Both of these lacquers along with all other lacquers of the same nature have a tendency to melt or soften before burning, should the flame be applied directly to a lacquered key or part. If not touched while hot, it would still retain its appearance but if you are seating a pad on such a lacquered part, the complete imprint of the rag with which you are handling the key would be left on the lacquered finish, completely spoiling the appearance of the lacquered job. We can definitely recommend this type of lacquer for instruments of the brass family. If saxophones are lacquered after assembly, this lacquer will suit the purpose. There is another type of lacquer put out by the same company known as porceleen. This lacquer has a hard finish and will not melt when heated but will retain its hard finish unless overheated to a point where it burns, whereupon such lacquer will discolor to a very dark brown and eventually black. If instruments are polished and lacquered prior to assembly, use nothing but porceleen lacquer to do the job. You can receive any color desired, by the insertion of the proper dye with your lacquer. There are two methods of lacquering. One is dipping and the other is spraying.

On musical instruments, we use the spray method. There are a few hazards to be on the lookout for: 1. adjust yourself to the distance you hold your spray gun from the horn while lacquering approximately six to eight inches. If the gun is held too close to the horn, it will result in too much lacquer being fed on too quickly. This will give you runs in your lacquering if held too far away, the lacquer sprayed will have a tendency to dry before it hits the instrument, thus an orange peel effect or a rough mat. You may, sometimes by twisting and turning the instrument while the lacquer is still wet, cause a run to even out. You can do away with a mat or sandy finish in a very simple manner. Let the instrument fully dry with this poor finish, then give it an-other coat of clear lacquer and lacquer thinner mixed with this proportion; three parts of lacquer thinner to one part clear porceleen lacquer. This over-amount of lacquer thinner will cause thin, dry overspray to melt and lie smoothly on the instrument and will bring back the gloss which should have been there originally. Runs will easily occur on lacquered instruments if a spot on the instrument is completely missed. This can occur while lacquering trumpets on the tuning slides or the back bow. A good practice to remember when lacquering such an instrument, is first to hit these spots which would ordinarily not receive lacquer quite as readily as an open portion of the instrument. After hitting these spots, spray over the instrument without fear of runs on these portions. An important thing to remember while lacquering is to never stop the movement of the hand in the middle of a stroke. Start your lacquer six inches before you hit the instrument, reversing this stroke six inches after you pass it. This will eliminate the possibility of excessive amounts of lacquer on any one portion of the instrument.

Most fire laws call for vapor proof bulbs in a lacquer booth. These are nothing more than containers for electric lights so as to prevent the heat of the electric bulbs from starting a fire. It is something we should not be without. It is understood that the exhaust fan should be used while spraying lacquer and the spray of the lacquer on the instrument should be done in such a manner as to allow excess or overspray to be pulled out of the lacquer booth immediately. This can be done by spray-ing directly toward the fan. The room should be as dust free as possible. We wish to take this opportunity to warn you that lacquer is highly combustible and no smoking should be allowed within a great area surrounding your lacquer room or booth. It is definitely advisable to maintain a baking oven or a hot box. This should not be kept too close to the lacquer room but at least fifteen to twenty feet away from it. This is used for the purpose of baking on each coat of lacquer which will, in turn, give you a better job.

On days when the humidity is extremely high, lacquer may turn to a milky color. Very often this can be cleared up and brought back to its original state by the application of another coat of clear lacquer when the original is completely and definitely dried. This is definitely not a guarantee but has worked successfully in many cases. On such muggy days, it is advisable to take special precautions and it is very, possible to eliminate such trouble completely by one of these:

1. In place of your normal lacquer thinner, use "retarding" thinner.
2. Warm the instrument prior to lacquering. The warm body of the instrument will cause the lacquer to dry quickly and may possibly give you a mat finish but this can easily be cleared up. It is the moisture that remains on the instrument prior to lacquering that causes this milky finish. "Retarding" thinner will aid in retarding the change of color. If, upon use of these two tips, you still receive a milky finish, your trouble can only lie in one place. You must drain your water from your air tank and filter. This should be done approximately once

a week regardless of how your jobs are turning out and that way you will never have trouble.

If it becomes necessary to remove a fresh lacquer job, due to a bad run, this can be done by use of lacquer thinner, whereupon the complete cutting process may be eliminated since you merely have to recolor this instrument prior to lacquering.

If a sax is lacquered after assembly, it is advisable to cork up all open keys by the use of small cork wedges under the feet of these kexs. This is done so that the lacquer will not hit over your pads causing them to dry. These small cork wedges will only cover that portion of the body. excluding lacquer where it cannot be seen. In reference to the small tips; on the lacquer gun. we have had our best results with a cone spray, in preference to the fan spray.

Lacquer spraying utilizes the aspirator principle for its working. By forcing air over the mouth of a small tube which is inserted in a liquid, we create a partial vacuum in this tube. Normal air pressure at 14.7 pounds per square inch forces the lacquer up this small tube where it is then blown out in a fine spray. There is always a small hole in the cap or cover of the jar: this is attached to the gun This hole should be kept clear at all times so as to retain our normal air pressure in the gun. Should this hole clog up, you will not be able to spray.

Silver Plating

If we have to silver plate a base metal. it is first necessary to clean the instrument properly and this should be done in the following manner:
(a) degrease the instrument in a hot caustic solution or with the use of carbon tetrachioride or similar solvent. (b) rinse the instrument in clear water if a hot caustic solution used. (c) bright-dip the instrument as discussed previously. (d) scratch brush the instrument with a soft wire wheel using soap bark and clear water. (Soap bark may be purchased from any chemical house). Any detergent will work as well.

If the instrument demands a satin finish, this satin finish must be applied prior to this preparatory work, either through a process of sand-blasting or buffing with a steel wire wheel.If it is to be a high gloss or burnished finish, this must be applied prior to the prepar atory steps of plating, through the use of buffing wheels, both muslin-stitched and soft flannel.

After the instrument is cleaned, it should then be dipped in a striking solution, the simplest of which is comprised of red oxide of mercury, sodium cyanide and water, the formula for which varies in accordance with the work at land is usually given by any concern from whom this chemical is purchased.
A decent formula would be 6 oz. of red oxide of mercury and 8oz. of sodium cyanide to every two gallons of distilled water. This can be mixed with regular water but distilled water, which is free from all chemicals, produces a more advantageous solution. An electrolitic strike can also be used. A decent silver solution would run as follows: 6 oz. of silver cyanide, 4 oz. of sodium cyanide and 4 oz. of sodium carbonate to every gallon of distilled water.

After striking of the instrument, you will note that it turns a white color. If any spots still show brassy, this is a definite indication that there still remains some grease or foreign matter on that portion of the instrument and the silver plating will not take at that point. Should this happen, the aforementioned process at that one spot must be repeated.

Once the instrument is completely struck, it is then attached to the negative pole of the rectifier and immersed in this silver cyanide solution. The silver anode (from which the material is taken) is attached to the positive pole. Current should be applied at approximately 4 volts for fine plating. If the part being plated does not show complete whiteness during the process, it is very possible that the solution needs agitation. You may stir this solution by merely moving the part being plated so as not to leave it stagnant. You will immediately notice the color change. Sometimes a dirty solution or a solution that has too much foreign matter therein will cause a grey color rather than a white. This is not quite as fine a plating job as a white colored silver.

When a sufficient amount of silver has been deposited on the instrument and usually at this rate of speed, approximately 15 to 30 minutes of plating time would deposit quite a good quantity of silver, the instrument is then removed and rinsed in cold water. After a thorough rinsing, the silver-plated part is then scratch-brushed on a very soft brass wire wheel to bring up its true silver color. A decent size wheel for this work would be a 4-inch wire wheel with approximately three rows of brass wire.

If this is to be a highly polished finish, it is brought to a high gloss by a process of burnishing with the use of a steel burnisher that is highly polished, using a detergent as its lubricant. Very often, many repair shops, for the purpose of elimination of this costly process of burnishing, which does take a great deal of time, merely color the plated part, using a combination of jewellers' red rouge dipped in kerosene. A very light application of this material to the soft flannel buffer will bring forth a highly-brilliant gloss and will not hurt the silver noticeably at any point. This does save a great deal of time.

Every other type of plating, whether it be copper, gold or brass, would undergo the identical process as that of silver plating. The entire secret lies in the proper knowledge of the method in which the electrical current is utilized for the purpose of electroplating. We shall now take time out to discuss the electrolysis involved in the process of proper electroplating.

Electric current flows from positive to negative. The positive pole is always referred to as the anode. The negative pole is always referred to as the cathode. In the future, throughout this chapter, and others, we shall refer to them in this manner. The 110-volt current that we use as our normal house current cannot be utilized in its present state for plating any parts of instruments as the voltage is too high. Furthermore, we must have direct current (DC) for plating and not alternating (AC) current. The use of direct current allows the direct flow of the plating material from the positive to the negative poles of the plating outfit.

For these reasons, it is necessary to use an apparatus known as a rectifier which steps down the current from 110-volts (house current voltage) to the proper voltage of approximately somewhere between 1 and 15 volts and then changes this voltage from alternating to direct. It is only then that we are able to use house electricity for plating. If you happen to be located in an area that uses DC current, be sure to purchase a DC plating outfit (rheostat).

Another thing, do not get the impression that the plating material is being taken from the anode and deposited directly onto the cathode. This is a fallacy. The cathode obtains its plating from the material in the solution. The solution is merely replenished by the anode bar. We must be very careful not to touch the anode and cathode at the same time, due to the fact that this would cause a short circuit in our plating equipment and might prove quite shocking. It couldn't possibly hurt you should this happen, due to the fact that the voltage would be too low but it can make the average person jump. At the same time, it might cause us to have the extra work of removing the part to be plated and doing the job over again.

Gold Plating

In plating gold, a gold solution is more simply purchased than made. For an anode, we may use a piece of stainless steel since the anode will merely complete the circuit and the cathode will accept its gold from the solution itself. In plating gold, we cannot leave it in the solution for such a great length of time but rather, we plate gold at approximately three volts for no longer than 10 second periods at one time. Trying to plate longer than this may result in the burning or discoloration of the gold.

We must hear in mind that gold is so expensive that we cannot afford, in the average shop, to maintain use of a gold anode. It is for this reason that the stainless steel anode is utilized for the purpose of completing the electrical circuit. A gold solution that would give satisfactory results is easily made using the following formula: One ounce of gold cyanide, four ounces of sodium cyanide, six ounces of bicarbonate soda, to one gallon of distilled water. It is important to use the distilled water since regular tap water has very definite mineral content and this mineral content, slight though it may be, will have a tendency to contaminate the solution so that it would impair the proper working of the electrolysis involved therein. It is very important to slightly warm this solution prior to use to a point whereby the solution maintains an approximate heat of 110°F. A warm solution has a tendency to become slightly agitated thereby helping to stir itself. If the solu-tion is kept moving either by moving the part or stirring the solution, it will tend to give a more even and satisfactory plating. Final cleaning of this plating would depend entirely upon whether or not it was to maintain a burnished finish or a satin finish. The proper finish must be applied prior to plating since the plating will merely act as a cover and will not conceal the finish applied in the preparation for plating. If a satin finish is desired, it must be applied to the part prior to plating and the finishing of this process is performed through the use of a scratch-brush and bicarbonate of soda with water after which the part should be rinsed in boiling water and patted dry with towelling. If the part is to be a burnished finish, it should be highly polished prior to being plated after which it may be either hand-burnished or highly colored with jewellers' rouge and kerosene.

Copper Plating

Copper plating is usually applied to valves prior to grinding same. It is applied in the same way and manner as any other type of plating. However, the solution used must be a copper cyanide solution or a copper sulfate solution (CuSo4) The recommended solution is that of a copper cyanide since in the average shop, most of the solutions would be a cyanide base. It is advisable to maintain the equivalent type solutions. In this way and manner, the cost of operation is cheaper and at the same time, we have a smaller variance of materials on hand. Formula for the solu-tion would be 3 ounces of copper cyanide, 1/2 oz. of sodium cyanide, caustic soda (lye) 1/2 oz. and one gallon of distilled water.

The sodium cyanide in any form is added first and then the copper cyanide stirred. The balance of the ingredients may be added as desired.

The copper sulfate solution would consist of 35 ounces of copper salts per gallon of distilled water, 6 to 11 oz. of sulphuric acid. This solution can be plated comfortably at room temperature. However, in all cases, warming the solu-tion tends to activate the plating process. Agitating the solution tends to give one a more even plating. It is wise, when copper plating a valve, to place the valve in a horizontal position since copper plating has a tendency to build heavier on the bottom side. Insertion of the valve on the horizontal position tends to even the plating. Cleaning of this plating can be done either by buffing or scratch-brushing.

Nickel Plating

In most cases on musical instruments repair, we are faced with the proposition of nickel plating such as on valves, etc., to give us a hard wearing surface that would work competently against the soft brass of the valve casing. However, it is to our advantage at all times to use a bright nickel in preference to the darker nickel plating. A good solution for this bright nickel plating is as follows: 32 oz. of nickel sulfate. 6 oz. of nickel chloride and 4 oz. of boric acid and 1 gallon of distilled water. This solution must be kept at a heated temperature between 115 and 1600 F to give the best results.

Valve Plating

When a valve is leaking and it is necessary to plate same (See Repairing Leaking Valves), the valve must be prepared to receive the plating. This is done by truing up the valve in the valve lapping block to a point where the pit marks are removed as well as the old plating. Upon completion of this procedure, the valve should be scratch. brushed with any detergent and water and then rinsed in clear water. It should be placed in a copper plating tank in a horizontal position and plating deposited there on See Copper Plating), until such time as it would fit into the casing from the bottom side approximately 1/4 of the length of the valve. At this point, the valve is prepared for grinding. Upon completion of the grinding process (See Repairing Leaky Valves) the valve is then lightly polished on the buffing wheel to a gloss finish after which, a thin deposit of nickel plating is applied (See Nickel Plating). Upon completion of the nickel plating process, the valve is lightly polished to bring up the gloss of the nickel plating. At this point, the valve will no longer leak and will have a hard wearing surface.

CHAPTER 6

FLUTE REPAIR

Flute Explanation

The flute is considered to be an instrument of conical bore. The conical portion of the flute is the head or mouthpipe of the flute. This head is completely tapered and it is because of this fact that the flute is built in octaves. To seal the upper end of the head, we utilize a cork which is put on a tuning pin or rod. A crown covers the upper end of this tuning cork assembly. The set of this tuning cork determines the intonation between the registers of the flute thereby keeping the flute in tune with itself. The tuning up of the flute with any other instrument is accomplished by either pulling the head of the flute out of its socket slightly or pushing it in closer. Once the head cork is set, it should not be moved for the purpose of tuning up with another instrument, since this would tend to throw the registers completely out of tune with each other.

The mouth-piece of the flute is soft soldered to the head of the flute. To assure perfect coverage on the head of the flute, it is important to bear in mind the fact that not only must the head cork be tight fitting but the plate against which it rests, both front and back, must be shellacked to the cork or leakage will take place through the hole in the head cork. By the same token, there must be no leakage in the soldered joint of the mouthpiece. The tenon extension of the head must be smooth yet firm fitting in the female socket of the body joint. The body of the flute consists of that main portion of the flute with all the keys attached there on. The male tenon of the body joint must be firm fitting in the female socket of the lower joint which is referred to as the foot joint. Flutes are made in two keys; C and Db. The more common variety being used is the C flute. Db flutes are only used in band work not in orchestras. The ribbed flute is that flute whereby the posts are silver soldered to a long rib and the rib in turn soft soldered to the body. This has a tendency to strengthen the flute in preference to that flute which is not ribbed whereby the posts. are silver soldered directly to the body. The body joint and foot joint of the flute are cylindrical bores. This is a point to bear in mind when dent removal becomes necessary.

