Reverse Tumbler, Mod-on-Mod

by Tsun Tam

I've waited well over 40 years to acquire a lathe. My dear friend and professor, Bill Siebert introduced me to lathemanship with his South Bend 9 incher and now I have one of my own! It's not a South Bend but it's a lathe albeit lacking features that I remember were on Bill's South Bend. I truly bless the day I discovered the 9x20 Forum and realized that there were many who also enjoyed working on and modifying their lathes.

One feature that was obviously lacking on my HF 9x20 was the ability to cut left-hand threads, not that I would use this feature often, but it was something I would like to be able to do. I researched the Internet and this Forum for solutions; found many, some very elegant, some very complex and then I lucked onto "Tricking Out the ASIAN 9x20 LATHE," Cletus L. Berkeley's manifesto on mods. On page 11, he detailed A. Kelemen's reverse tumbler design. As a card-carrying member of the "K.I.S.S." school of design, I love Kelemen's approach - it was the simplest one that I found I prepared myself on duplicating his version.

My $0.02 (i.e., my additions)

Like cooking (another hobby), I'm never content with published recipes and often had to change a little here and there and then cook with abandon. And I did. Though the Kelemen design reduced a reverse tumbler to its bare essential, I felt that I needed to give it my added value. I made two refinements - used two skateboard ball bearings for two of the gears, the 45 and the 80-teeth and designed a more functional (for me) tumbler engagement mechanism. The ball bearings simplified the Kelemen tumbler further by eliminating the need to machine the two bearings for these gears.

I also felt that the original method of switching between the forward and reverse positions of the tumbler was a tactile exercise. It's very simple, effective but requires attention with each engagement of the tumbler. Too much pressure, and the gear mesh would be too tight. Too little pressure, and the mesh is incomplete. In my research, I found many different approaches that would move and lock the tumbler in 'forward,' 'neutral,' and 'reverse' but all required much machining and careful execution with many parts.

Please refer to the Ticking Out manual for additional reference on machining this reverse

tumbler. I will detail only my refinements. No dimensions are given as you may use this monograph ONLY as a guide for fabricating your own version of a reverse tumbler.

For my tumbler, I need the ability to quickly set the tumbler in any one of these three position without need for tactile feedback or any visual alignment of a stop mechanism. After some consideration and being familiar with camera repairs (another hobby), it dawned on me that many internal camera adjustments were effected with eccentrics, and why can't I use them in my reverse tumbler? Situation analyzed, solution found and all that's left was to fabricate the eccentrics to handle both the gear alignment and act as stops in both the forward and reverse positions of the tumbler.

Bill of materials (only for my enhancements)

1-1/2 plastic knob with 3/8x16 internal brass threads
2 8x32 - 1/4 inch pan head screws (to attach eccentrics bracket to sheetmetal panel)
2 8x32 - ½ inch pan head screws (to fasten eccentrics)
1 10x32 - 1/4 inch pan head screw (for the ball detent)
2 skateboard sealed ball bearings (8x22x7)
2 cap screws - 7x0.75 x 16mm (diameter to match ID of ball bearings)
4 washers 1/4 inch ID, OD LESS than the outer race of the ball bearing (2 each needed for each ball bearing equipped gear. These are positioned on each side of the ball bearing
1 3/4 inch OD steel washer, ID should be clearance fit for the 8mm threaded end of the pivot shaft (a 0.6+ inch diameter recess will be machined on one surface to mate with the bronze pivot bearing)
1 small piece of rectangular 1/4 inch thick aluminum for the eccentrics bracket
1 3/16 steel ball
1 short (6 inch) piece of 0.004 inch piano wire to make the spring for the ball detent
1 piece 1-1/4 inch diameter acetal rod to make the acetal washer

