REPAIR SHOP

INSTALLING TENON END CAPS

ON TENONS OF WOOD - BODIED INSTRUMENTS

by Lars Kirmser

It is customary for manufacturers of professional woodwinds to provide end caps on the vulnerable tenons of wood bodied Flutes, Piccolos, Clarinets, Oboes, English Horns, and the wing joints of some Bassoons. Not only do these end caps provide additional strength to the vulnerable tenons of woodwinds, but they also offer some protection against exposing the end grain of the section to the player's saliva. When this moisture is allowed to permeate into the end grain of the wood section, the tenons will often swell-up over time, and become lodged in its corresponding socket. This tends to be the case, especially when an instrument is purchased and played by a musician living in a geographic area having a significantly higher ambient humidity than the conditions under which the instrument was kept during the manufacturing process. A third benefit of the end cap is the protection it offers the wood tenon when a technician is eventually required to replace the worn-out tenon cork.

It is common for the center joint (especially) of the soprano clarinet to gradually become unstable or "wobbly" over time. This is usually the result of when a technician fails to take care when replacing the cork on the tenon, and hastily sands off a bit of the rail (at the end of the tenon). This will occur to clarinets made of wood, plastic, vulcanized rubber, or whatever. The solution to this problem is identical, no matter the material from which the instrument is manufactured.

Conditions Requiring End Caps

- When upgrading new wood-bodied instruments lacking end caps
- Cracked, chipped, or otherwise damaged tenons
- Worn or undersized tenons

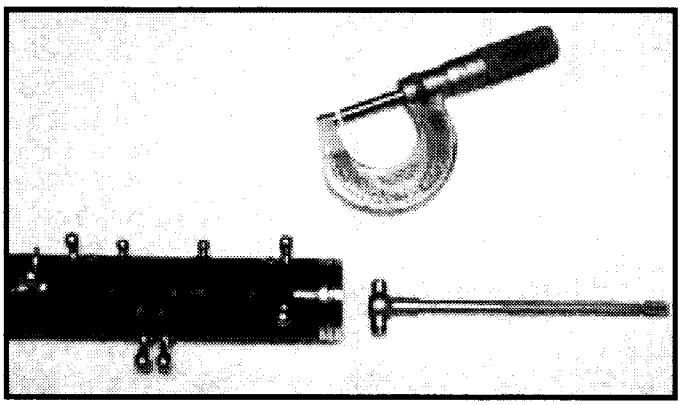
Tool and Machinery Requirements

- Machine Lathe
- Inside Holding Mandrels
- Live Center
- Lathe Bits
- Burnishing tool or roller
- Dial Caliper
- Telescopic Gauge
- End Cap Holding Tools
- Adjustable Tenon Reamer
- Cyanoacrylate Adhesive

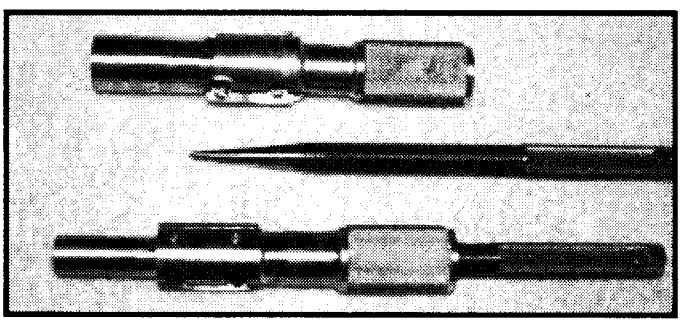
Truing the Worn or Misshapen Tenon Receiver

Before you proceed to the actual installation of the end cap, it will be necessary for you to examine the state of the tenon receiver (socket). Often, over time, sockets will wear unevenly and become part of the problem of an unstable joint. In my experience, I have noticed that, more often than not, the *lead* edge of the socket (i.e. the end with the body ring) will become slightly oversized from repeatedly inserting and removing the tenon from the socket. Before a tenon may be fitted for an end cap, the corresponding socket must be made to be perfectly cylindrical throughout. Also, as the material expands and contracts over time, you may experience a socket, which is slightly oval-shaped. In either case, we have to make the socket perfectly cylindrical. To do this, we employ the adjustable socket reamer (illus. #2). Begin by carefully measuring the socket at the opening, and at its base. Make a second set of measurements by rotating the axis 90 degrees and compare the two sets of numbers. If they are within .002" - .003" from the smallest dimension to the largest dimension, then you will not be required to ream the socket. If, however, there is a significant indication of unevenness or of an oval shape, then reaming will be prescribed.