Post Repair

Quite often on ribbed flutes, the end post on a rib may raise or become unsoldered at that point. This must be firmly soldered back in place or it becomes a virtual impossibility to make this flute cover either in the seating of the pad or the regulation of the instrument. If the post is completely broken off the band, the entire rib must be unsoldered from the body after which the post is then silver soldered to the rib and the rib remounted on the body through soft soldering. On a flute that is not ribbed and the post is silver soldered directly to the body, the repair of a post broken from the body would consist of silver soldering a plate to the bottom of the post after the length of the post has been cut the same amount as the thickness of the plate after which the plate would then be soft soldered to the body. The plate would not only give a better contact point but could act as a patch over the hole as well, still allowing the flute to look as though no repair had been made.

Phosphor Bronze and Gold Springs

The springs of sterling silver flutes are made from 10 karat gold spring wire, while the cheaper flutes use phosphor bronze. In any event, bronze will work as well as the gold and it is much cheaper. These springs are riveted in place in the same way as clarinet needle springs. However, the ends of the spring are not heated. Merely squeeze the spring end in a pair of pliers to attain the rivet or flange end.

The springs are riveted in the posts, bearing in mind these rules:

A spring goes in the direction of the tone hole for which it works

A spring is bent for tension toward the hone hole if the key is to remain open, away from the tone hole if it is to remain closed.

The perfect type of pliers for removing springs from a flute is a 4 1/2" round nose pliers with the noses cut off. This allows you the grip of the box joint, whereby the leverage pressure is such that it cannot slip and yet it will not mar the spring. (See chapter on Spring Removal, Clarinet Repairs.)

Key Extensions

On such instruments as saxophones where there is a sufficient amount of room to build bridges or extensions from one tubular hinge to another so that keys work in between, the operation is simple. However, on a flute, there is very little room to work since a man s hand has to envelop the actual flute, therefore, it becomes necessary to eliminate these extensions or bridges and still maintain the same gap between the tubular hinges of the key. To accomplish this end, pin rods are used. The Selmer flute still uses bridges for connections between tubular hinges on the same key.

Key Pinning

Pins used on pin rods are made from saxophone springs the diameter of which is determined by the size of the hole through the rod. The pin should be a press-fit into place so that the key is firmly pinned to the rod whereby the rod and key act as one complete unit without any lost motion whatsoever between the two. The bottom of the pin should be close enough to the key to eliminate any interference with either the springs or other keys. The top of the pin should extend enough to allow the repairman gripping space to remove the pin.

Joint Fitting

Loose tenon ends such as the male tenon on the body joint are stretched to fit perfectly by using flute tenon expanders such as sold by the many tool companies.

Key Truing

Flute keys are straightened in the same way and manner as saxophone keys. (See Straightening Bent Keys— Saxophone Repair.) However, in many cases, the key will have to be almost perfect fit against the rod with no lost motion whatsoever and it may be necessary to actually grind the tubular hinge of the key using pumice stone and oil on the steel rod and lapping out the tubular hinge using the rod as the tubular hinge lap. Removal of this material upon the completion of the process is easily accomplished with the aid of a pipe cleaner and kerosene.

Cork Sizes and Key Corking

The same rules for sizes of cork as applied on saxophone apply to flute.

Rules—If the key hits the body (stopping action) apply 1/16 cork. If the key slides on another key (sliding action) apply 1/64 cork. The back thumb Bb lever key takes either a felt or 1/32 cork. The two top trill keys take 1/8 cork curved to fit the spatulas.
The D# key on the foot joint takes 1/8 cork.

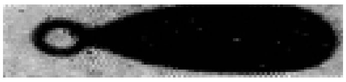
The head cork must fit the head securely and it must be shellacked to the front and back plates to eliminate any leakage. The head cork must be set with the tuning rod for that purpose or the registers will be out of tune.

Packing and Seating

Flute pads must be a perfect fit in the key cup. Do not shellac in flute pads. They are held in place with a metal washer and a screw. They are built up to the proper height by means of paper washers. Here is the big trick:

Moisten slightly the paper washers and the flute pad when putting the pad in the key. This allows the washer to conform to the shape of the key and it firmly seals the washer to the pad, thereby eliminating any possible chance of leakage underneath the pad. The small pads on the top trill keys and the B key are glued in place with shellac.

This is important. Each pad must cover perfectly individually or it will be impossible to properly regulate the flute. The pad slick used should have a hole in the center to clear the pad washer and screw. The first key on in the order of assembly is the G# key. To seat this pad, apply a small amount of heat to the key and placing your. pad slick between the pad and the tonehole while applying a small amount of pressure, turn the suck from side to side. Remove the slick and check for leakage from either the front or back. Paper washers must either be inserted or removed to build up the low areas or to build down the high areas. When the pad shows perfect coverage, apply pressure to obtain a seating on the pad. On


Flute pad slick.

the average flute (we do not mean the Italian flutes) the same number of paper washers are required in all keys. When we say put a key on the flute, this includes seating the pad.

Head Cork Fitting

The head cork, although a solid piece of cork, must have a hole cut through it to allow it to fit on the head cork rod. However, it must be held or sealed firmly against its bottom plate with the use of hot shellac. It is also sealed against the top plate with the use of hard shellac. To properly fit the new head cork to the head of the flute, the head cork rod is chucked up in the lathe or bench motor and while turning around, it is sanded to a perfect fit for the head.

It is wise to bevel the two ends of the head cork slightly so that it maintains a slight belly at the center of the cork which will compress sufficiently to allow it to be a firm fit in the head, thereby allowing a positive seal at its point of operation. Before applying the head cork to the head, grease should be used. The head cork must then be set in its proper position and this is done with the use of the tuning rod which is supplied by the factory on every flute. The tuning rod has a line cut in it so that when the tuning rod is inserted through the tenon end of the head, this line must appear in the dead center of the mouthpiece hole to keep the registers of the flute in tune. (See Flute Explanations.)

It is extremely important to remember that when the cork is replaced in the body of the instrument, it must be put in from the tenon side since in this manner, we would then be applying it through the larger bore of the tapered tube. It must never be put in from the top end of the flute because the plates on the cork rod might have a tendency to mar the taper at that point.

Body Repair

Most of the dents that can occur on the body of the flute are usually straightened or removed through simple burnishing of the body while it is placed over a firm fitting mandrel. This mandrel should be no greater than approximately .713 of an inch. Definite creases which occur when a flute has been bent may have to be removed through light tapping or hammering and the body refinished thereafter. It is wise to remember that both the female sockets of the average flute are soft soldered in place. Should the head receive dents that must be removed, we must use an undersized rod since we cannot do anything that would mar the taper of this portion of the instrument. Therefore, in using an undersized rod, we still allow ourselves the complete freedom of burnishing.

Flute Polishing

The method of polishing a flute is determined by the type of finish. The following are the most widely used types of finishes on flutes:

1. Silver plate
2. Sterling silver
3. German or nickel silver
4. Nickel plate

Silver plating and Sterling silver are polished in the same manner. It is not necessary to boil out the instrument unless the flute is very dirty. The average job requires a light cutting with any white lime polish and kerosene. The next job is coloring with jewellers' rouge and kerosene. There will be a small amount of buffing dirt clogged on the instrument in the small corners. Do not try to polish this out with the wheel. This dirt can easily be removed with a degreaser. Since most shops do not have such equipment, I suggest the following: Using a wool clarinet swab, wash the body and the keys in lacquer thinner. Thinner will melt the dirt and wash it away. This method will also remove any dirt in the small corners of the keys. Do not be too surprised when it cleans all the corks up like new, since thinner is the best cleaning agent we know of.

German silver and nickel plating are handled in the same manner except that we can use, the cutting process with a little more effort.

Tone Holes

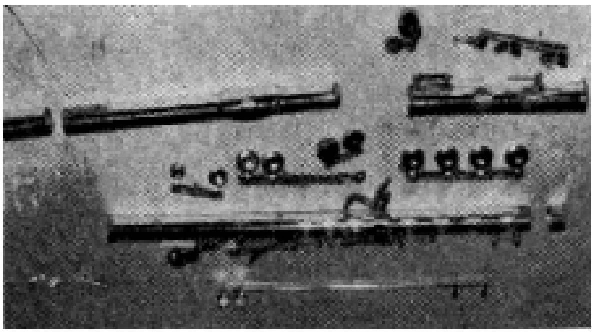
Toneholes on a flute come in two varieties. There is the drawn tonehole which, with the body, comprises one piece thereby eliminating the possibility of leakage through breakage in soldering. When these toneholes are damaged or bent, they are easily straightened by merely pushing a dent plug the proper size through the tonehole and when the dent plug is firmly in place, burnishing the tonehole against it. This burnishing process is not necessary since the plug pushed right through the tone-hole will tend to straighten the tonehole out completely. The toneholes that are separate pieces from the body are soft soldered in place. If these become damaged, they must be removed, put back in a perfect round through the application of the dent ball being pushed through it. However, the pad surface of the tonehole must be levelled and this is done by placing it on a jewellers' anvil or any flat piece of steel with the pad surface down and light tapping the opposite side so as to cause the pad surface to level itself against the steel plate, after which this tonehole is remounted on the body through soft soldering. On sterling silver instruments, it is advisable, when re-soldering a tonehole. to wire down at least the next two toneholes to the soldering job since sterling silver has almost perfect heat conductivity. It will have a tendency to cause the other soldered joints around the portion that is to be soldered to become loose. Wiring of these parts tends to hold them in their proper position at all times.

Flute Disassembly for Overhauling

The average flute has four simple rods; namely, a pivot pointed rod on the B key on the upper stack of the body joint, a short rod for the back thumb and thumb lever keys, a rod for the double G key and one for the G# key. The G and G# rods are usually quite similar. The foot joint has only one rod. There are three rods on the body joint of the flute known as pin rods. We shall take them individually to explain their proper functioning.

Upper Stack Pin Rod

This rod has the bridge of the Bb key firmly affixed thereto. On the cheap Italian flutes, the bridge and the lever arm that extend over the back thumb lever are one solid piece. On good flutes such as the Haynes Powell, etc., the extended lever is a free riding key on the pin rod. On the simplified or cheap flute, while the bridge section is firmly set to the pin rod, the A key rides free on the same rod. The Bb key is also pinned to the same rod, thereby making the Bb key and the bridge act as one



Disassembled flute.

solid key. The important point to remember is that true regulation cannot be achieved unless the bridge and the Bb key are extremely secure to the pin rod. The pin used for this purpose is made from a Steel Needle Spring tightly fitted and riveted in place in the same manner as a needle spring in a saxophone post.

Trill Pin Rod

This rod has two pieces attached with pins in the same manner as the upper stack rod while the third part of the key rides free. The two pieces attached are the spatula of the D# trill key and the pad cup of same. The third- part is a long key with long hinge. Be careful not to bend this hinge. If it is bent, it is straightened in the same way as previously described in the saxophone section.

Lower Stack Pin Rod

This rod has the F# key and either three or four adjustment screw seats attached to it by pine. This allows the F key. the E key and the D key to ride free on the rod.

Order of Assembly

1. G# key
2. Double G key
3. Two top trill keys
4. Entire lower stack (F#, F, E, and D keys)
5. Small B key
6. Balance of upper stack (Bb bridge and A keys)
7. Thumb Key (after seating the thumb key put on the thumb lever).
8. D#, C# and C keys on the foot joint.

Flute Regulation

Perfect regulation of a flute is achieved by means of adjustment screws with two exceptions on the body joint.

Rules:

1. Regulate F to F#
2. Regulate E to F#
3. Regulate D to F#

By means of adjustment screws

4. Regulate A to Bb
5. Regulate Bb bridge to F key by raising or lowering bridge
6. Regulate back thumb key to Bb key by raising or lowering the spatula of the back thumb lever key.

Removal of Lost Motion

Removal of lost motion is achieved by cutting corks on the feet of the keys. Do not bend keys to remove lost motion.

1. Cut the cork on the foot of the F key to raise the F key to the desired height.
2. Cut the cork on the foot of the E key to attain the same height as the F key.
3. Cut the cork on the foot of the D key to remove all lost motion in the lower stack.
4. Cut the cork on the foot of the A key to remove the lost motion between the F and Bb keys.
5. Cut the cork on the foot c4 the back thumb lever to remove all the lost motion on the entire instrument.

It is important to follow the order of regulation and removal of lost motion.

6 . Raise or lower the spatula of the C key to regulate the C and C#.

Flute Heads

(See Flute Explanations and Head Cork Fitting.)

Flute Ribs

(See Flute Explanation.)

Sterling Silver Flute

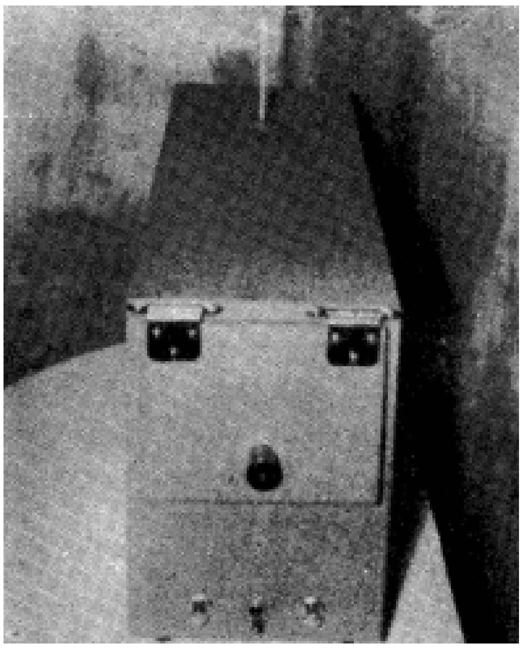
Sterling silver flutes usually are of the better variety of instruments and as a result, many of the headaches that usually occur on the average instrument are thereby eliminated. The main basic difference in the repair of this instrument as against the cheaper instruments is the application of cork to the keys through the use of hot shellac. Since sterling silver is such a perfect conductor of heat, it will have a tendency to make corking quite difficult using the normal procedure since the key will be cold by the time we attempt to apply the corn even though it is only a fraction of a second between the shellac application and the application of the cork. To eliminate this problem, it is wise to paint a few sheets of cork with soft orange shellac. Two thin coats are usually advisable. When the shellac has dried, we then can apply the cork directly to the key after heating without having to apply any further shellac. Since soft shellac uses as its softening agent denatured alcohol, its fusion or melting point is therefore considerably lower than that of flake shellac which is rolled into a stick and uses heat as its softening agent. In this manner, cork with the shellac already applied, simplifies the job of corking sterling silver keys.

It is wise to remember that sterling silver has the same material throughout and is not a plated instrument. Therefore, we cannot mar the finish of this instrument to a point where any plating would have been necessary. Furthermore, sterling silver is one of the precious metals and as a result, will feel heavier than a base metal. However, it is a soft material, therefore, easy to work with when removing dents but easily damaged. Sterling silver will further have a tendency to tarnish or oxidize far beyond that of the average plating and normal polishing may not always remove the tarnish stains. The easiest way to remove these tarnish stains is to immerse the instrument and keys in a sodium cyanide solution which is made up of 4 oz. of sodium cyanide per gallon of water. Immersion in this solution for a period of only a few seconds will change the color of the tarnish from the black or dark purple to an extremely white color. This white color can easily be polished back to the natural finish of sterling silver. Warm cyanide tends to work better and quicker. Immersion in the cyanide solution will have a tendency to whiten the inside of the bore of the flute giving us a very fine appearance internally. It is extremely important to remember that since sterling silver is a softer metal than the base metals used in the manufacture of flutes, we must be extremely careful when buffing this instrument and, under no circumstances whatsoever, should we allow the buffing wheel to hit the edges of the toneholes lest we cut the edge of the tonehole so that the tonehole is no longer level.