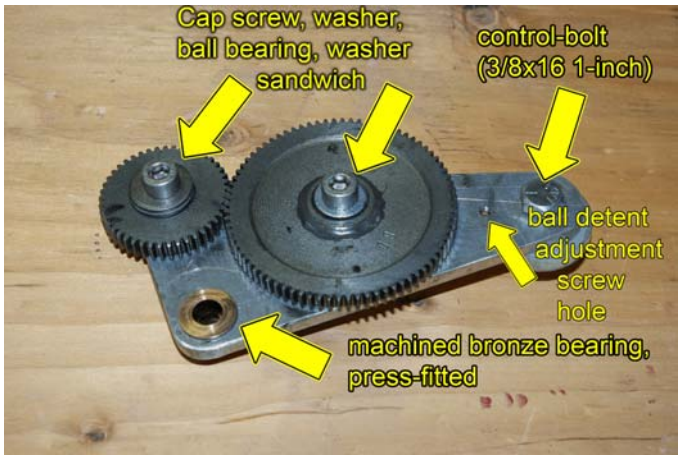
Stacked gear shaft (shaft 'A') - the Pivot bearing surface

The original Kelemen pivot has the bottom of the newly machined bronze bearing 'rub' against the cast iron surface of the headstock. I fashioned a steel washer with a machined recess for the bronze bearing to seat itself. Bronze against smooth steel will guarantee that no lubrication is necessary and that the bronze will not be roughed up by the cast iron surface with repeated shifting of the tumbler.

The ball bearings

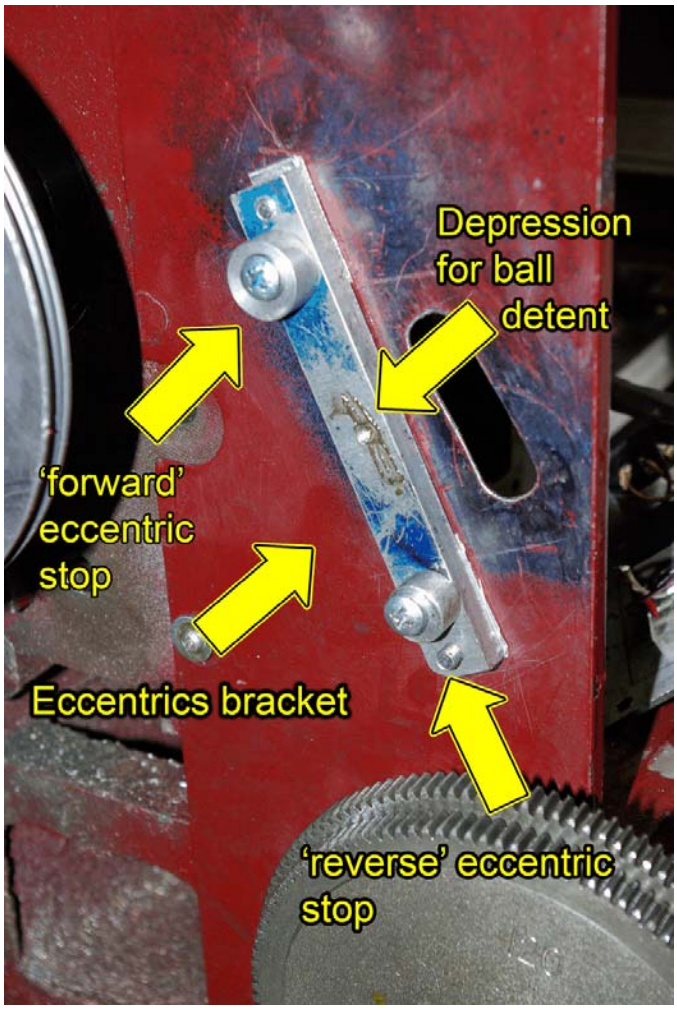
In order to effect the installation of the ball bearing on the 80-teeth metal gear (I didn't want to use the plastic gear), I had to face off the protruded hub. After this is done, I bored out the inside diameter so that it's 1 to 2-thousandths undersize so I can press fit the 22mm OD bearing with my arbor press. I also bored out the 45-teeth gear in the same manner. Using sealed ball bearings eliminated two onerous metal working details: lubrication and friction. Now I have two carefree gears.

