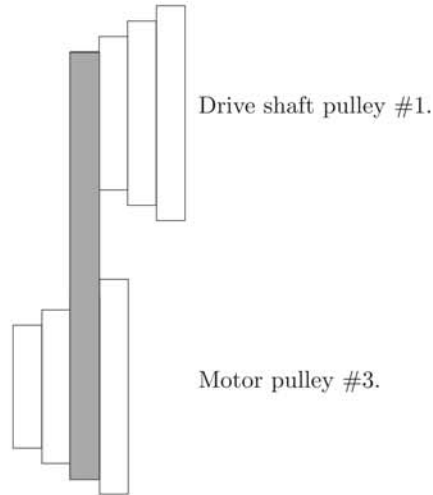


String Winder Manual #1

Operation, Precision Components, and Maintenance

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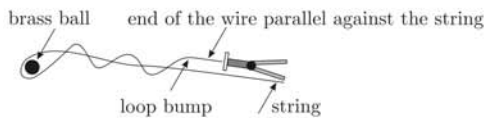
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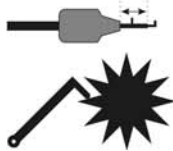
I. This pulley setup produces a speed of approximately 3184 rpm. For this speed, the DC motor speed control – which operates the motor that moves the spool carriage from *right to left* during the winding process – should be set to 40.

II. On the looping machine, place a brass ball into the custom-made holder, and turn the hand crank five times. While turning, hold a thick and separate wire between the string and the end of the wire (where the loop bump will occur) to flatten the bump against the string and force the end of the wire parallel against the string.

III. Cut the end of the loop from this direction to minimize a burr at the end of the wire, which may sever the bronze wrap wire during the winding operation.



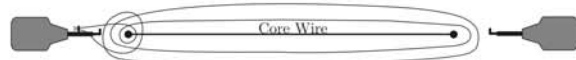
IV. Adjust the *left* ball hook shaft so that . . .



. . . when the string is lightly tensioned, the pawl sits in the middle of a ratchet tooth. Turn the hand wheel 1.5 clicks to tension the string; 2 full clicks will cause too much tension, and will break the string half-way through the winding.

V. Tension the wire, and wipe it down with a paper towel. Make sure the core wire is clean and smooth. Also wipe down the linear bearing shafts of the spool carriage so that carriage continues to glide smoothly.

VI. With small needle nose pliers, pinch the end of the loop against the core wire. If the loop bump at the end of the loop is too high, the wrap wire will not advance, but will back up and destroy the winding.

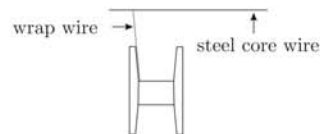


VII. (A) Tie floss at *left* post. (B) Wrap floss around *left* ball. (C) Wrap floss around *right* ball. (D) Wrap floss around *left* ball. (E) Wrap floss around *right* ball. (F) Wrap floss around *left* ball. (G) Tie floss at *left* post. When done correctly, this technique results in two symmetrically spaced strands of floss on either side of the core wire. Do *not* wrap floss around the balls too tightly because this will fray the floss.

VIII. Unwind the wrap wire from its spool a couple of turns; determine the natural curve of the wire, and follow that curve while attaching the wrap to the core loop at the *right* ball hook.

IX. After the wrap wire clears the loop, with the left hand, gently lower the floss against the spinning core wire. This will ensure an even distribution of the floss around the core wire as the winding advances from *right to left* along the core wire.

←
... the winding moves from *right to left* ...