Wood Flutes

The keys on the wood flute are basically the same as those on metal flutes. The basic difference between a wood flute and the metal flute is on the body, the head and foot joints. Being a wood instrument, it naturally has to have a heavier wall to maintain a sufficient amount of strength to do the job. This instrument does not have raised tone-holes such as on the metal bodies but rather the toneholes are recessed as on clarinets except for the fact that the depth of the recess is much smaller. As a result, it becomes more difficult to seat the pad properly and unquestionably the use of feelers for leaks is an absolute requisite. Furthermore, in view of the fact that there is a recess for the key to fit into, it allows an extremely small amount of clearance between the pad cup and the ends of the recess. Therefore, an absolutely perfect fitting pad is a definite requirement.

All wood flutes have their post assemblies on ribs. These ribs are attached to the body by means of small screws such as used on clarinet thumb rests. As a result, very often, we find these screws breaking loose from the body. Should this happen, a fast method of re-applying these screws to the body so that they will again hold firm is to apply plastic steel in the hole and re-insert the smaller screw in place holding the rib firm to the body with bind-ing wire. When the plastic steel has dried, the screw will be firmly in place and the rib held secure. The male tenon ends of the body joint require cork in the same way and manner as clarinet corks. Usually these tenons have tenon rings on them. The bodies are either grenadilla wood or in some rare instances, hard rubber. The mouthpiece on the wood flute is eliminated and only the mouthpiece hole is used since the curvature of the head at that point is sufficiently wide to allow the circumference to act as a perfect chin rest. The head cork rod utilized on a wood flute consists of a tapered wood screw to which is attached the cork by means of hot shellac. The crown of the wood flute has a hole which allows the wood screw to fit at its further end through it. It is wise to remember that most wood flutes require the pad being built up through the use of washers to a point whereby the pad extends from the key up a great deal further than on metal flutes. This has a tendency to eliminate the possibility of the key cup striking any portion of the tone-hole recess and thereby allowing for easier and better coverage of the pad. It is a normal natural occurrence to find cracks in the head joint and the foot joint. A flute foot joint will usually crack between the D# tonehole and the end of the female socket. There is a metal sleeve inserted in the female socket which eliminates the possibility of shrinkage of the wood at that point. This, in turn causes the crack. The repair of this type of damage is best accomplished by either filling the side crack with plastic steel and after drying and



Baking oven for Perma Pads.

finishing, coloring the material with a light touch of black lacquer so that it becomes unnoticeable, or by gluing a sliver of grenadilla wood in the crack accomplishing the same method sometimes referred to as spleaning a Dutchman, in string instrument repairing. The same type of crack which occurs on the head joints usually upward from the female tenon is repaired in the same way and manner. Chips which occur in the tonehole of the wood flute are repaired with the use of plastic steel after which they are dressed back to the original size.

Plastic Pads

Plastic pads have come forth for use on flutes and clarinets. These pads are installed in the following manner: With the exception of the two small trill keys and B key in which the pads must be placed with a special plastic pad cement, there is cement necessary in putting the remaining pads in place and seating same. Place the proper pad in the key cup with the flat side of the pad facing up. Secure in place with a pad screw and metal washers. On those type flutes such as the old Pan American which had extremely deep key cups, it may be necessary to insert paper washers to bring the pad level up to a point that is slightly above the edge of the key cup. Assemble the entire flute making certain the keys are lined as close to the proper position as possible, thereby eliminating bent keys or keys that are tilted from side to side. Level the key out with a pad in this position as close to good coverage as possible without a seating. Put light tension clamps on each key. Camps are unnecessary on those keys where the spring tension is such that it holds the key in a closed position such as D#, G# and two upper trills. The instrument in its clamped position must then be put in a baking oven for a period of approximately ten to eleven minutes on plated flutes, whereas sterling silver flutes require only 8 minutes. The oven the instrument is placed in, should be preheated to a temperature of approximately 212 degrees F. (1OO degrees C). This is the temperature of boiling water. After this has been done, remove the flute from the oven and allow to cool slowly to normal room temperature before removing the clamps. After removing the clamps, make the necessary adjustments by means of the adjustment screws, etc. and finally remove the lost motion. If clamps are too tight, it will result in an excessive depth to the impression and may cause sticky pads. Stickiness can be removed from the pad with the use of ordinary talcum powder. The bad feature of this type of pad is the fact that it requires a major job if only one pad is to be replaced. The 3 small pads on a flute must be put in with pad cement by applying a small amount of cement to the key cup. Then heat the key until the cement starts to bubble in the key cup. Place the pad in the key cup with the flat side up. This will hold the pad in position in lieu of the fact that there are no center screw and washers on these keys. The heating in the oven will obtain the impression in the pad for you. A smart stunt is to reverse the spring tension of all the keys so that they are all held down with the springs rather than with clamps. This gives a sufficiently light tension so that a better impression is received from baking.

CHAPTER 7

PICCOLO REPAIR

Piccolo Explanations

To properly understand a piccolo, we must realize that a piccolo is nothing more than a miniature flute, whereby the C and C# keys are eliminated and the body joint consists of what would normally be the foot joint of the flute. In view of the fact that the keys are so small as to eliminate the use of center screws and metal washers, all of the pads must be held in place-with shellac. However, we cannot use the type of pad in a piccolo key as used on clarinet keys although they have the same appearance. The thick clarinet pad would have a tendency to leave its surface in not too flat a position so that it will make pad seating on a piccolo difficult. This arises from the fact that the tonehole of, the piccolo by comparison to that of the clarinet is extremely large for the size pad used in the key cup. Therefore, to make seating easier, it is necessary to float extremely thin pads on piccolo keys. This enables us to have an absolutely level surface on the pad to facilitate coverage. Some companies have been known to use the medium thickness clarinet pads for piccolo work. In this manner, they eliminate total floating and merely use a little extra shellac in the key cup to help float the pad. However, you will find very many satisfactory results from full floating. Piccolos come in two types. The first type has the posts soldered to the body. The second type known as a ribbed instrument has its posts silver soldered to plates. These plates or ribs are then soft soldered to the body. This instrument has a little more strength than the first type. However this type usually gives the repairman a little bit of extra trouble due to the fact that these ribs have a tendency to break loose from their soldering job easily by the slightest bend of any post. The piccolo utilizes gold or phosphor bronze springs in the same way and manner as the flute. The head cork is fitted in the same way and manner as on a flute. The regulation of this instrument is identical to that of the flute. However, many piccolos do not have adjustment screws to facilitate their regulation and in the repair of this type of piccolo, it is usually advisable to regulate the instrument while seating the pads so that the impression in the pad actually takes up a sufficient motion to allow for the regulation points. Piccolos come in two keys; namely, C and Db. The Db piccolo is used for band work whereas the C piccolo is used in orchestras. The only tapered section on a piccolo is the same as on the flute—in the head. Therefore, we must remember, when inserting the head cork, to place it in from the tenon side. Insofar as dent removal is concerned, we must be careful not to use a tight fitting mandrel in any point on the head of the piccolo. There is a flare fit at the lower portion of the body of the piccolo which starts from the bottom of the low D tonehole to the end of the piccolo. This gives us a megaphone effect. Most piccolos have drawn toneholes. They are not removable and should a tonehole ever be so badly damaged as to require a replacement, it must be actually filed or cut away from the body and a new tonehole soldered in its place.

CORK SIZES

Most piccolos, due to the fact that the instrument is so small, require a 1/32 cork for stopping action on the feet of the keys. For sliding action, a 1/64 cork is used. It is advisable to cut small pieces of cork in a circular design with the use of a small hand punch for place-ment between such keys on the stack section as the spatula of the A key and its point of contact between the A and Bb, bridge key and the F spatula at its point of contact to the F# key. It is also extremely advisable while corking a piccolo to use cork with shellac painted on the back of it This liquid shellac melts at a lower fusion point thereby making the corking process a great deal more simplified than if we were to use ordinary stick shellac. Furthermore, it performs a much neater job than we would receive by applying the shellac separately from the stick. The D# key of the piccolo usually requires a 1/8” cork which is then beveled so that the end of the cork comes to a point. This is dressed according to the fit against the body. In most cases, the same rule pertains to the wood piccolo as well as the metal regardless of whether or not the metal piccolo is sterling silver or a plated base metal. In any event, the shellac cork is much easier to work with than the normal cork and sterling silver instruments make corking keys with shellac cork an absolute necessity due to the fact that sterling silver has a tendency to transmit its heat so rapidly that application of the cork with a shellac stick will seem almost futile.

Pad Floating

The terminology here-in used is descriptive of the actual job involved in padding piccolo keys. The key cup is filled almost to the brim with hot shellac. To eliminate this hot shellac from spilling out the key is momentarily chilled against a wet rag. This has a tendency to cool the bottom of the shellac that is in the key cup, leaving the top surface of the shellac still hot enough to adhere to the piccolo pad which is then placed on top of the shellac. This must be done quickly so that the shellac does not cool off too much. As soon as the pad is placed in position, the entire key is cooled against the wet rag. This eliminates the hot shellac from bubbling up and spilling over the edges. In this manner, the thin pad will lay on top of the key cup in such a manner as to look as though it were actually filling the key cup. However, the important feature is the fact that the entire surface of the pad will lay level. It is advisable when applying pads to piccolo keys to hold the key in small flat nose pliers that have smooth jaws. This will not mar the finish of the key. However, it would eliminate burning of the fingers since the fingers would seem clumsy alongside the small keys such as these. It is further advisable to puncture a small hole in the side of the piccolo pad to eliminate air expansion under the skin of the pad. This is done prior to applying the pad to the hot shellac. It is further advisable to lightly scratch the back surface of the pad prior to application of the pad to the key cup. This will have a tendency to roughen up the cardboard back of the piccolo pad, there-by giving a better holding surface for the shellac to grab.

Pad Seating

Seating of a piccolo pad requires even more attention than any other type of instrument with the exception of oboes due to the fact that absolute coverage is a necessity if the instrument is to play freely and fully. In seating the pad, we must bear in mind that the entire back of the key is filled with shellac. Therefore, we cannot apply the same amount of heat as we normally would on a clarinet key. In other words, we have to be extremely careful to barely warm the key cup so that the shellac just begins to soften. This will enable us to move the piccolo pad to a point of perfect coverage. Prior to placing the key on the instrument for seating, it is advisable to slightly moisten the skin of the piccolo pad. This has a tendency to soften the skin thereby allowing it to accept its impression more readily. We must bear in mind that the moistened skin is what gives us the seating and not the heat. The heat merely allows us to shift the pad. It is further important, when seating the pads on a piccolo to try to bring them into their close and perfect adjustment or regulation as possible with its coordinated keys, thereby eliminating undue work in the regulation of this instrument.

Assembly

The order of assembly of a piccolo should be as follows:

1. Back thumb key which usually consists of a double pad. These two pads must be seated simultaneously. They must be applied to the instrument first so that both sides of the keys can readily be checked. After the pads are seated, we may proceed with the normal order of assembly.
2. The back thumb key is then removed and the back thumb lever applied with the back thumb key as it is returned to the instrument.
3. The G# key
4. The entire lower stack assembly which consists of the F#, F, E and D keys placed together in the same manner as on the flute. (See Key pinning, Flute Repair).
5. The G, Bb and A keys which utilize the pivot point of the B key rod as one of the holding points. The upper stack consists of the Bb, the A and the double G keys. This double G key must have each pad seated individually. However, the regulation between the two pads is such that the height of the pad must take up the regulation point since there is no method of bending these keys or adjusting them to cover together.

6. Low D# key.
7. Two high trill keys.

It is important to remember that when we speak of assembly we mean putting the key in place, seating the pad and making the necessary adjustments insofar as the regulation of this instrument is concerned. (See Regulation).

Regulation

The regulation of a piccolo usually takes place coincidentally with the seating of the pad and the assembly of the piccolo. These are the points of adjustment to watch for: After the F# pad is seated, we seat the F key pad. However, in applying this seating, we assure ourselves that the F covers perfectly with the F#. Any adjustment that is to be made can be made, either through the height of the pad in the key cup which can be maintained at proper level when seating the F pad or by trimming the small round piece of cork on the spatula of the F key. When the E pad is seated, the height of the pad in the key cup will determine the regulation point between the E and F# keys. If there are adjustment screws for regulation on the piccolo in question, the adjustment point can be taken up through this regulation point. However, on so me piccolos where there is no adjustment point such as a regulation screw, the height of the pad in the key cup must be seated to coordinate with that of the F# key to eliminate bending of any keys so involved. The D key pad is then seated bearing in mind the exact same procedure described. It must be in perfect regulation with the F# key of the lower stack. Upon the seating of the Bb bridge key, the regulation point between the F key of the lower stack and Bb bridge key of the upper stack is so adjusted by raising or lowering the bridge of the Bb key so that the F and Bb keys cover perfectly together. When the A key pad is seated, it must be treated in the same way and manner as heretofore described, except for the fact that it must be kept in perfect regulation with the Bb , bridge key of the upper stack. The adjustment between them is the same as the adjustment between the F and F# keys. The regulation point is the small piece of round cork under the spatula of the A key.

The final regulation point is between the back thumb key and the Bb key of the upper stack. This is achieved by raising or lowering the spatula of the hack thumb key so that the 2 keys cover perfectly together. In a manner of speaking we do not actually raise or lower
the spatula of the back thumb lever but rather, we tilt it from one side to another. Removal of lost motion on a piccolo follows the exact line of procedure as on a flute. (See page on Removal of Lost Motion—Flute)

Bass clarinet (plateau) joints and alto clarinet (ring) joints.

Bass Clarinets Plateau Key Assembly and Automatic Registers Key Assembly

In view of the fact that bass clarinet toneholes are too big to allow the fingers to actually cover them, we must utilize plateau keys. As a result, we have many more regulation points on a bass clarinet than we would have on the ordi-

Complete bass and alto clarinets with bells and mouthpipes.

nary standard instrument. For this reason the top ring F key is a split consisting of a plateau key where the normal clarinet has a ring. The adjustment point is usually a regulating screw between the plateau key and the small F key that fits under the A key of the upper stack. These two keys must be placed to cover perfectly. The back thumb key is a plateau key that must cover perfectly with the small top F key. It is usually advisable to regulate the back thumb key to the small F key first. This is done by bending the back arm of the small F key up or down, as the case may require. The adjustment between the plateau key and the F key is then achieved with a regulating screw. When the Bb bridge key has a pleateau key in place of the ring, this plateau key is regulated to the BE, key by raising or lowering its finger tip spatula as the case may require. The G key is then regulated to the A key by raising or lowering its spatula. The lower joint of the bass clarinet has a plateau assembly in place of the three ring F key; however, the 4 D key which is the equivalent of the third ring is not regulated to the F# key but usually is nothing more than a lever closing the D key. The F and F# keys are regulated by raising or lowering the back bar of the F# key. The E key is then adjusted to the back bar of the F# key by raising or lowering the E key.

The only other point of adjustment involved on the bass clarinet is that of the register key. Some bass clarinets such as the Kohlert utilize an automatic register key strictly in conjunc-tion with the A key for the clarification of the Bb, throat tone, the regulation of which is identical to that of a soprano saxophone. (See chapter on Octave Key Regulation—Saxophones.) The average bass clarinet not only utilizes this type of automatic register key but also has its automatic register key working in conjunction with the low D key of the lower stack. It follows the same rules of regulation as a saxophone with the exception of the fact that the D key is the alternating factor in the register key assembly of the bass clarinets where-as the G key is the alternating factor in the regulation of a saxophone octave assembly. Many alto clarinets are built along the same lines as the bass clarinet with plateau key assembly. However, there are ring assembly instruments. These are much more simplified and as a result, much less regulation is involved. It follows along the lines of your standard clarinets. The usual bass clarinet will go to low Eb, thereby add-ing one extra key; namely, the key on the bell. If the instrument goes to low Eb, there will be a third spatula along-side the low E spatula for the right hand. This consists of a lever key for the right hand to operate the key on the bell. It must be kept in perfect adjustment with the low E key. This adjustment is achieved at the small regulating point between the low E and Eb spatula.