The reamers pictured in illus. #2 are ones I have had for many years, and I do not remember exactly where I came by them. The unique aspect is that they are equipped with a pilot sized to fit perfectly into the relative bore size of the section being reamed,

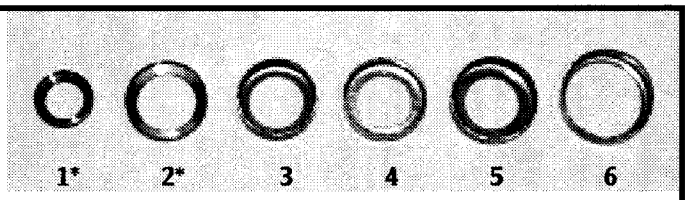


Illus. 1 - Measuring the socket's I.D. with a Telescopic Gauge.



Illus. 2 - B^{b} Soprano Clarinet adjustable socket reamers (the upper reamer is disassembled).

thus keeping the cut symmetrical throughout. The two reamers pictured are fitted with pilots corresponding to the bores of the B♭ Soprano Clarinet (upper and lower sections). The pilot helps to avoid "chatter" marks when making the cut. In addition to this feature, the cutters may be set to very close tolerances. When I set the tool for the cut, I set the cut to be .002" below that of the largest measurement (I.D.). One important consideration to be made at this point is the largest O.D. that your blank end cap will be capable of handling. In other words, if you ream the socket larger than the O.D. of the end cap blank, you will not be able to achieve the requisite fit. Incidentally, never make these cuts under power; these reamers are designed to be operated by hand. (note the measurements of the blanks below).



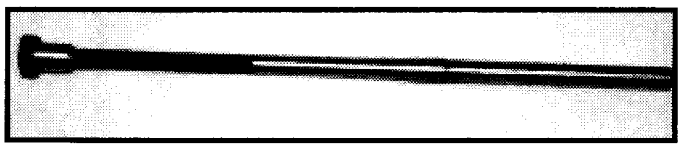
	1*	2*	3	4	5	6
O.D.	.620"	.870"	.850"	.880"	.925"	1.030"
I.D.	.595"	.843"	.810"	.840"	.890"	1.00"
†	D54A	D54B	D55D	D55C	D55B	D55A

* **Brass; pre-turned** (for oboe's)
† **Ferree's Catalog Number**

Illus. 3 - End Cap Blank Dimensions

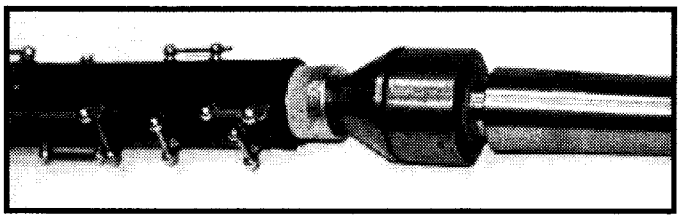
Preparing the Tenon

As mentioned earlier, there are a number of reasons requiring a tenon to be fit with an end cap. For example, the tenon may be cracked, or worn significantly, or both, for that matter. In the event that a tenon is cracked, begin by preparing a mixture of 2-part epoxy (I use the Armstrong 24-hour epoxy with a black dye). After the epoxy is mixed, carefully flex the crack(s) open a bit and work a small amount of the black epoxy into the crack(s). The purpose of the epoxy is to stabilize the tenon and to reduce the chances of air leaking at this point once the instrument is back together. After applying the epoxy, clean up any squeeze-out and secure the tenon by firmly wrapping a string around it several times; let the clarinet set over night. The next day, you may remove the string wrapping and clean up the tenon (inside and out). Next, select the end cap blank that you will be using, and measure it's inside diameter. When selecting the blank, you will be primarily interested in matching the internal dimension of the blank to be within a range of adjustment to the prepared tenon, and the outside diameter of the blank at least equal to, or slightly greater than the internal diameter of the socket. (Note that the hole in the blank is precisely the same as the bore size of the clarinet, so you shouldn't have to adjust it at all.) Next, symmetrically reduce the outside diameter of the outer rail of the damaged tenon so that it will fit snuggly (friction-fit) relative to the inside diameter of the end cap. We will now leave the tenon preparation momentarily.