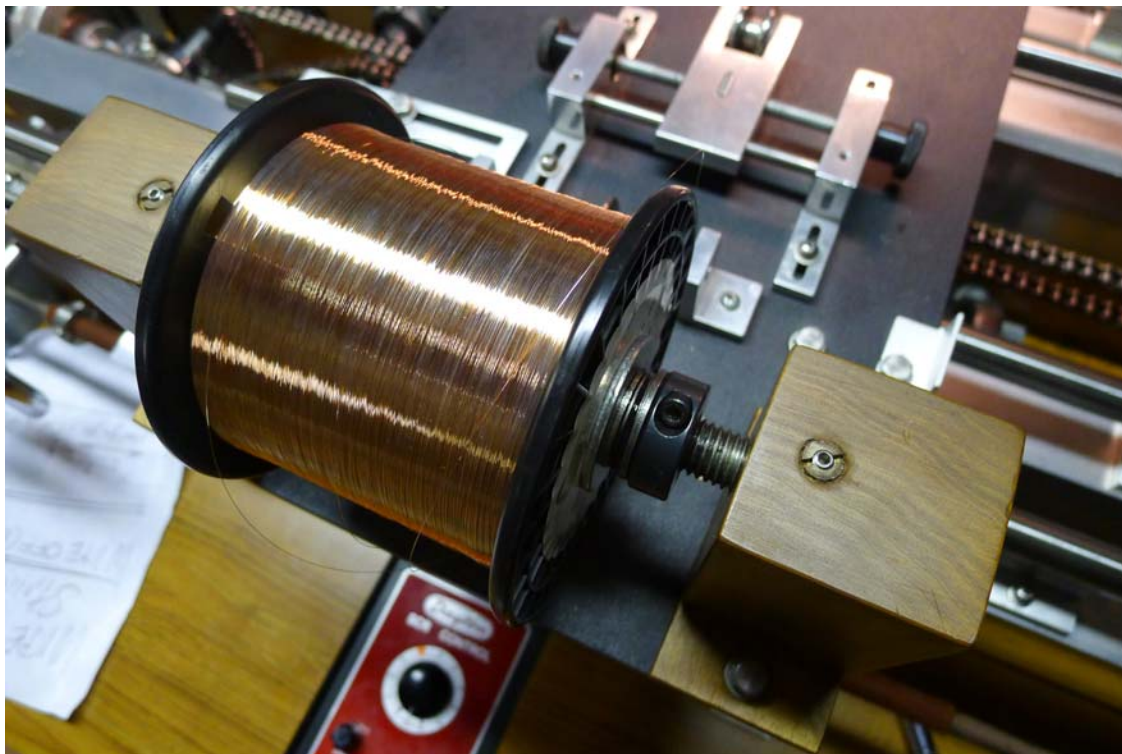


X. During the winding process, the *back-angle* of the wrap wire should be the same as the inside angle of the horizontally adjustable guide wheel.

XI. Distance between the left and right brass balls on the string winder = 166 cm. From hitch pin to tuning gear (including 2.5 turns), the longest required length for a bass string on the Bass Canon = **156 cm**. Make all strings **160 cm** long. Wound string diameter dimensions: 0.022 in. steel core; 0.007 in. phosphor bronze wrap × 2 = 0.014 in.; 0.002 in. nylon floss × 4 = 0.008 in. Grand total diameter: 0.022 + 0.014 + 0.008 = 0.044 in.

Phosphor Bronze Wrap Wire Feed Direction

The graphic below shows that the phosphor bronze wrap wire spool is mounted on a threaded shaft between two wood mounting blocks.



Located between a large washer next to the spool and a threaded clamping collar



is a needle thrust bearing assembly



that enables the spool to rotate smoothly. However, to prevent the spool from unwinding too rapidly, it must *also* rotate with a maximum amount of friction or drag. To produce the right amount of friction that will *not* break the bronze wire, first tighten and then lock the threaded clamping collar against the needle thrust bearing. A maximum amount of friction also ensures that the phosphor bronze wire wraps around the steel core wire as tightly and evenly as possible.