The reverse tumbler's 'control' end



On the control end of my tumbler carrier, I drilled and tapped for a 3/8x16 hole, attached a 1-inch bolt, this will serve as my 'handle' to control the engagement of the tumbler. Since the pivot point (the stacked gears - shaft 'A' in the threading chart) raises the carrier by about 1/4 inch, I machined an acetal (DuPont tradename, "Delrin") plastic spacer-washer to be fitted to the 3/8 bolt. This serves as a spacer and gives the tumbler one of its two good supports, the pivot shaft and the control bolt. I used acetal, an engineering plastic which exhibits very low frictional properties, well suited for my purpose. Please note that I milled away one section of the acetal washer to clear the bracket for my two eccentrics (refer to the photo at the end of this monograph). I didn't want to use a smaller diameter washer as I wanted as much support as I can get to support the control end of the tumbler carrier.

The 'eccentrics' bracket



For each eccentric to function both as an alignment jig and a stop, I fashioned a small rectangular piece of 1/4 inch aluminum, drilled and tapped two holes (one at each end of the bracket) for securing the bracket to the sheetmetal panel.

I did a simple test placement of the eccentrics bracket and the tumbler carrier on my lathe and marked the approximate location where I need to drill the two holes for my two eccentrics and the location for my ball detent. I also marked out the arc which I needed to cut out of the support sheetmetal panel where my control knob would be supported.

I milled out a 'dimple' using a 3/16 end-ball mill and milled in a depression for a 3/16-inch ball detent, mustn't mill too deeply or the ball will never be able to 'climb' out of the depression! I used 8x32 for all my mounting hardware.

For the sheetmetal, I removed the panel

from the lathe, used my center punch and laid out a series of closely spaced marks. Using these marks, I drilled out the arc and finished it off by filing.

The eccentrics

I machined the two eccentrics using a piece of 1/2-inch aluminum rod. I chucked it up on my 3-jaw chuck but added a thin (1/16 inch) piece of aluminum on one of the jaws. This threw off the concentricity of the rod and permitted me to drill an off-center clearance hole for a 8x32 screw. I cut off two discs approximately 1/4-inch thick - one to serve as the end-stop for 'forward' engagement and the other as the end-stop for 'reverse.'

Ball detent

To complete the control end of the tumbler carrier, I drilled and tapped a hole for a 10x32 screw. On the underside of the carrier (the side that has the acetal washer), I drilled this hole to 3/16 diameter and a littler over ONE-HALF THE THICKNESS OF THE CARRIER. This is to facilitate assembly of the reverse tumbler. I'll address the assembly later.

Spring for the ball detent

I used 0.004 inch piano wire and a 3/32 inch drill bit to make the spring. Clamped the drill bit and one end of the piano wire on the chuck, vise-gripped the other end and I jogged the lathe's motor to wind the spring. After the spring is wound, I cut off a 1/8 inch section for my detent.