Illus. 4 - Clarinet holding mandrel for the lower section of the B♭ Soprano Clarinet from Ferree's G71B

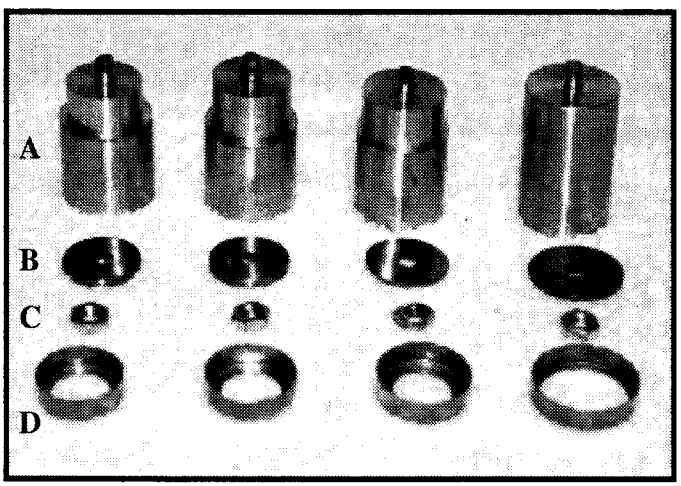
Illus. 5 - Clarinet holding mandrel for the upper section from Allied's T4100



Illus. 6 - Always use an end cap blank when securing the clarinet on a live-center to avoid cracking the tenon.