The phosphor bronze wrap wire first passes under a feed roller, and then under a guide roller. At the guide roller, it makes a 90° turn and passes up and over the steel core wire. When one faces the right chuck, as in the

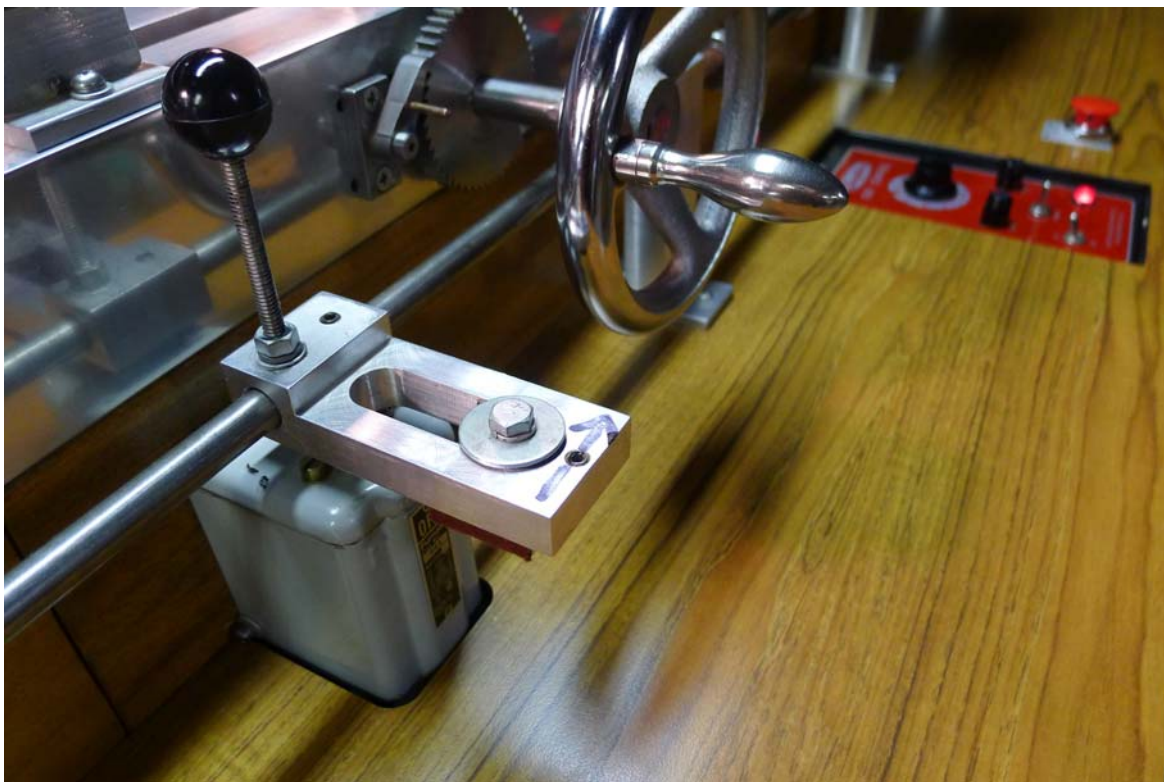
graphic below, the chuck and the core wire must rotate in a counterclockwise direction to pull the wrap wire from the spool.



This detailed graphic shows the counterclockwise rotation of the right chuck and core wire:



To produce the required counterclockwise rotation, throw the drum switch of the drive shaft motor in the direction of the arrow, or to the right.



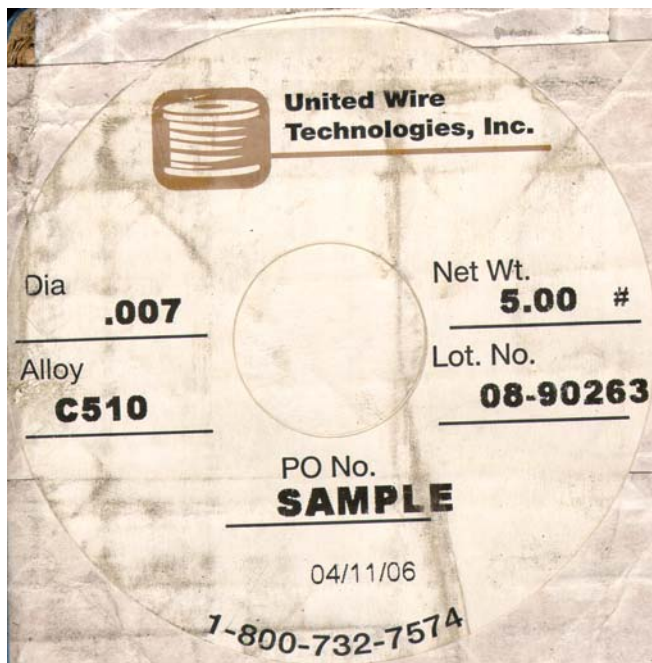
Variable speed DC gearmotor and chain that drive the spool carriage.