Full Boehm Clarinets

The full Boehm clarinet consists of addition to the normal standard clarinet. For instance, it has an articulated Bb, or Eb, key which consists of an extra ring instead of the opening hole, which utilizes a fingering for Eb, or Bb, with the use of the first and third fingers. There is a small pad on the Bb, bridge key which we refer to as the auxiliary key. The third ring key is attached to the actual Bb, key. The regulation point between these two pads is usually an adjustment screw fitted on an extended arm from the auxiliary key over the top of the pad arm of the Bb, key. These must be covering perfectly. It is usually wise to use the floated piccolo pad in the small auxiliary key which as a result is 71/2mm. The articulated G# is another assembly on the full Boehm clarinet. This allows the musician to finger the G# or C# with the right hand as the left, in view of the fact that it operates in the same way and manner as the G# key of a saxophone. There must be an adjustment point between the G# and F# keys. This is usually a regulating screw. The spring tension of the G# key is extremely light and the G# lever heavy enough to quickly and easily offset this tension. The articulated D# or G# key allows for fingering with the left hand as well as the right hand. This consists of one lever key placed between the B and C# spatula of the left hand so that when applied, the D# or G# lever lifts the pad cup of the D# key. The last extra feature on the Full Boehm clarinet is the extra note of low Eb, on the lower joint by the addition of the extra key adding to the length of the instrument so that the spatula of the key is along-side the right hand spatula of the low E key so that the low Eb, E and F keys cover perfectly together.

Omega and LeBlanc Clarinets

The Omega clarinet is the most expensive model clarinet sold by the Selmer Company. The basic difference between this instrument and the Selmer Center Tone clarinet consists of firstly, the fact that the Omega clarinet utilizes bronze hinge bearings but most important of all is the fact that the Omega clarinet utilizes an automatic register key for the clarification of the throat tone of Bb using the back ring key as the alternating key for this type of assembly in a manner quite similar to the LeBlanc clarinet which utilizes the A key for its alternating point. The LeBlanc clarinet was the original one to have the automatic assembly. However,it is only fair to state that many years before the LeBlanc came forth with such an item, there was a European company that had such a key arrangement on their instrument. This company has since gone out of existence. The purpose of the automatic assembly is to open an equivalent key to that of ‘the high Bb trill key so that absolute clarity of tone is achieved on the throat tone. The LeBlanc clarinet has one model whereby it utilizes a double pad cup on the C or F key on the lower joint. This, in turn, has a tendency to give better clarity to the low G or middle D notes. The pads, when seated, must be kept in perfect adjustment with one another so that they act as a single key.

CHAPTER 8

OBOE REPAIR

Explanation Systems

The oboe is a double reed instrument and actually the soprano of its family. The double reed family consists of the oboe, the oboe d'amour, the English horn and the bassoon. There are two systems of oboes. The older one is called the military system. This was replaced with the more modern conservatory system. In effect, there was the same difference as between the Albert system clarinet and Boehm system clarinet. Of the more modern system (conservatory) there are two types. The first type is referred to as a ring job or simplified system. The second type is the plateau which actually eliminates the use of open ring keys whereby pad corks are used on the same particular keys so that it entails a tremendous amount of regulation and adjustment. There are, many articulations on different oboes. However, most of the articulations are only put on the plateau instrument. Both the ring and plateau jobs come in two types insofar as octave arrangement is concerned. There is the double octave or the automatic octave. We refer to this key arrangement as the octave key in view of the fact that unlike the clarinet, which is built in twelfths, the oboe is built in octaves since it is of the conical bore family. There is a perfect rate of taper throughout the oboe consistent with the metal tube in the double reed through the bore to the middle of the bell. The type of wood used on the instrument is grenadilla (Mozambique). The top of the oboe has an umbrella like, effect which is referred to as the crown. Most of the oboes utilize tenon caps on the male tefloris. The oboe uses the time of pin rods as on flutes whereby bridging of keys can be eliminated. However. in place of pins, the oboe uses threaded screws through the steel rod in most cases. There have been models that use the type of pins as on flutes. Due to the fact that the pad sizes of an oboe are so small (7 1/2mm), it becomes absolutely necessary to achieve a perfect level to the pad surface so that perfect coverage can be achieved. To do this. we use thin bladder pads such as the one used on piccolos and we float these pads in place. This holds true even for the larger keys which take approximately l4mm pads. Many of the pads on the oboe require a hole in the middle of the key for clarity of tone and therefore, the average pad has to be eliminated due to the fact that it has a skin cover. On these types, cork pads are used.

Cork Sizes

There is very little to learn about the cork sizes on the keys of an oboe since there is only one size cork used. Regardless of whether the key hits the body for stopping action or sliding action against another key, the only size cork used on an oboe is the thin or 1/64. The keys are so small that in corking the keys, it is sometimes advisable to hold the key with a small pair of pliers so as not to burn your fingers. Cork that has the shellac painted on the back works to good advantage on this instrument. It may be necessary for the removal of lost motion, to cut the 1/64 cork in half on some keys. This can be determined as the instrument is being assembled. There are many adjustment screws on the keys of an oboe. We must remember that if we place a cork over the adjustment screw, the adjustment screw then becomes useless. Therefore, when there is an adjustment screw on an oboe, we must realize that the corking is done on the opposite key.

Key Assembly Explanation

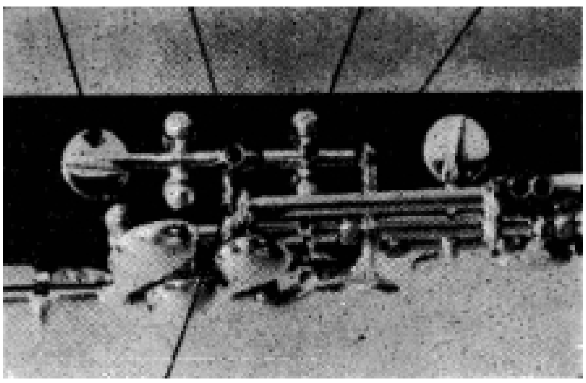
Basically speaking, we must describe this twice so that we can cover both the ring job and the plateau oboes.

Ring Job

On the upper joint, there is very little other than an automatic octave key that requires explanation. The two small pads of the upper stack have their spring tension set to be as light as possible so they barely hold the keys open and can be operated individually. The adjustment point between these two keys is on an adjustment screw so that the two cover perfectly together. The G ring is adjusted to these two small keys by means of a set screw so that when the G ring is pressed down at its proper height (barely above the tonehole) the two pads will cover their respective toneholes. The two trill keys must have a slight amount of lost motion between their levers and their respective keys. The side lever that acts as the bridge to the lower joint has a heavy enough spring tension to offset the tension of both the small keys on the upper stack so that this lever will hold these two keys in a closed position until such time as the tension of its spring is released by the F key of the lower stack. If there is an automatic octave, the set of the automatic octave must be such that the G key will use for its stopping action the G octave key. When the G key is pressed down to its proper position so that the two small keys of the upper stack are held closed, it must be at a perfect point of adjustment to the octave. The octave lever maintains a heavy enough spring tension to close the A octave and G octave simultaneously by offsetting their spring tensions. The thumb octave lever is merely used in this case as a point of operation for the finger and its spring tension should be light and there should be a small amount of lost motion between it and the lever that holds the two small octave keys closed. This small amount of lost motion is necessary to assure us of the fact that the octave lever is doing its job. The lower joint of the ring job is fairly simplified since the F ring, as an open key, has basically no point of regulation until the two joints are placed together at which point there is a small amount of lost motion left between the side bridge lever of the upper joint and the F ring as an assurance that the two small keys of the upper stack are remaining in a closed position. When the F ring is depressed to a point whereby it is slightly above its finger hole, there is a point of contact to hold the G# key in a closed position so that the G# leyer would not cause the G# key to open. The back bridge of the upper joint rests upon the F key or ring of the lower joint. Therefore, it is put into operation by the F ring. However, there is an extensison of the back bridge of the lower joint so that it becomes also operated with the E auxiliary key. Therefore, since the E auxiliary key is an adjustment with both the F key, E key and the D ring, the back bridge can then be operated from any key of the lower stack. The actual point of regulation consists of the E key which utilizes a cork pad on both the ring job or the plateau being put into perfect adjustment with the E auxiliary key by means of an adjustment screw at the back arm. The D ring merely has to close the E auxiliary key when it approaches the proper height above its own finger hole. There is an extension of the E key (cork pad) that leads under the C key that is fingered from the right hand so that the bending of the arm of the C key is your point of adjustment to allow the C key to cover perfectly with the E thereby causing both the C key, the E key and the E auxiliary to cover together. However, we must bear in mind that we never regulate more than two keys at the same time with the thought in mind that if the E key cover perfectly with the E auxiliary, and the C key covers perfectly with the E key, those things which are equal to one another are equal to each other. The C# key of the lower stack actually has no point of regulation other than the fact that the extended arm of the C key is set against the C# key so that there is no lost motion between them. This is not a point of regulation; it merely eliminates what would be a bad feel to a musician. The C# key merely opens until such time as the C key stops. There is an adjustment screw on the D# key which is a point of adjustment to the back foot of the C key so that when the C key is pressed to a closed position, it should cover the D# key perfectly. The D# key has a light spring tension which tends to keep the key in an open position. However, there is a heavy tension spring set in the body of the lower joint that reverses the spring tension of the D# key and extends past the D# key so that the D# key will remain in a closed position until such time as the tip of this extended spring is depressed at which point, the spring tension of the D# key goes into operation holding the D# key in an open position. The lever for the D# key must have a small amount of lost motion between itself and the D# key as an assurance that the D# key is held in a closed position. The B key is an independent working key that merely has to have its pad covering. There is a tremendous key affair which consists of a D# lever, a B lever and a low Bb, lever. This key is set up whereby the D# lever and the Bb lever are actually one and the same key so that when the Bb lever is operated, the key is pressed toward the left side so that its prong, which is placed on its left side, closes the low Bb key. If the key is fingered from its opposite edge so that the key is depressed to the right side, its arm extension rests against the extended tip of the D# spring and depresses this spring thereby allowing the D# key to operate under its own spring tension. The low B lever is a key on the same assembly by means of the pin rod which presses against the foot of the B key which is closed by depressing this extra spatula. However, the opposite tip of the low Bb lever operates an extension lever of the low Bb key which, in turn, is the bridge for the low Bb key which is on the bell. There is an. adjustment screw between the low Bb lever and the fingertip extension lever for the perfect point of regulation between the low B and Bb. However the smart trick is to set the adjustment screw so that the extension lever rests against the body before it is put into operation and the point of regulation between the low B and Bb key should be taken in by bending the low Bb key which is on the bell either up or down as the case may require. By doing it in this manner, we can thereby eliminate any lost motion.

Plateau Job

All that has been described on the ring job holds true for the plateau job. However, there are some extras insofar as the plateau keys are concerned. Firstly, the ring job utilizes a musician s fingers as keys for perfect coverage over the finger holes. The plateau job must have a perfect point of adjustment on closed key cups rather than open rings. The A ring becomes a cork pad with a hole in it and must be perfectly adjusted to the A auxiliary or Bb, key. The open G ring becomes a closed key with a cork pad that has a hole in it and it must be perfectly adjusted to the G auxiliary which must be kept in perfect regulation with the A auxiliary key. The normal side Bb, fingering of the ring job now becomes an operating source for the G# key where the side Bb key no longer has a pad but instead uses itself as a point of leverage between the G#key and the G key so that when it is applied it closes the G key which in turn closes the A auxiliary and G auxiliary keys and opens the G# key by depressing its foot. If there is an automatic octave on the plateau instrument, it also brings the G key into play with the octave assembly so that it releases its tension against the G octave and comes to a perfect point of coverage with the A octave. The B key of the oboe is a cork pad with a hole in the center which must be kept extremely close to the body when it is in its open position due to the fact that the C# on the oboe is an extremely sharp note and by keep ing this key extremely close to the body, it tends to flatten the C# so that it would bring it into better intonation. On the ring job, the G ring has a small extension wire under the G# lever so when the G# key lever is applied allow-ing the G#key to open, it closes the G ring and uses same for its stopping action. This extension is eliminated on the plateau job and replaced with a dual lever that is depressed by the G# lever so that the first lever that is depressed, presses the second lever which has an extension against the A key thereby using the A key for its stopping action. On many of the plateau jobs, there is a very small tip of a key which utilizes a heavy enough spring to close the A and B auxiliary keys. This small tip is operated by the bridge extension to the lower joint which, in turn, has a light spring tension and is used to press the small tip to release the two auxiliary keys. The two trill keys of the upper joint are operated on the plateau in the same way and manner as on the ring job. On the lower joint, the open F ring becomes a closed pad which is set into adjustment with the G# key of the upper stack by raising or lowering its arm and there must be a small amount of lost motion between the back bridge which is operated by the closed F ring and the upper bridge extension to assure us in the same way and manner as on the ring job that the B auxiliary and A auxiliary are remaining in a



Resonant F assembly.

closed position. The next change is the fact that the D ring becomes a closed key with a hole in the center so that a cork must be utilized whereby this cork pad is kept in adjustment with the E auxiliary of the lower stack. The plateau oboe usually has a resonant F asembly since the fork fingering F is extremely dead and has a tendency to sound flat. This resonant F key assembly sharpens the note by virtue of allowing an extra escape hatch for the sound waves.

It further brightens it to a point whereby it has a better pitch and sound. (See Resonant F Key Assembly). The plateau oboe also utilizes a small extension arm which is placed alongside of the D key to act as a C trill lever. It further utilizes another extension arm which operates with the D# lever of the left hand to close the D key of the lower stack. There are extra articulations on many different models. However, they are too numerous to enumerate and their purpose is easily visjble as well as their method of operation. There is one model instrument (Loree) which utilizes a Bb lever which is directly beneath the thumb rest on the lower joint and is operated with the thumb. However, this model is pretty well outdated.

Replacing Crowns

Very often, an oboe can crack so that the crack actually goes through the crown of the oboe. This is quite common. When the crack intercepts the crown, it is advisable to not only put to either put a ring on the crown so as to crush the crack together at the crown or to cut the crown away and replace it. If the crown is to be replaced, it is done after flush bands have been placed on the body. (See Flush Banding, Clarinets). The flush band of an oboe is made of sterling silver since a tremendous amount of shrinkage that is necessary to apply this, will cause the German silver to become too hard prior to proper shrinkage. The replacement of the crown is quite simplified. The body must be cut down on the lathe so that the complete umbrella affect of the crown is eliminated leaving just a thin shell approximately 1/16 of an inch thick over the reed retainer. A new piece of wood or rubber as the case may require, is then cut to fit over this extended end. It is held in place with a firm glue (plastic steel is recommended). After the glue is dry and secured, the shape of the new crown is then cut on the lathe. This will, in no way, affect the instrument and it can be put on in such a manner as to not even be visible as a replaced part. The cracked oboe should have the crack filled first by forcing plastic steel down into the crack after the ring has been applied so as to seal any leakage, after which, crack filler is used as a disguise so that the crack cannot be visible to the human eye. Crack filler used can be purchased from any one of the suppliers in this country. However, I prefer to make my own of a mixture of wood shavings and hard shellac and rolled into a shellac stick since this will make a better appearance than a shiny black finish of the type of crack filler sold by the suppliers.