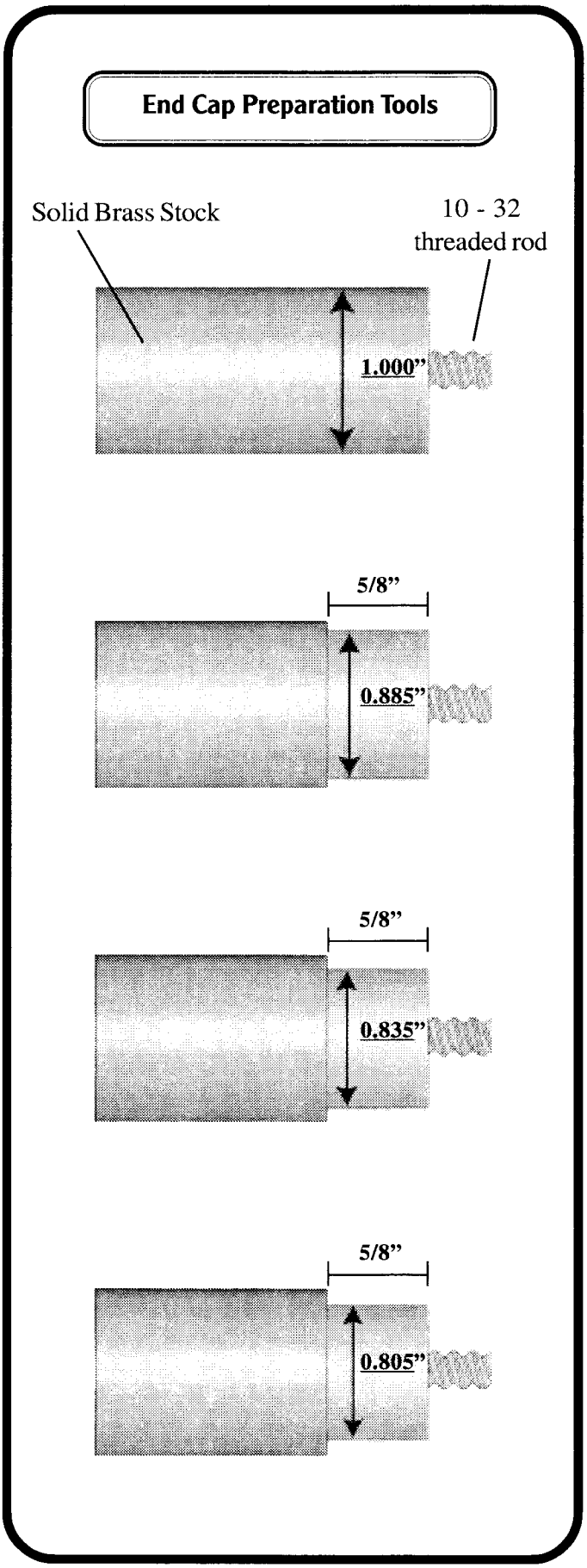
Preparing and Installing the End Cap

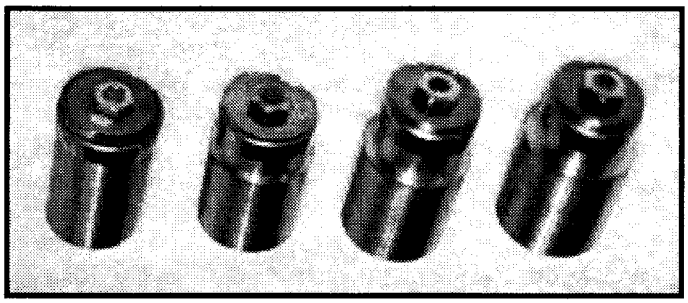
After having installed many end caps over the years by the "seat of my pants", I decided that it was necessary to develop a set of specialized tools, whereby I was able to prepare the end cap blank *prior* to its installation on the prepared tenon. These tools (Illus. #8) allow me to begin by facing the uneven (rough) edge of the blank.



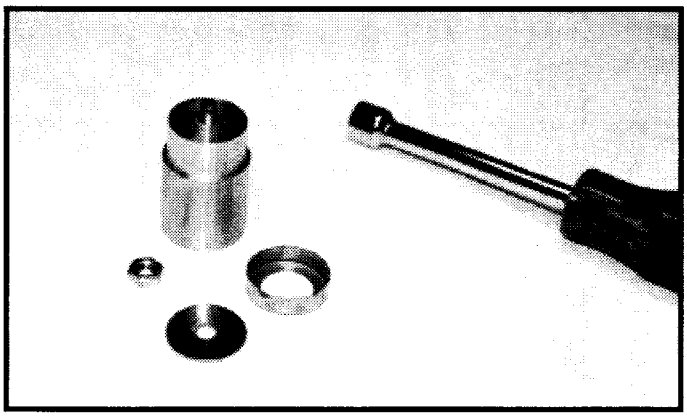
Illus. 7

A *Blank Holding Tool (dimensions next page)*
B *Blank Retaining Washer (the O.D. of each washer must be the same as the I.D. of its relative end cap blank).*
C *10-32 Hex Nut*
D *End Cap Blanks*