Phosphor Bronze Wire: Strings-to-Weight Ratio

November, 2012

This label on the shipping box is identical to the label on the spool:



The gross weight of this spool is 2600 grams = 5.732 lb.

Since the net weight of the bronze wire is 5.0 lb., the weight of the plastic spool is 0.732 lb.

After winding 80 strings, the gross weight of the spool is 2142 grams = 4.722 lb.

So, the weight of the wrap wire for one set of Bass Canon strings — plus eight extra strings — is 1.010 lb., which means there is enough wrap wire on this spool for at least three more sets of strings.

W.M. Berg Inc. Components

4 @ 36 in. x $\frac{3}{4}$ in. linear bearing shafts that support two chuck carriages: LMS-13-36 (C1060 Steel) with custom #10-32 tapped holes to secure shaft support rails.

2 @ 108 in. x $\frac{3}{4}$ in. linear bearing shafts that support one spool carriage: LMS-13-108 (special length cut to 9 ft.) with custom #10-32 tapped holes to secure shaft support rails.

6 @ 24 in. shaft support rails for $\frac{3}{4}$ in. linear bearing shafts: LMR-2. Cut these into smaller sections for intermittent support of linear bearing shafts.

12 @ $\frac{3}{4}$ in. diameter linear pillow blocks (linear bearings) that support two chuck carriages and one spool carriage: LMP-OPN12

2 @ timing belt pulleys with *standard* $\frac{1}{2}$ in. bores for two chuck carriage shafts: 50TP8-26, with 26 teeth each.

2 @ timing belt pulleys with *custom machined* $\frac{3}{4}$ in. bores and keyways for $\frac{3}{4}$ in. main drive shaft: 50TP10-26, with 26 teeth each.

2 @ timing belts for four timing belt pulleys: 50TB-70, with 70 pitches each.

Maintenance

1. Grease eight main-shaft bearings with grease gun; too much grease will cause the bearings to “knock.”
2. Grease four chuck-shaft bearings.
3. Grease two sprocket flange bearings that support the spool carriage chain.
4. Spray the spool carriage chain with WD-40.
5. Grease the key slot of the main-shaft on the right end of the shaft; that is, grease the slot that holds the key of the timing pulley of the movable chuck carriage.
6. Remove four spool carriage linear bearings; spray with WD-40, then blow out with air gun; spray with WD-40 again and replace.
7. On the far end of the spool carriage, remove three machine bolts that hold the solid aluminum block, which supports the ends of the spool carriage chain; role the spool carriage back and forth on the linear bearing shafts to verify that the shafts are clean and smooth. ***If the spool carriage does not move smoothly and evenly, the bronze winding will also not be smooth and even.***
- ❖ Check the smooth and even motion of the spool carriage after making 40 strings. Also, regularly clean the linear bearing shafts while making strings: if the shafts are not cleaned regularly with WD-40, floss remnants and dust debris will clog the linear bearings.
8. After a long period of storage, remove the bronze wrap wire spool from its $\frac{5}{8}$ in. threaded shaft, and clean the needle thrust bearings, support-plate washers, and Belleville (spring) washers; this will assure even rotation of the spool during the winding process.
9. Oil the outer sleeve bearing of the electric motor with motor oil.