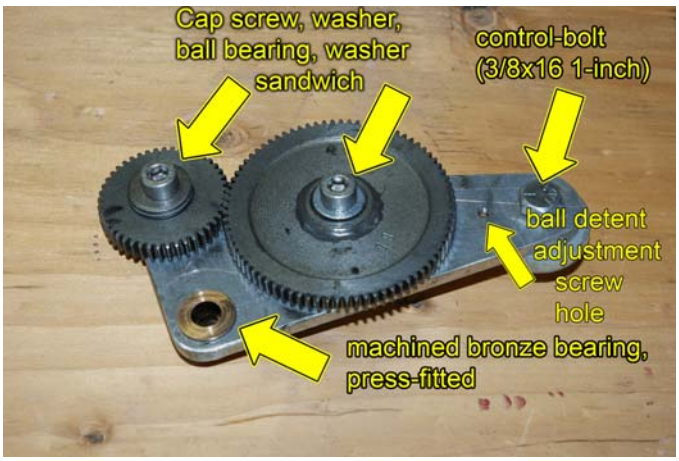
Assembly

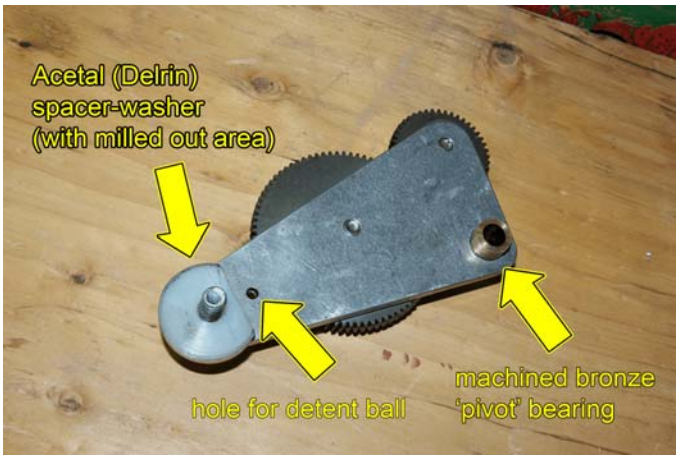
The ball bearing gears

Place a washer on each face of the ball bearing and attached gear using cap screw for each gear.

The eccentrics bracket

Attach the bracket to the sheetmetal panel on the lathe using two 8x32 1/4 inch screws. The ball detent depression must face outward. Fasten the two eccentrics with the remaining 8x32 screws, keep the thin portions of the eccentrics facing each other.





The reverse tumbler carrier

Assemble the two stacked gears onto the pivot shaft. Turn the carrier over so that the geared side is facing down. Fill the hole for the ball detent with some fairly heavy grease - for lubrication AND to keep the steel ball 'captive' during final assembly. Press in the steel ball.

Attach the acetal (Delrin) washer to the 3/8

inch bolt and carefully feed the carrier into the lathe so that the pivot shaft can be threaded into the headstock. DO NOT tighten completely, just SHORT of finger tight. The 3/8 inch bolt must exit the arc'ed slot that is cut into the sheetmetal panel.

At this point, insert the ball detent spring into the hole on the tumbler carrier. There should be a sufficient amount of grease to keep it in place. Next, thread the 10x32 screw into the same hole - only finger tight!

Affix the plastic knob on the 3/8 inch bolt that is sticking out of the other side of the sheetmetal panel. Do not tighten.

Alignment of the reverse tumbler

You may now tighten the pivot shaft using a 10mm open-ended wrench. Tighten it sufficiently so as to reduce any axial play in the stacked gears, but not so tight that these gears do not turn freely.

Grab the plastic knob and move the tumbler upward (in the forward engagement position) and rotate the chuck by hand and assess the gear mesh of the 80-teeth gear with the 40-teeth spindle gear. Reposition the knob as necessary, and tighten the knob! Now loosen the top eccentric screw and rotate the eccentric so that it bears against the top edge of the tumbler carrier.

Do the same with the knob in the 'reverse' position and adjust the bottom eccentric accordingly. Your two eccentrics now serve as 'stops' for the 'forward' and 'reverse' positions of the tumbler and your gear mesh will be perfect!

The ball detent is used to indicate the 'neutral' position of the tumbler. The tumbler should set to 'forward,' 'reverse,' or 'neutral' and nowhere else! Turn in the 10x32 screw so that you can have a 'positive' tactile 'click' when 'neutral' is reached. Caution - turn in the screw too much and your tumbler will be locked permanently in neutral until you release this screw!

Now you have a carefree and very usable modified Kelemen reverse tumbler!