Tenon Replacement

There are only two tenons that might have to be replaced on the oboe, the center tenon (male) of the upper joint, center tenon (female) of the lower joint. It is an extremely rare occasion when the bell tenonthe lower joint of the oboe has to be replaced. Tenons are replaced when they have been broken and for no other reason. If the male tenon of the upper joint is to be replaced, we must remember that in order to bore this instrument out to receive this tenon, we must change the taper bore of the instrument to a straight bore by the insertion of a liner stud or bushing which will hold firm in the body at a point approximately the height of the G auxiliary key. At this point, we have a sufficient clearance for a cutting tool. This stud or bushing should have a 1/4 inch hole through the dead center of itself so that our boring bar which would be 1/4 inch in diameter will use this hole as its pilot for a perfectly straight and true cut. This quarter of an inch boring bar can then utilize 1/8“ piece of drill rod set crosswise through it so that the 1/8“ drill rod would act as a cutting bit in the same way and manner as a normal boring tool used on clarinet tenon replacement. The instrument is then bored out to a point past the G tonehole but not up to the G auxiliary key. The new tenon that is made to replace this must have a perfect rate of taper continuing from its point of contact in the upper joint to a point whereby it is a perfect match to the continued rate of taper at the end of the female tenon of the lower joint. The G tonehole can then be drilled away after the tenon is inserted and the glue properly dried and this C tonehole can be brought out to its perfect size by means of circular files. Tonehole under cutting tools can then be used to bring the A to a perfect intonation. The cork recess is then cut in the tenon and the cork replaced. If the female tenon of the lower joint is the part to be replaced, the ring of the lower joint must be removed since this ring not only fits over that broken part but has two extended arms which are fastened to the body by means of small wood screws and this ring holds three posts. The line up of these posts is important and actually determines for the repairman the exact length of the female tenon since it calls for the perfect fit of the keys back in place. The replacement of this tenon is quite simplified since the only portion of the instrument that would be cut away from replacing this type of tenon would be cut in such a fashion that the tenon replacement consists of nothing more than a sleeve which fits over the lower point past the F tonehole. To prepare the body for this tenon, the extension must be removed and if there is a metal sleeve in the tenon, this is also removed. The body is then cut down to a point deeper than the measurements of the old female tenon. The length of the cut is to a point just past the F tonehole but not to intercept the E auxiliary tonehole. The new sleeve is then cut to fit over this so that its length would put back the exact length of the tenon extension. When the glue is hard, the body is cut down so that the outside diameters match. The ring is replaced on the body and the tonehole relocated by measuring it with the key then dressing the hole to match the exact measurernents of the old hole with circular files after which, if it is a plateau job, the new tonehole is cut. In a ring job, a finger hole is replaced. Lastly, the metal insert for the female tenon is replaced. This is held in place with hot shellac. In some rare instances, bottom screws are sunk into the old tenon. However, if these bottom screws are utilized, to begin with, the old hole would still be intact in view of the fact that replacement of this type of tenon does not cut deep enough to disturb it. The bell tenon uses the same procedure as the male tenon on the upper joint except for the fact that it requires a larger stud or bushing insofar as the size is concerned. On this tenon, however, it is not necessary to intercept any toneholes since the depth of the cut will have sufficient room to merely approach and not intercept the low B tonehole.

Cork Pads

Cork pads are utilized whenever a hole is built in the key so that a skin pad will have a tendency to leak by virtue of such a hole. They are further used to eliminate any buzzy tones and because of the fact that they have longer life. In cutting cork pads, we must remember that cork is a form of wood and as such it has small knots. These knots are actually points of leakage on cork pads. Therefore, any cork pads that are cut must be cut from absolutely nonporous cork. It is advisable when applying these cork pads not to cut the pads from a thickness that would bring it to the perfect size, but rather to bevel the back of same and with the use of a little extra shellac, allow the cork pad to ride in the key so that the pad can be easily set for perfect coverage. Applying the impression on the pad must not be done with extreme pressure but rather the impression is applied when the shellac is hard by lightly pressing against the key after which we are assured of the fact that the coverage of it is perfection itself. The hole on the cork pad can be applied either before or after the pad is inserted in the key depending upon the type of stud inserted in the key cup.

Padding

The pads of an oboe require a perfect level in order to maintain a perfect seating. Therefore, we do not use regular bladder pads such as the medium or thick clarinet pads but rather, we use the thin bladder pad referred to as piccolo pads. These pads are floated in place. (See Piccolo Repair.) On some oboes, there is a stud similar to a flute stud in the larger key cups (Loree). In putting these pads in place, one should be careful so as to get the shellac in the key cup in the same way and manner as the normal floating job requires. The shellac must not touch the threads of the screw studs that protrude from the center of the key cup. The pad must be floated in place and the stud put on after the shellac is hard. The seating of these pads is performed in the same way and manner as on piccolos. One of the basic reasons for using the thin pad is due to the fact that the small pads of the oboe are usually 7 1/2mm and the larger pads have tone holes almost the size of the key cup. Therefore, the only way we can make these pads cover is to have a flat pad floated on top of the key cup whereby the pad is the size of the outer wall of the key cup. We must further be careful not to utilize a pad that is wider than the outer dimensions of the key cup. In applying the seating, we must be careful not to attempt to receive too deep an impression in these pads or they will have a tendency to cause the side to sink in causing a belly in the pad. It is advisable, at all times, to scratch the back of the pad slightly so as to allow for better adherence to the shellac.

Regulation

The regulation of the upper joint of the average ring job oboe is quite simplified in the fact that the only true point of regulation is between the Bb key pad and the A auxiliary key pad. The regulation of these two pads is set by means of an adjustment screw at the back arm of the A auxiliary key so that both these pads cover simultaneously. The back lever to the F bridge of the lower joint has a spring tension sufficiently strong to overcome both the springs of the two aforementioned keys. We should have a hairline of lost motion between the trill levers and the two trill keys. In the event thait there is an automatic octave key on the oboe, it is regulated in the following manner:

The G ring is set so that at its point of perfect contact to its open finger hole, it closes the Bb, and A auxiliary keys. This is easily achieved by means of an adjustment screw on the G key. At the same exact point of closing, it must also close the A octave key. At its opening point, it uses for its stopping action the G octave key thereby assuring us that when the G key is not in use, the G octave will remain closed. The octave lever must cover the A and G octave keys simultaneously. The thumb octave lever, when applied, must raise the octave lever to a point where-by the A octave comes down to touch the G key without any lost motion between the thumb lever and the body. The spring tension of both the A and G octave keys should be as light as possible, yet capable of a fast, smooth action. The lower joint requires a slight amount of more regulation than the upper joint. The first ring key has two adjustment points. When this is depressed to its proper position insofar as the seat of the ring against the finger hole is concerned the extended arm must touch the G# key. Its back foot must raise the back lever of the upper joint at the bridge assembly to a point whereby the Bb and the A auxiliary key of the upper joint open to that point which just touches the wire of the G ring to the G# lever. The G# assembly consists of a G# key and a G# lever which works in the same way and manner as the G# on the saxophone, that is, the spring tension of the lever must be heavy enough to offset the light spring tension of the G# key. There is a wire off the G ring that extends under the G# lever. In the event that there is no automatic octave key on the oboe, it is this point of contact that determines the height of the G ring. The E auxiliary key which is usually a number 91/2 mm pad must be in perfect regulation with the E cork pad. This is accomplished by means of an adjustment screw between the two. The D ring is a part of the E auxiliary key by virtue of the fact that it is affixed thereto by means of the small pin screws that fasten the two pieces to the same steel rod. The height of this ring must be set so as to facilitate fingering of the instrument. The extended lever of the top trill key on the lower joint must maintain a slight amount of lost motion between the bridge lever of the upper joint and itself for the same trill key to assure us that the height of the trill key wilt remain in a closed position until it is used. There is an extended arm off the E cork pad at its lower extremity which fits under the arm of the C key so that when the C key is closed, it must be in perfect adjustment with the E cork pad of the stack section. The C key must also be in perfect adjustment with the D# key. This is set by means of an adjustment screw whereas the arm of the C key is regulated to the E cork pad by bending the arm of the C key up or down as the case may require. It is important to remember that we must eliminate the use of a pair of pliers at all times, if possible, so as to eliminate leaving any marks on the key. The danger point on this portion of the instrument is the fact that the post of the C key and C# and D# assemblies have a tendency to loosen and turn, thereby causing an improper feel on these keys. This post must be tight and firm in place. (See Post Tightening—Clarinet Repair). There must be a slight amount of lost motion between the D# lever and D# key to assure us that the D# key remains closed until applied. There is actually no point of adjustment between the C and C# keys since the C key uses its point of contact to the C# key for its stopping action by means of a small prong extended from the arm of the C key under the cup-like spatula of the C# key. This point of contact determines the height of the C key and by virtue of this fact, it determines the height of the E key of the lower stack. Therefore, if. we want to raise the height of the E key of the lower stack, we must lower the small prong extension and this is done with the aid of a pair of pliers. To close the E key, we raise the small prong. The next point of adjustment is the B lever against the B key. The B lever is the center key in the triple key assembly on the lower stack. There should be no lost motion between these two. The final adjustment of the lower stack is performed by eliminating the lost motion between the D# lever for the left hand and the spring that is placed on the body which holds the D# key closed. It should be a perfect point of contact. At the same time, the low Bb extension lever should be resting on the body with no lost motion between the low Bb lever and its extension lever. This is all performed through the adjustment of the two set screws on the Bb fingertip lever and the D# left hand lever. The adjust-ment between the low B and Bb key is achieved by raising or lowering the arm of the low Bb key on the bell as the case may require so that the low B and Bb keys cover simultaneously.

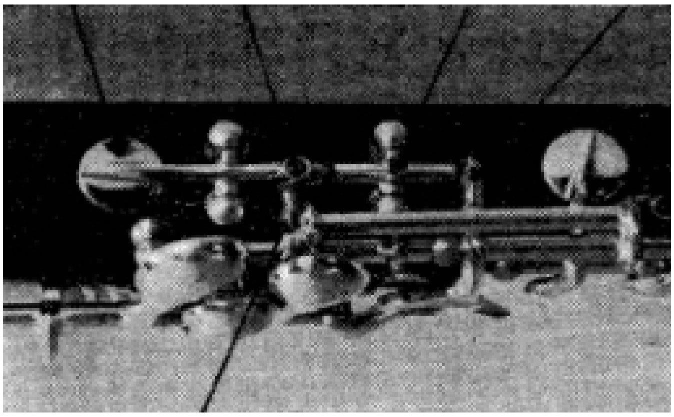
There must further be no lost motion between the left hand B lever and Bb lever. This lost motion must be removed by raising or lowering the fingertip spatula of the B key as the case may require prior to any other regulation point on these keys.

Plateau Key Assemblies
Upper Joint

On the upper joint the basic difference between a plateau oboe and the ring job is the fact that we have closed keys in preference to rings. Therefore, the ring which would ordinarily be the A key utilizes a cork pad in a plateau key (See Cork Pads). This cork pad must be in perfect adjustment with the Bb key just above it. This is achieved with the aid of an adjustment screw between the two. The G ring is also a closed pad and this must be in perfect adjustment with the A auxiliary key so that it will automatically be in perfect adjustment with the Bb key as well. This is achieved by means of an adjustment screw between the G key and the A auxiliary key. This would, in effect, eliminate the wire extension of the G ring that fits under the G# key. However, in order not to eliminate this fingering, there is a double key placed on a rod so that the upper extension of the upper key fits over a small extended arm built off the A key. The lower extension of the lower arm operates under the G# lever key so that the same effect is achieved. However, when the G# key is applied, it uses for its stopping action the closing point of contact of the A cork pad. The side Bb key is actually in contact with the G# key without lost motion, still allowing the G# key to remain closed until the side Bb lever is applied at which time it must open the G# key which in turn will open the G# lever so that the A key will close to its tonehole. There is very often a point of contact on the upper register key assembly between the G key and B key cork pad on the upper joint. It is advisable to keep these two in perfect adjustment. However, a more advantageous arrangement on the B key is to have it completely individualized so that it may be set as close to the tonehole as possible since the C# on the oboe is a note that is extremely sharp and to bring this note into proper intonation, it is necessary to keep the B key of the upper joint extremely low, thereby flattening the note so that the instrument will play in tune.

Lower Joint

There is very little difference in the plateau assembly of the lower joint. It requires a closed key instead of an open ring on the first ring of the F key. At its point of coverage, it must be kept in adjustment with the G# key of the upper joint through its extended arm as heretofore described. (See Regulation—Ring Job.) The outer plateau key replaces the D ring and is a doughnut type cork. However, in view of the fact that the F or the fork F fingering of the oboe is extremely dead or flat. it is necessary to add to this instrument an arrangement of keys known as the resonant F key assembly to add more brilliance to the fork F fingering. As a result, the D ring which is now a closed key on the plateau oboe, must have a ring on top of itself. This ring operates the E key of the lower stack so that the D key



Resonant F assembly.

and the E auxiliary pad are in perfect adjustment. This is usually accomplished by means of an adjustment screw between the two. The plateau oboe further gives an extended arm built off the assembly of the long lever keys so that when the D# key is applied, the extended arm contacts the D cork pad closing the one specific key, using this point of contact for its stop-ping action on the D# key. There is usually a low C trill lever built in front and alongside of the D cork pad. This lever raises the back foot of the C key so that the C key can be operated with that third finger.

Resonant F Key Assembly

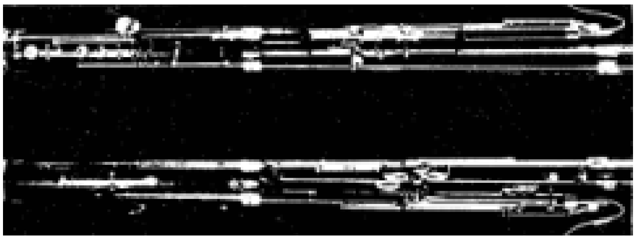
The resonant F key assembly consists of two keys placed at the bottom of the stack keys of the lower joint so that although the key remains in a closed position, it opens with the application of the D key and must be put into ad-justment so that the E key cork pad will close it. This is so set by means of an adjustment screw between the E key and the resonant F lever. This key, therefore, would open upon the fingering of the fork F and by giving an extra escape hatch to the sound waves, it clarifies the fork fingering F. However, it is independent of the D key in this respect. When the D key is held in a closed position, it allows the resonant F, by virtue of its own spring, to open and therefore, this key can be closed by the point of contact with the E cork pad so that there is no difference in the fingering of the instrument, insofar as the musician is concerned, but the clarity of this note is then achieved, automatically.