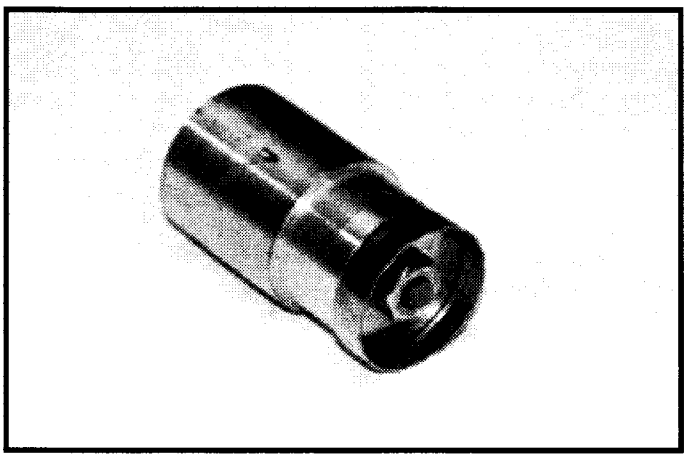


Illus. 8 - End Cap Preparation tools assembled



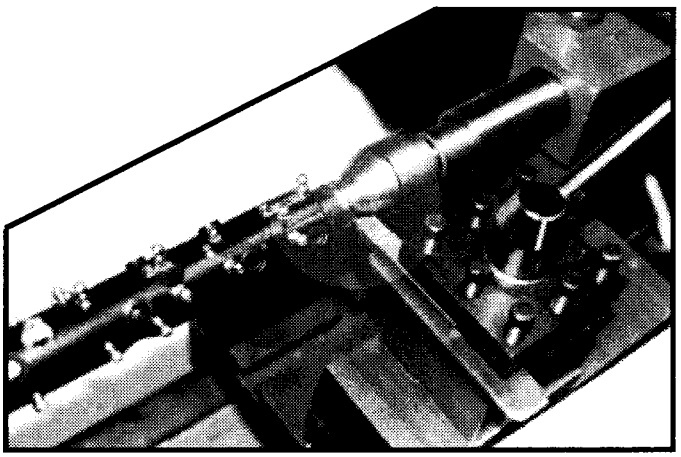
Illus. 9 - The End Cap Tool is assembled/disassembled with a nut driver

Begin by securing the rough blank (rough edge facing to the right) on the preparation tool having the exact outside dimension as the inside dimension of the blank. Next, I secure this tool in the 3-jaw chuck of my lathe and face the rough edge, bringing the final width of the blank to be approximately 2 times that of the original rail.

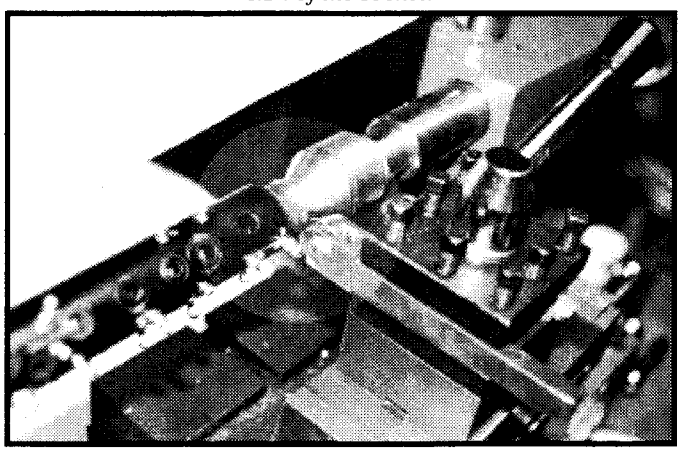


Illus. 10 - Place the rough edge of the blank outward on the tool to trim the edge to size.

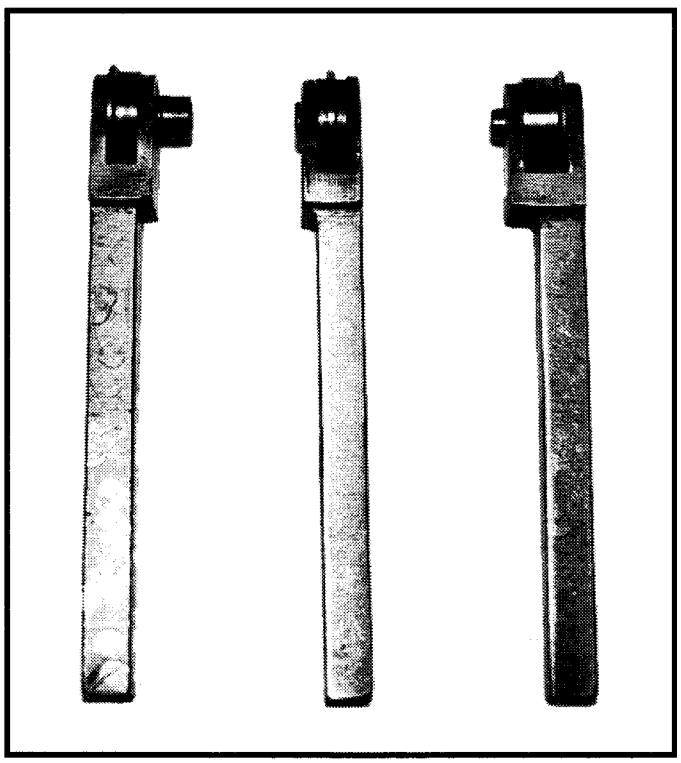
(Most soprano Clarinets will have the center outside rail approximately 2.5mm; the barrel and bell outside rails will be slightly wider at approximately 3.5mm.) By making the width 2 times the anticipated rail width, we are then able to make sufficient allowance for the thickness of the metal at the end of the blank (usually .020") and the "wrap" required over the prepared rail. After we have reduced the width of the blank, remove it from the tool, turn it around, replace the blank back on the tool so that we may turn its O.D. to be exactly .002" less than the I.D. of the socket.