CHAPTER 9

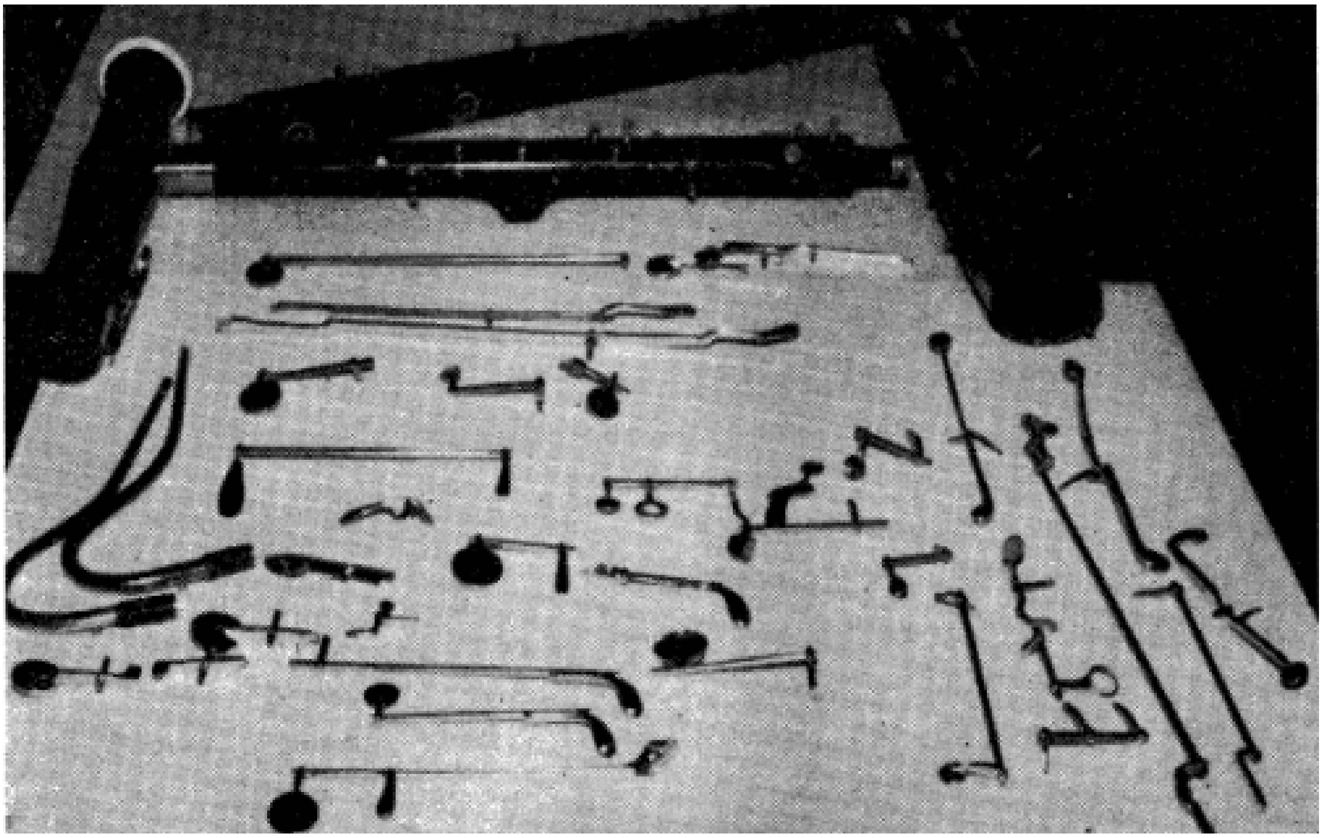
BASSOON REPAIR

Explanation of System

The original bassoon, as we know, was known as the French system. This instrument is the equivalent of the Albert System in the clarinet, or the Military System in the oboe, or the Meyers System in the flute and piccolo lines. In other words, it is outdated and very rarely used. The present system used today is known as the Heckel System. There are differences in the fingering of these two types of systems not unlike the difference in the systems on other instruments. The Heckel System was brought out by the Heckel Company for the purpose of facilitating fingering and articulation for the musician. The bassoon consists of a bocal or mouthpipe. The upper joint is rubber lined because the type of wood used on the average bassoon is such that it would deteriorate and rot from its contact with the saliva. Therefore, it is extremely important to bear in mind this one particular fact. In the event that a new tenon has to be made on the bassoon upper joint, it is extremely urgent to remember that while this tenon is replaced, the rubber lining must also be replaced and it is this rubber lining which must have the perfect rate of taper for the continuance and replacement of the proper size bore. The spring tension of many of the keys must be extremely heavy due to the fact that the keys are so big. To maintain this extremely heavy spring tension, we must keep the posts in a firm position and this is a point to look out for due to the fact that the wood is much softer than the grenadilla wood used on other instruments. As a result, these posts

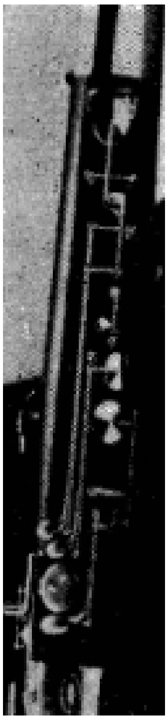


The Heckel System Bassoon



Disassembled bassoon.

have a tendency to turn completely in the body. This in turn upsets the spring tension. To alleviate the tension from the threads of the posts, we must either use lock screws in the posts wherever there is spring tension or a smart trick would be to put a small screw in the body, approximately 1/8 of an inch from the posts so that the spring itself would be pressing against this small screw, applying its tension at that point, thereby alleviating any pressure against the threads of the posts. The lower joint of the bassoon runs parallel to the upper joint. The bell is affixed to the lower joint. Both of these joints are placed in the double joint known as the boot joint. This boot joint receives its name from its bottom boot



Bootjoint

which consists of a brass tubing silver soldered to a main plate which is fastened to the boot joint at its bottom to act as a connecting tube between the joints. This piece of brass tubing uses gasket cork to seal the leakage at that point. It is removable for the purpose of cleaning the boot joint connecting it. The joint can be either corked or threaded. By threaded, we mean wrapped with cotton thread to act as a cork. Many people prefer the threaded type joint since they feel that the thread at this point acts as a reinforcement on the male tenon. In view of the fact that the bassoon wood is much weaker than the grenadilla wood as used on other instruments, this is quite understandable. The ring on the boot joint over the two female sockets is held in place with shellac, although it must be a firm fit to eliminate the possibility of cracking this joint. It is advisable to have smooth fitting joint corks but they should not be too tight since tight joint corks could result in breaking of the female tenons. The upper joint and the lower joint are held together by means of a body lock. This instrument is actually the bass instrument of the double reed family. The finish of this body can either be varnish or lacquer as determined by the factory that manufactured the instrument. (See Body Refinishing.)

Body Pins

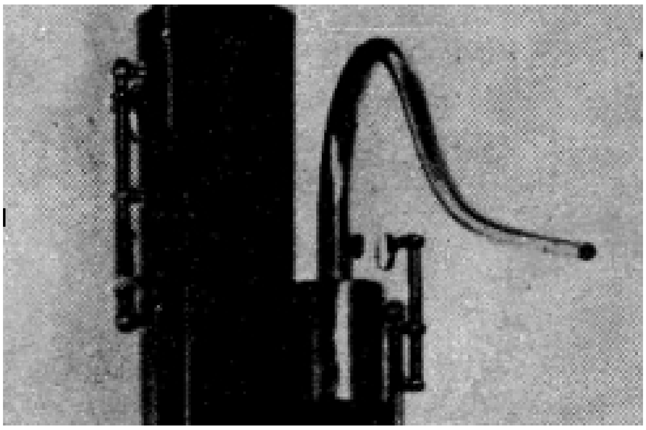
Body pins on the bassoon are utilized strictly on the boot joint. They are used for the purpose of allowing a key from one side of the boot to operate a key on the opposite side. These pins run through the solid wall on the boot joint and do not intercept the bore. They can be either wood, metal, glass or plastic. The size of the pin is determined by the regulation points of the various keys for which they are operated. They must be smooth working and loose fitting in their particular holes. There are three or four of these pins on the average bassoon, depending upon the model.

Threaded Joints

Thread is sometimes applied to the male tenons to take the place of joint corks. This thread must be carefully wound so that it does not overlap its seat at the far end and the joint is built up to the proper size with the thread for the perfect fit of the male tenon into its female socket. When sufficient thread is wound on these parts, to accomplish this end, this thread must be waxed so as to hold itself in position. Threaded joints do have a tendency to strengthen the male tenons. As a matter of fact, they are recommended by most factories. They are not as neat in appearance as cork. However, they do the job sufficiently well. They can be wound very simply on the lathe with the body turning very slowly.

Bocal Repair

The bocal of the bassoon is usually damaged by the musician when placing it into position without grease. Since this is a long thin piece of tapered German silver tubing and



Bocal and whisper or piano key.

extends quite a distance, its point of leverage is extreme. Therefore, it can bend usually at its first turn which is its weakest point. In bending this back it may crack. The proper repair of this bocal is to remove the dent, file a crevice in the cracked portion and run silver solder in this crevice. If a bocal should crack, it is usually advisable after repairing the same to place a brace on the under side in the same way and manner as the type brace used on a saxophone neck. This will strengthen the bocal and eliminate, to a great degree, the possibility of future damage. A joint cork is put on the bocal in the same way and manner as the neck cork on a soprano saxophone. We must be careful to remember that the whisper key hole on the bocal must be kept free and clear at all times.

Cork Sizes

The sizes of cork used on the keys of the average bassoon follow the same line of continuity or set of rules as heretofore described in saxophone repairing. (See Saxophone Repairing—Key Corking.) In the event that the key utilizes a stopping action whereby it contacts the body, the cork size on the average key would be 1/16 of an inch. Sliding ac-tion between keys requires a 1/64" cork. However, the spatulas that contact the body pin requires a 1/32" cork at the point of contact. There are some keys such as those on the upper joint which actually use 3/32" cork to allow for the proper opening of the key, still maintaining the proper height of the spatula when the key is in a closed position. As on the flute, some corks are so heavy, since there is no post in the body to act as a stop for them, that it is necessary to make these corks from bottle corks. The corks are applied in the same way and manner as on clarinet keys since the bassoon keys are made of German silver. There are some cork pads on the bassoon on the upper joint in those particular places when the top pads hit on metal tubes in the upper joint. In view of the fact that the kid pad in these particular keys would allow far too deep an impression in the seating of the pad, thereby causing the pad to contact the body, possibly causing leakage at this point, it necessitates a cork pad with a very light impression. On the long lever keys on the lower joint it is advisable to cork-line the guide posts for the extended lever to the bell key to allow for the elimination of noises that may occur between the guide posts and the key, due to side play between the key and the guide posts.

Padding Hints

The application of the bassoon pad to the bassoon key is repetitions of saxo-phone work (See Saxophone Padding— Regular Pads) with this exception: Bassoon pads utilize the same material in the make-up as saxophone pads except for the fact that it is unwise to use any backing of paper or cardboard on the bassoon pad. We must allow the shellac to hit the felt on bassoon pads so that through the application of the shellac to the felt, we can soften the pad completely through the heating process while seating the pad since the depth of the impression in a soft pad is a virtual necessity in making bassoons cover their respective toneholes. If pads that have a cardboard or paper back are used in the repair of bassoons, it is wise to cut away that piece of cardboard that is exposed at the back of the pad. It is certainly not wise to use riveted pads. There should be no rivet. However, on some of the pads, we can allow for a stitch to hold the skin to the felt so as not to allow it to become loose or droopy. Some bassoon key cups are built in the same way and manner as saxophone key cups. However, the older bassoons work with case cups which allow no actual depth to same. On this particular type, it is advisable to flatten the pad so that it is extremely thin and since the bottom of the key cup is a complete curvature, it is necessary to actually simply float the pad. As on all other instruments, the perfect coverage of the pad is an absolute necessity on the boot joint. We have two toneholes which are segmented.

That is to say that it has two toneholes rather than one, over which a circular pad must be seated so that the impression in the pad allows for a perfect coverage over both the holes. This occurs when the holes go into opposite tubes in the boot joint. To allow for perfect coverage on this type of pad, an extremely soft pad must be used. The upper joint of the bassoon utilizes pads from your brown clarinet pads or thinner than saxophone pads.

On the upper joint, tremendously deep impressions are to be completely avoided. On the lower joint, we have two open keys which demand perfect coverage. A slightly deeper impression is advisable on the closed keys. This is easily obtained due to the fact that the spring tension on the closed keys of the bassoon is quite heavy by comparison to any other instrument. The boot joint pads for the. most part follow the same rules insofar as the depth of the impression is concerned. However, it must be understood that when we speak of a deep impression, we must still bear in mind that the pad must cover perfectly before the impression is applied. The pads are seated in the same way and manner as saxophone pads. That is, the pad slick is used to move the pad to a point of perfect coverage when the key has been heated to soften the shellac that acts as the glue for the pad. It is extremely advisable in the assembly of the lower joint and the boot joint to use a leak light which will allow you to see rather than guess at the perfect coverage of the pad. In view of the fact that the upper joint toneholes - are so small on the few pads that are utilized on same, the use of a leak light is actually unnecessary. Furthermore, the inspection light that will have to be used on the upper joint of the bassoon will have to be extremely small to fit the bore of the instrument.

Rubber Lining—Upper Joint

The upper joint of the bassoon, to eliminate the possibility of deterioration or rot of the bore of the wood due to contact with the saliva, is lined with hard rubber. This rubber lining maintains a tapered bore of the instrument and this must not be disturbed in any manner, shape or form. This rubber lining is held fast in the center of the instrument by means of a waterproof glue. In the event of tenon replacement of this section of the instrument, we must bear in mind the fact that the rubber lining riiust be replaced and the replacement portion must continue the exactness of the bore of the instrument to maintain the proper intonation. Besides having a rubber lining on the upper joint, the average bassoon maintains a tenon cap on the male tenon of the upper joint. This section is mandatory to prevent chipp'ing of this fragile part. The upper joint and lower joint both fit into dual

Spraying finish on upper joint of bassoon.

receptacles at the top of the boot joint which is usually metal lined. When the instrument is placed together, there is a perfect rate of taper continuing from the tip of the bocal through the entire instrument. We must bear in mind that the bassoon is the bass instrument of the double reed family and therefore follows along the same pattern as all other double reed instruments.

Body Refinishing

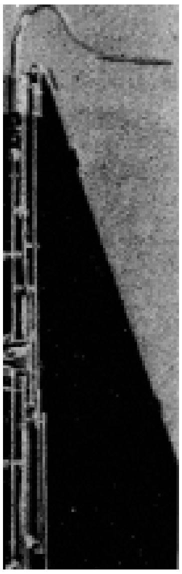
Unlike other wood instruments such as those made of grenadilla, the bassoon has a color finish. The usual color of the average bassoon is cherry mahogany. We cannot merely polish the finish of the average bassoon and expect to have it look like new as we do on the average oboe or English horn. Very often it becomes necessary to remove nicks, scratches, etc., and to replace the actual gloss finish of this instrument. To do this requires a complete refinishing of the joints. To refinish the body of a bassoon entails the removal firstly of all of the posts and metal parts so that only the wood remains. The old finish can be removed with any normal paint remover since the average finish of the bassoon is a varnish finish over the instrument after it has been properly stained. When we have removed the finish down to the bare wood, all traces of the paint remover must be removed with benzine. When this is done, the final dressing of the wood prior to staining must be accomplished. This is done by dressing out the scratches through light filing and then sanding, breaking down to the finest sandpaper that can be purchased, after which, the instrument is rubbed completely smooth with very fine steel wool. In all of the preparations, we must be extremely careful to eliminate, contact of any of these abrasives against any of the toneholes. When the body is completely smooth, it must then be stained, as we would stain any piece of furniture. A smart stunt is to purchase a wood sealer, thin this wood sealer and mix the stain in it. Spraying of the instrument rather than painting it allows for a much smoother job. After the original coat is sprayed, this type of preparation will not only stain the body to its proper color, but will seal the wood so that it stops breathing. When this finish has completely dried, it must be rubbed completely smooth. After the instrument is completely stained, a coat of thin shellac must be applied to act as a sealer so as to close the pores of the wood. In this fashion, any further finish coat that is placed there on would not seep into the body but rather would remain on the surface giving us a glass smooth finish. After the sealing of the wood has been accomplished, it must be rubbed smooth and the first coat of varnish applied thereto. This coat must be thinned out to a watery state so that it can spread evenly and thinly on the instrument.

When this coat is completely dry, it must be completely rubbed down so, it is absolutely smooth and a second coat of varnish is applied in the same manner. When this second coat is dry, a third coat is applied in the same way and manner. The number of coats of varnish depends entirely upon the quality of the finish desired. After the final coat of varnish is applied, the instrument must be rubbed down and then waxed as a piece of furniture so that it maintains a beautiful finish. Prior to the application of the last coat or finish coat of varnish to the instrument, all of the previous coats must be removed from the toneholes, either on their seats or the bore so that the wood shows directly forth. It is wise to leave whatever varnish has gone into the threaded holes since they will tend to act as a tightening agent when the posts are replaced. When the toneholes are completely clean without any disturbance to the finish of the body, the final coat of varnish, completely thinned out, is applied so that an extremely thin coat of varnish will remain on the toneholes thereby preserving the wood at these particular points. Before reinserting the posts and metallic parts to the different portions of the bassoon, it is wise to polish them. It is smart, for the purpose of handling, to screw these posts in their proper order into a block of wood. In this manner, all of the posts can easily be polished at the same time after which they can be replaced in the bassoon joints.