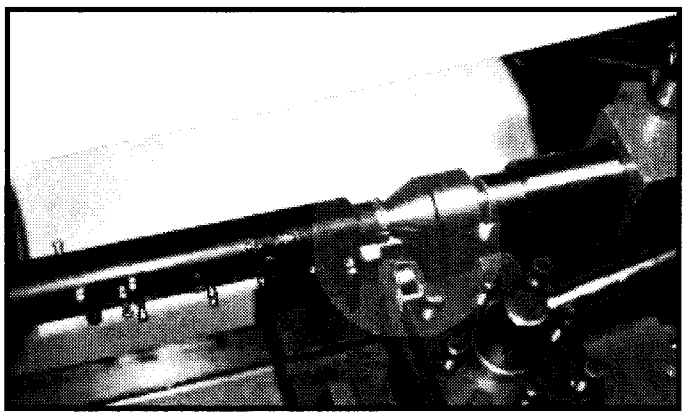
Illus. 11 - Turning the end cap O.D. to .002" under the I.D. of the socket.



Illus. 12 - Rolling the end cap lip over the outside rail of the tenon.

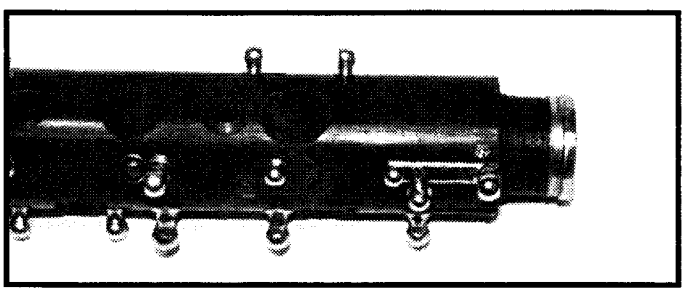


Illus. 13 - Tools used to roll the end cap lip around the tenon rail.



Illus. 14 - The finished "roll-over".

The final step will be to reduce the inside edge to an approximate thickness of .010". The reduction of this inner portion of the blank will allow us to more easily burnish the metal around the inner edge of the prepared rail. Some technicians like to remove the entire prepared blank at this point and anneal it by slowly heating it up to red heat and allowing it to cool slowly. This makes it a bit easier to roll the inner edge around the rail with a hand held burnishing tool. I find this step to be unnecessary, however, when using a roller-type burnishing set up (Illus. #13). In the absence of this roller-type burnishing tool, you may wish to anneal the end cap so that you may more easily employ a knife burnisher (supported on the tool rest) to "roll" the inner edge over the rail. I use a lathe speed of 200 RPM when performing this operation. After the cap is fully installed, apply a drop of cyanoacrilate (Hot Stuff) to the edge of the end cap. This will secure the end cap by sealing the end grain of the wood, and fill-in any gaps that may still remain.



Illus. 15 - The completed tenon.

Tightening up Loose End Caps

Sometimes you may come across a tenon having a loose end cap. You may set the clarinet section in the lathe (as described above) and use the roller tool or burnisher to tighten up the fit. Again, follow the operation with a drop of cyanoacrylate adhesive.

"Her voice sounded like an eagle being goosed." Ralph Novak on Yoko Ono