If lacquer is utilized as a desired finish on the bassoon, the stain must be applied to the part, then shellacked with a very thin coat of shellac. In any event, regardless of whether we use varnish or lacquer, the one trouble spot to watch out for is settling dust on the wet finish. Especially, if lacquer is used, since it is a pretty rough deal to rub the dust out of lacquer. However, should this happen to varnish, it can he rubbed down with any normal rubbing compound and then waxed.

Bassoon Boot

The only important feature on the boot is the application of the cork which acts as a gasket at the base of the boot so as to seal any possible leakage between the boot and the body. It is wise to use gasket cork approximately 1/16” thick for this purpose. To apply the cork, hold the bassoon boot in a pair of pliers without damaging it over the flame until it is hot enough to receive the stick shellac. Apply the shellac so that every portion of the plate of the boot is covered with a thin film of shellac. Press the boot plate firmly against the gasket cork which should be resting on an absolutely level surface so that every portion of the plate is completely sealed to the gasket cork. This should be held in this position until the shellac is hard. Trim the cork around the outer plate of the boot in the same way and manner as if we were cutting the cork on one of the kays. After this is accomplished, the holes in the boot are cut away so as not to change the size of the bore at the boot. A small rat-tail file will help in cutting this cork out. At the same time, two cutous must be made for the screw studs which are on the bottom of the boot joint. Once again, the rat-tail file will do this job. On many bassoon joints, there are two small guide pins which cause the boot to fall in perfect alignment with the bore to the body. These can be merely pushed through by placing the boot against its plate and pressing firmly. Putting a gasket cork on the boot is insufficient to seal the leakage completely and it is wise to use either grease or melted wax to act as a sealer between the plaet of the boot and the bottom of the boot joint. The lock screws that hold the boot in place should be firmly affixed thereto. Prior to the application of this cork, we must remember to clean the boot joint completely. The bottom cap that fits over the boot joint is


Whisper or piano key assembly

merely a hand-pressed fit.

Bell Rings

Bell rings on the bassoon are unlike the bell ring on any other instrument due to the fact that they utilize the rings strictly for design whereby the bell rings are made of either celluloid, bone plastic, or ivory. The bell rings are applied by merely gluing them in place and dressing the edges of same so that it is a perfect blend to the bell. While these bell rings serve no purpose other than to add beauty to the instrument, we must remember that the tenon cap or ring on the bell of the instrument must serve the purpose of holding the wood firm so that the bell does not split when placed on to the lower joint male extension. Very often the ivory type ring will have a tendency to turn yellowish. We cannot turn this finish back to a white color. However, a clean buffing wheel with any white line polish can bring a gorgeous luster to the ring itself.

Whisper Key Assembly

The whisper key is an extremely long key allowing for a small pad to cover a small hole on the bocal. This key is applied to cover this hole from two different points. It is used in conjunction with the thumb of the left hand on the small thumb lever of the whisper key. This thumb lever has a light spring tension on it to hold it in its normal position which is the finger tip lever raised off the body. Its extended arm fits under the arm of the whisper key so that when the finger tip lever is applied, there is sliding action between the whisper key whose spring holds the whisper key in an open position. This sliding action causes the whisper key to close. At this point, there is no point of regulation involved since the key merely moves until it is stopped by the tonehole which it must cover. The back thumb pad of the right hand has an extended foot which extends under a lever extension for the whisper key on the upper joint. This lever extension has a second arm which fits under the whisper key so that when the back thumb key for the right hand is applied, it raises the extension lever so that it, in turn, raises the extended arm of the whisper key there-by closing the whisper key. In view of the fact that the position of the joint could slightly vary, there is a flat spring placed on the extended arm of the whisper key. This in turn rests upon the extension lever of the whisper key so that although there is a perfect point of regulation between the back thumb key for the right hand and the pad of the whisper key, exactness is not necessary. The flat spring would take up any variance at this point of regulation or adjustment. There is no spring tension on the extension lever of the whisper key since this extension lever has its upper arm fitted between the left hand whisper key and the whisper key itself. It utilizes the spring tension of both these keys for its proper movement.

Assembly

The upper joint of the bassoon has a very simplified assembly, since all of the keys are individual side keys operated on flat springs so that they merely have to cover the tone-hole. On some models (the better instruments) there is a finger ring instead of finger holes at the front side of the upper joint. This finger ring is held normally in a closed position by the spring tension of a fork lever key which is underneath the thumb key arrangement. Two keys operate against this fork lever key. The point of adjustment is to allow for a small hairline of lost motion between this fork lever and the two keys that rest upon its spatulas. When these keys are pressed, the spring tension is released from this fork lever key. This, in turn, releases a padded key on the op-posite side of the instrument whose spring tension is sufficient to overcome the extremely light spring tension of the finger ring so that the finger ring can then act as the operating lever for this aforementioned padded key. Actually, there is no adjustment point other than the spring regulation involved there-in so that the spring tension on the ring must be extremely light. The spring tension on the padded key operated with it must be heavy enough to operate the ring key and the fork lever must be sufficiently heavy enough to overcome both springs. If a whisper key is on the instrument, although its finger tip lever can be operated with the thumb of the left hand, it has no point of regulation or adjustment and the whisper key and whisper key extension lever are individually operated with no point of adjustment or spring regulation.

Assembly—Lower Joint

The lower joint of the bassoon has three points of regulation or adjustment. The basic key involved therein is also operated by the thumb of the left hand. This basic key is operated on a flat spring to hold the key in an open position. There is a spring extension from a lever slightly below this key so that the spring extension extends under the spatula of this basic key. This spring extension is utilized so that perfect regulation between the key operated by this lever and the basic key is not necessarily a necessity since this spring extension will give slightly to allow for perfect coverage between the two particular keys. There are two extremely long levers placed on telescopic hinges so that one extension of the lever fits over the basic key. This lever extension operates an open key at the opposite side of the lower joint near the bell fitting. This is a point of regulation between this key and the basic key. This is brought into adjustment by raising or lowering the spatula of the lever involved. The other long lever is merely utilized for the purpose of operating the bell key.

The Boot Joint

In assemblying the boot joint of a bassoon, we must remember that the boot is a two sided affair so that we must actually assemble one side at a time. Basically speaking, there is no point of regulation between any of the keys on the bassoon boot joint due to the fact that the keys all work in the same fashion as the C# and C keys of the clarinet whereby one key moves as far as the next key will let it. Therefore, the only real point of adjustment on the bassoon is the elimination of lost motion as close as possible and the adjustment of the spring tension of the various keys so as to allow them to operate one another. The body pins are inserted in their proper places after one side of the boot joint is assembled, after which the opposite side of the boot joint can be assembled bearing in mind the fact that one of the most important things in the assembly of the bassoon is the lubrication between the keys at sliding action points to allow for a smooth feel in the operation of these keys.

CHAPTER 10

DRUM REPAIR

Mounting Heads, Batter and Snare

Mounting of drum heads is an art that is very rarely used any more today in view of the fact that it is too easy to obtain already mounted heads in the factory. However, if it is necessary to mount your own head, it should be done in the following manner: For both the batter and snare heads, there is a top and bottom to each head. The smooth part of the head is the top surface; the rougher part, the bottom. The head must be soaked to a point whereby its raw-hide skin is soft enough so as to have complete pliability. It should be soaked in water at room temperature. Do not use hot water or it will deteriorate the head. When the head is removed from the water, it is placed with its smooth surface down on a flat surface such as a piece of glass or some similar object. The hoop is then placed on top of the head. (For snare heads, the snare cutout should be facing down). We should allow ourselves approximately one inch extra head past the edge of the wood hoop. Tucking of the head is performed by bringing the outer edge of the head over the hoop and under the hoop again so that the head would lock itself against the hoop. We do this to one corner, then the exact same thing on the opposite side of the hoop. Now take the head and turn it so that we can perform the same operation halfway between the two places that we have already worked on and finally, the same thing is done on the opposite end so that four points of the head are tucked into position. Now, we must work between each point. In tucking the head, we must be careful not to allow the head to crease over itself since this can be the cause for splits in the rawhide as it tightens. We may have to tuck the portion between these four points at approximately three points prior to completing the section involved. Air bubbles should be removed by pressing the edges of the drum tucker against the top of the air bubble and pressing it down lightly. Then wet the finger and run the finger along the inside of the hoop so as to smooth out the inner sections Qf the head against the hoop. This procedure is continually repeated until the entire head is tucked securely around the hoop. Upon completion of this procedure, the outer edge of the head against the hoop is smoothed out with the finger and the finger should be kept wet while so doing. The head should never be allowed to tighten or dry unless it is placed on a shell so that the hoop can be kept in proper position. The raw-hide tightens vigorously when drying. As a result, if the head was left off the shell, it would have a tendency to completely warp the entire hoop so that it would be pretty rough to be able to put it on a shell. If we have a mounted head that has warped out of position, it is wise to wet the entire head, place it on a shell and force it into position holding it in place by means of a counter hoop. Upon drying, it will assume its proper position. When the head is mounted, it should be dried as much as possible by lightly wiping it with a piece of towelling. If any dirt appears on the head, it is easily removed by wetting any piece of cloth and wiping the head off. In the case of the snare head, the head must be pressed down over the beveled edges that are the cut-outs for the snare of the drum. This eliminates the possibility of the snare's tearing the head. In the case of heavier heads, such as bass drum heads, we must be careful not to tuck this too tight since a heavy piece of rawhide will tighten that much stronger and if the head is tucked too tightly, it might split upon drying. This is exceptionally true of tympani heads. These must be tucked extremely loose since they tighten so much.

Silk Heads

There have been heads put forth in the market known as all-purpose heads. These heads were made of silk and worked proficiently with the exception of the fact that a drummer's wire brushes will get caught in them and tear them. As a result, they do not last very long. Replacement of these heads meant replacing heads which were already mounted at the factory.

Plastic Heads

Plastic heads are the newest thing on the market. They have, beyond any doubt, proven themselves to be excellent for drummers since they will stand up in any kind of weather, regardless of humidity and they will take as much of a beating if not more than any other type of head. These heads are purchased in an already mounted condition.

Lug Work

Snare drum lugs consist of the lug housing which is mounted to the drum by means of two screws with washers between the screw and the shell of the drum. These, screws are usually a 6/32 thread. They merely hold the lug housing tight to the shell. The lug itself consists of a screw with a square head; the lug arm which comprises the counter hoop hook and the washer between the two. It is easily changeable due to the fact that they are supplied by the factory at an extremely cheap cost. The thread size of these lug screws is usually a 12 x 28 and in some models a 12 x 24 is utilized.

Snare Strainers

The snare strainer consists of an arm that pulls that portion that holds the end of the snare so that the bottom portion works which on a cam shaft thereby allow for the tightening of the snare strainers. The opposite end of the snare is held into position by having a bar tightened against the ends of the snare so that they are held secure whereas the strainer section can be used by means of a screw to tighten the snares to such a point that when the cam shaft is employed, it tightens it a little more against the head giving the snare effect. The only repair that could ever be performed on a snare strainer is possible tightening of the riveting of the extended arm of the cam shaft. This is done by lightly tapping it with a hammer on the riveted end to a point whereby it is firm, yet movable in its cam. The old type gut, or silk on snare strainers must be individually set into position using six strands of the snare doubled in such a way as to act like twelve pieces. However, gut or silk wound, they must be held in an equally firm position throughout. This is achieved by loosening the screws on the opposite side of the drum from the snare strainer and drawing six strands firm. Tighten the screw on that particular side, then draw the other six strands equally firm and tighten the second screw. This is only done with the snare strainer in its completely relaxed position with its lead screw engaged to a point whereby the screw shows itself on the opposite edge of the stud.

Snappi Snares

Snappi snares eliminate the use of gut snare or silk wound by virtue of the fact that they are metal snares from metal plate to metal plate with a piece of cord set in its two ends extending down to each side. It is locked at the rear position of the drum and is simple to lock in place since instead of having twelve strands through the back edge, it merely has two ends of the cord easily held in position one against each screw. The opposite side is merely tight in position at the snare strainer's edge.

The same previous rule for proper setting prevails. However, we must assure ourselves that the snappi snares are centered on snare heads.

Mounting Banjo Heads

To mount the banjo head, it is necessary to remove the back plate resonator which is usually done by means of two clips. Remove all strings and bridge and remove the neck. To remove the neck, we must loosen the tail's screw which is actually a locking point for the neck. To tighten the neck firmly in place, a tapered hook is forced into position with a cross bar holding it in place. We must remove this cross bar and this tapered screw to finally remove the neck from the head side of the banjo. All of the banjo lugs have to be removed completely so that the counter hoop comes away from the banjo itself. The banjo head is then removed from the banjo and the head or what is left of the old one must be cut away. The banjo head hoop is usually a square piece of brass rod. This is sometimes wound with material to eliminate corrosion. It further holds a banjo hoop together since this is very rarely one solid piece. We advise silver soldering of this hoop prior to reinsertion. To mount a banjo head, we must wet the head and it makes no difference if there is excess head. It is then placed in its wet condition in position over that section of the banjo on which it must be mounted. The banjo head hoop is then placed around the shell of the banjo and the head pulled so that there are no creases involved. The counter hoop is then placed in position on top of the banjo hoop and the head must come around the head hoop under the counter hoop. It is sometimes wise to pull the head through firmly with the aid of a small pair of pliers. When the head is pulled through at one point, a banjo lug is then engaged. When this is engaged at this point, it is advisable to continue working in the same manner around the head in a circular motion. As one quarter of the banjo has its head pulled through, a second lug is put in position. This lug is merely to hold the counter hoop from shifting. This procedure is continued until the entire head is pulled between the counter hoop and the head hoop at which point, it is then pulled firm so that there can be no creases involved anywhere. When four lugs are on the banjo counter hoop, we reinsert or replace the balance of the lugs. At this point, the lugs are tightened slightly so as to allow the shape of the banjo head to take place. In tightening lugs, it is wise to remember to tighten every fourth one with the key and tighten two in between, by hand, so that the head will tighten in line. It is imperative to set the banjo head to a point whereby the cut-out for the neck piece is in its proper position and is brought down almost to its perfect position while the head is wet so that there is very little tightening left to take place to bring it into perfect position for the insertion of the neck since the finger board of the neck must fit over that cut-out and it must have enough clearance to do same. At this point, there is an excess amount of head that must be cut away. A single edge razor blade is the easiest tool to work with. In performing this job, use the edge of the razor blade with the side of the razor blade resting against the head. Cut through the excess portion of the head (which will cut easily while it is wet) and draw the razor blade slowly around the inside of the counter hoop cutting the excess of the head while pulling the excess with the opposite hand. This allows the head to stay taut while it is being cut which will allow it to cut itself very easily. When the entire piece is cut away, the banjo head will be completed. The excess moisture should be dried off with a piece of towelling and any spots that may be visible can easily be wiped away with a wet cloth. In this position, the head must be left to dry for at least one day after which the banjo head can be perfectly set and the entire banjo remounted. Unlike drum heads, where any excess amount of calf skin must be cut away prior to mounting, the banjo head is trimmed after mounting but it must be trimmed while in its wet condition.

CHAPTER 11

VIOLIN REPAIR

Sound Post Setting

The sound post of a violin consists of a piece of one quarter inch wood doweling. This sound post must be set behind the bridge slightly to the left of the E string. It is set in position by means of a sound post setter. The sound post setting tool has a knife edge on one side which is actually forced into the sound post so that the sound post can be held by it and inserted through the F hole to a point whereby it can be turned into position between the top and back of the violin. If, after setting the sound post, we find that there is an insufficient amount of resonance on any string, the sound post must be moved slightly toward that string to give better quality of sound. There is another type of sound post setter which is the plier type and is used to hold the sound post in its jaw. In both cases, the opposite edge of the sound post setter consists of circular cutouts which allow us to push the sound post into its proper position. The sound post should be held firm and upright in its position. Quite often, a sound post is found to be too short which may occur due to the variance of temperature and if it falls down and cannot be held firmly in position, it must be replaced and if a new sound post is cut, it should be cut slightly larger so as to be able to hold it since the purpose of the sound post is two-fold. Firstly, its man purpose is for the conductivity of sound so as to give proper quality of tone. Secondly; it acts as a reinforcement under the bridge so that when the strings are tightened, it won't crush the top of the violin. You must bear this in mind when fitting the sound post. If the sound post is too small, we are putting a tremendous strain against the top of the violin.

Gluing

There is one type of glue to use on a violin and that is fish glue. This is purchased in either beaded form or in sheet form. It must be used with water as its lossening agent. This must be heated to achieve a liquid stage. When this glue is applied, any excess is easily washed away with a wet cloth wet with warm water. One of the major reasons for using this type of glue is the fact that this instrument can be taken apart easily, if so desired. A hot knife blade will easily cut any section that has been glued; for instance, if we wish to remove the top or the back of the violin, we merely have to draw the heated knife blade through the glued section while the knife is warm. It will easily cut through this glue like a hot knife through butter. Any other glue might hold so firmly so as not to allow us to remove certain parts for the repair of the instrument.

Crack Repairing

Cracks can be repaired in one of three fashions. The first method is to merely force some glue into the crack making certain that the crack is clean prior to forcing the glue into position. A body clamp is then placed there on and tightened so that the crack is pulled together. The excess glue is then removed with a cloth wet with warm water. This is not the strongest method of repair but it is the simplest. The second method is to remove the back or top, whichever the case may require. Place glue in the crack section, apply the body clamp and to add sufficient strength to the repair, small cross sections should be placed across the crack every quarter of an inch starting above the crack to a point below the crack. This should be made of very thin wood and merely act as braces. To prevent the crack from reopening when these are put on, they should be trimmed after drying to a point whereby they are particularly smoothed out with no sharp edges left over. The top or back is then replaced and held in place after gluing with small clamps. The third method is utilized when the crack is so severed that it is almost impossible to pull this crack together. This calls for the insertion of a piece of wood to take up the space caused by the crack. This is known as "spleening a Dutchman." This entails cutting a section of wood of the same material as the violin so that the grain is running in the same direction barely tapering the edge of each so that it can be forced into position in the crack itself. Glue the part in place so that it is held securely and after the instrument is fully dried, any excess is removed, and the body dressed so that the adges of this joint look like a portion of the grain and finally that portion of the instrument refinished.

End Nut Fitting

The end nut is that small ebony part at the top of the neck which elevates the string slightly above the finger hoard. When the end nut is glued in place, it should be slightly high and long enough to allow for dressing on each end at the top. After it is secured in place and the glue dried, it is then dressed into position. Firstly, allow for the proper height over the finger board and the string slots that are cut into the same, are equally spaced to allow for the proper position of the string. The two ends are dressed to match the neck of the violin and the hack end of the end nut must be rounded slightly so as not to allow for a sharp edge against the string. The tail piece is held in position against the bottom peg of the violin (which is held securely in place by virtue of its own fit), by means of a cat gut string. This is usually a red piece of cat gut the thickness of a cello string. The insertion of this piece of gut in the tail piece is performed in the following manner: The tail piece gut is measured so that the tail piece will rest comfortably and securely on top of the instrument. Once it is measured to the proper size, the tail piece gut is inserted in the bottom of the tail piece so that the loop end extends past the back of the tail piece. The two ends that come through the underside of the tail piece must be held securely in place in the following manner: First, one edge of this gut must be heated slightly over the flame. This will cause the gut to uncurl itself and spread into a firm position at its tip. Then wind some cotton thread around this gut before the curled edge. A sufficient amount of thread is used to prevent the tail piece gut from being pulled through the tail piece.

Repeat the same procedure on the opposite end. A drop of resin can then be applied to the two ends after the loop is pulled securely. This holds the tail piece gut tight so that it can be replaced on the violin with the loop end fitting around the bottom peg.

Bridge Fitting

The violin bridge must first be fitted to fit the body or contour of the top of the violin. This is done in the following manner: The two legs are shaped to fit the body so that there is sufficient amount of support on each leg. However, final dressing of the bridge to the body is easily achieved by placing a piece of sand paper over the top of the body and subsequently drawing the bridge across the sand paper so that the body itself acts as a form for the feet of the bridge. We must be careful not to cut the feet too low or they will lose their support or strength. Once the feet are cut to size so that they rest completely and thoroughly on the top of the body between the F holes, the top of the bridge must be cut to the proper height so that the string will not be too high above the finger board. After this is trimmed to the proper height by use of a file, it is wise to dress the side edges of the bridge so that the sharp edges disappear and leave a rounded appearance assuring ourselves that the part of the bridge which accepts the E string is slightly thinner than that portion of the bridge which accepts the G or D strings. The reason for this is the fact that both the G and D strings are heavy whereas the E string is a thin piece of steel. The usual bridge has an ebony insert. The other strings are equally spaced across the bridge so that the depth of the cut is the thing to take into consideration prior to final fitting of the bridge. When the string is set, the height of the string is easily determined by its cut-out, allowing for a sufficient amount of height so that it can be fingered by the violinist. When the cut-out is such that the string is in its proper position, final dressing on the top of the bridge can then easily be achieved.

Peg Fitting

The pegs of the violin must be such that they are firmly fitted in the holes so that a small extension remains on its far side. These pegs are either dressed into position or the hole is fitted to the peg. The hole is very rarely worked on unless it is slightly damaged, at which time a tapered reamer is used to redress the same and the peg fitted so that it is firm in its own receptacle. The peg must be fitted prior to having its string hole drilled since a peg might have to be cut at its tip allow for the proper appearance after which the hole in the peg is marked and drilled. Very often a slipping peg is easily cured by application of chalk to the peg which will have a tendency to roughen the inside of the hole.

Bow Rehairing

Before a bow can be rehaired the old hair must be removed. It is done in the following manner: Secure the bow firmly to the bench in either a small clamp or vise. For the aforementioned purpose, we recommend the "Monk rehairing device." Remove the frog from end of the bow. Bring the frog backwards so as to allow the small block of wood in the bow tip to be visible. Remove this small piece of wood with a sharp tool.

After the hair has been removed in the head or tip of the bow, it must be removed from the frog. To remove the hair from the frog the following procedure is used: Remove the slide ferrule with a knife or small scraper. This is sometimes more easily accomplished by removing the small wood wedge placed between the width of the hair and the frog. When the wood wedge and the ferrule have been removed, remove the pearl slide. Bend the hair backwards and remove the small block of wood which holds the hair in the frog. Both the holes in the frog and the tips should be throughly cleaned before attempting to replace the hair.

It is wise to place the new hair in the tip first. To do this we must soften the resin end of the new hank of hair. This is done by holding the end near a flame. DO NOT MELT the resin. Place it in the hole in the bow tip. Use a warm tool to press it as deep in the hole as possible. Replace a small block of wood in the hole so that it holds the hair securely. Spread the hair evenly as the wood block is replaced. Soften the hair by soaking it in water for about a minute. This eliminates the chances of the hair breaking while it is being combed out. Comb the hair with a fine comb from the tip that is already fastened in the head, with even strokes. This will eliminate crossing of the hair. Place the frog in a forward position in the slot in the bow. Cut the hair so that it is 1/2" longer than the hole in the frog. Tie the hair end with a fine cotton thread. Apply melted resin to the tip. Place the hair through the Jerrule. Soften the resin and replace the hair end in the hole in the frog. Replace the small wood block as previously described. Replace slide and ferrule. Comb the hair once again with a wet comb, from the tip to the frog. Spread the hair evenly and replace the small wood wedge. Hold the thumb and index finger of the left hand on the hair near the frog. The fingers of the right hand are held in the same position near the tip. Draw the fingers lightly together. The long hairs will show at the center. These can be shrunk into the proper position by running the bow lightly and quickly through a small flame. Broken hairs should be clipped off at the ends. Apply powdered resin to the bow hair.

GLOSSARY OF TERMS

Arm—The extension of a key that engages another key in its operation.

Barrel—

Spring—Housing for spring on valve instruments.

Valve—Upper section of outer valve casing, usually soft soldered to valve casing.

Clarinet—Small top joint of instrument with two female sockets to receive the mouthpiece and the upper joint. Used for tuning the instrument.

Bead—Small ring cut in tubing to add design to tubing end.

Bell Rim—End of the bell of brass instruments that has been spun over itself, usually with a steel ring inside its turn. After spinning the rim is soldered.

Bocal—Mouthpipe for bassoon.

Beet—Connecting joint on double section of Bassoon, usually consisting of a tubular curve soldered to a metal' plate, held secure by screws with cork acting as a gasket to seal the leakage at the lower extremity of the Bassoon.

Bow Knobs—Small brass pieces soldered to the first, second or third valve slides of brass instruments to facilitate the moving of the slides by allowing a point to grip on the same.

Brace-—

Single-One piece brace or reinforcement between two pieces of metal to eliminate weakness of instrument at that point.

Adjustable--Brace consisting of two anchored plates with movable rod soft soldered between them, allowing the brace to assume any length.

Bumper— Saxophone—Small piece of round felt usually used on the low (D#, C, B and Bb) keys.

Trombone—Felt washer placed in the Slide bumper retainers to eliminate noise when the slide is brought to a closed position, used to adjust the slide in its first position.

Button—Pearl tipped, usually used on brass instruments to allow for easier fingering of valves.

Cap— Mouthpiece—Protective covering over mouthpiece to safeguard the reed on saxophones.

Tenon—Metal protector spun over the end of male tenons on wood instruments to prevent chipping of the wood ends.

Valve-Top cap used as stop for up-stroke as well as downstroke of valve.

Casing—Outer housing in which valve operates.

Comb—Heavy piece of brass used as a design on the bottom of instruments, also serves as a bumper to eliminate damage to weaker lower section of instrument.

Key—Pad retainer.

Mouthpiece—Tone chamber of brass instrument mouthpiece.

Ferrule-Slide-Small piece of tubing acting as joiner for two other pieces of tubing.

Mouthpipe—Reinforcement ring.

Fingerhook—Curved hook allowing the musician to utilize the small finger of the right hand to help hold the instrument.

Feet—That portion of a key that contacts the body stopping the action of a key.

Frog—Hand grip of a violin bow that is adjustable to allow for loosening or tightening of the bow hair by means of a lead screw.

Guard—Protective Wire covering over keys on saxophone to prevent bending of the same. Usually holds the bumper retainer.

Guide—There are three varieties of guides used for the purpose of directing a valve in its casing so that the valve does not turn around thereby maintaining the proper passage alignment at all times.

The first type is the threaded tip. The normal thread size is 3x48. There are some guides that utilize a 4x48 and some that use a 5x40 thread. The two or three star types are used when the valve has an encased spring in a spring barrel. This type rests on the top shoulder in the valve casing with its star tips in their specific slots, thereby eliminating the turning of the valve.

Heads— Drum—Usually calf skin tucked around and under a flesh hoop of a drum, tympani or Tom Tom. This skin, in a heavy

form is used on banjoes and tamborines.
Flute—Refers to the top section of the flute. It consists of the mouth-pipe of the flute, the tuning cork, the crown and the mouthpiece. It is the only tapered section of the flute, thereby putting the flute in the classification of conical bore instruments. This causes the flute to become an instrument built in octaves.
Piccolo—Same as flute.
Ligature—Metal band usually has two tightening screws to hold the reed firm to the lay of the mouthpiece.
Mandrel— Wood—Stick used to hold the instrument to facilitate working on the same. Mandrels come in all sizes, shapes and tapers.
Steel—Tools used to place in the bore of the bell or other tubing to allow for hammering or burnishing on the opposite side for the purpose of dent removal.
Mouthpipe— Trumpet—Portion of tapered tubing
placed between the mouthpiece receiver and the tuning slide.
Trombone—Often referred to as the "VENTURA PIPE", placed in the mouthpiece side of the inside trombone slide. It is approximately nine inches' long. It is tapered to continue the rate of taper from the mouthpiece thread to reach the size of the bore of the inside slide.
Saxophone—Referred to as the "GOOSE NECK". One end acts as the male end to receive the mouth-piece, while the other end is the male socket that fits the body of the upper section of the horn.
Passage—Any piece of tubing that connects two other portions' of the instrument such as in valves and casings.
Pearl Sockets—Retainers for pearls used as contact points for the fingertips. Used on valve stems and saxophone keys.
Pin Rod—Rod that has two or more holes drilled through the side to allow pieces of keys to be pinned to it, thereby causing the two pieces to act as one, eliminating the need for outer bridge work to make more than one piece act as a unit. Found on flutes and piccoloes on the top trill keys as well as' on the upper and lower stack assemblies. Equally useful on oboes. Pins can either be steel pins, tapered, so that they can be wedged in the hole or they can be the threaded type used on the better type oboes.
Piston-—Another name for the valve of musical instruments. Sometimes referred to as a pump. Used to add or remove extra lengths of tubing by changing the path of the passages used to direct the length of the air column through the horn, thereby changing the pitch of the instrument.
Quick Change to "A"—Rotary, springless valve which can add sufficient amount of tubing to the air column to change the pitch of the instrument 1/2 tone from Bb to A. Usually found either on the tuning slide or directly after it before the third valve section.
Receiver—Trumpets and trombones, etc. use tapered receivers to accept the mouthpiece. Also used on trombones to act as joiner between the bell and slide sections. Term used for any female socket on any musical instrument.
Ring—Reinforcement on female sockets of clarinet or other wood instrument joints.
Sleeve—Outer tubing of any slide as-sembly.
Slide bow—Curved tubing connecting any two inside slides, joined to the same by means of ferrules.
Slide—Can be either the tuning variety or valve slide assembly, consisting of two inside stockings, two outside sleeves, two ferrules, one or two bow knobs, and one slide bow. Valve slides are used to tune or change the pitch of each individual valve. Tuning slides are used to change the pitch of the entire horn. To maintain perfect intonation the valve slides must be pulled proportionately with the tuning slide.
Spatula— Key—Part engaged by the fingertip or any other portion of the hand. Tool—Flat metal plate used to level
pads and key cups.
Spring track—Receiver for end of flat spring at point of contact to the body.
Spline—Valve key or guide (See valve guides).
Stack Section— Upper—Consists of pearl tipped keys operated by the fingers of the left hand.
Lower—Consists of all keys that are fastened to the body with the same rod as the pearl tipped keys that are operated by the fingers of the right hand.
Stack Body Section— Consists of the long tapered straight section of saxophone, which contains most of the toneholes and key assemblies.
Stocking— Tight fitting sleeve such as six

inch sleeve on the ends of the inside trombone slides. The name is sometimes used in reference to the ends of slides (Trumpet) that are undercut for the purpose of finger tuning.

Tailpiece— The piece of the violin that is held to the instrument with red gut around the end pin. Its purpose is to hold the strings so that the strings can be tightened with the finger pegs to change the intonation of each individual string.

Tenon— Any extension used to join two together. Can be either male or female type.

Valve— There are two types of valves. The type that operate in an up and down motion are referred to as the pump or piston type (see Piston). The rotary type are used on french horns mainly but can be found on 2 any valve instrument if it is that variety. These valves operate in a turning motion. They can be of the machinery action ‘with its springs encased in the machinery housing or on the tubular hinge of the key with universal connecting joints to the valve or the connection to the valve can be the string type action.

Waterkey Assembly— Consists of the waterkey, usually placed on the tuning and third valve slides for the purpose of removing the saliva from the horn, the key posts, key rod or pin and the water hole or gutter. This key utilizes a cork to cover the hole and is held in a closed position by either a flat spring or a coiled type spring. The coil spring comes as an inside coil or an outside coil spring.