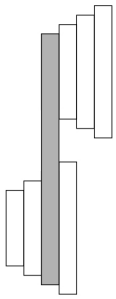
String Winder Manual #1

Operation, W.M. Berg: Precision Mechanical Components, and Maintenance

StringWinder_Operation.cdr



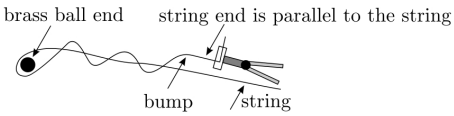
Drive shaft pulley #1.

Motor pulley #2.

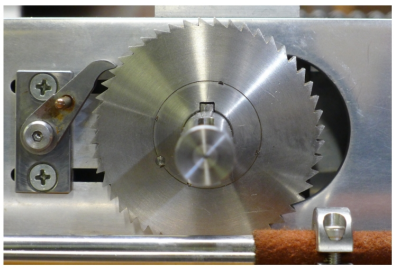
I. This pulley setup produces a speed of approximately 3184 rpm for the drive shaft and steel core wire. For this speed, the DC motor speed control — which operates the gearmotor that moves the spool carriage from *right to left* during the winding process — should be set to 40.

II. On the customized looping machine, to prevent the string and the string end from twisting at the clamp, insert a thick wire (≈ 0.042 in.) *horizontally* between the string and the string end near the clamp. Turn the crank handle five times. At the end of the twisted length, or at the location of a bump, the string end is now parallel to the string.
See: BassCanon_Customized_Looping_Machine.pdf

III. To minimize the formation of a burr, with high quality wire cutters, cut off the bent string end in the direction facing the brass ball end. Such a burr may sever the bronze wrap wire during the winding operation.



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

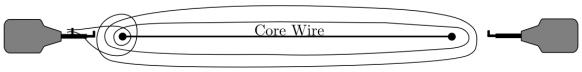


...when the string is lightly tensioned, the pawl sits in the middle of a ratchet tooth. Turn the hand wheel 1.5 clicks to tension the string; 2 clicks will cause too much tension and will break the string halfway through the winding.

V. Mount and tension the steel core wire on the string winder. Wipe the string down with a paper towel. Make sure it is clean and smooth. Also wipe down the linear bearing shafts of the spool carriage so that the carriage continues to glide smoothly.

VI. With small needle nose pliers flatten the bump by pinching the string end against the string. If the bump is too high, the bronze wrap wire will not pass over it. Instead, the wrap wire will back up and destroy the winding.

VII. (A) Tie floss at *left* post. (B) Wrap floss around *left* ball end. (C) Wrap floss around *right* ball end. (D) Wrap floss around *left* ball end. (E) Wrap floss around *right* ball end. (F) Wrap floss around *left* ball end. (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 ball ends too tightly because this will fray the floss.

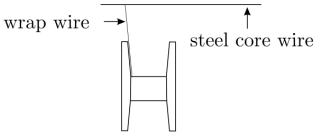


VIII. Unwind the wrap wire from its spool a couple of turns; determine the natural curve of the wire, and follow that curve while attaching the wrap to the core loop at the *right* ball hook.

IX. After the wrap wire clears the twisted length, 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* . . .

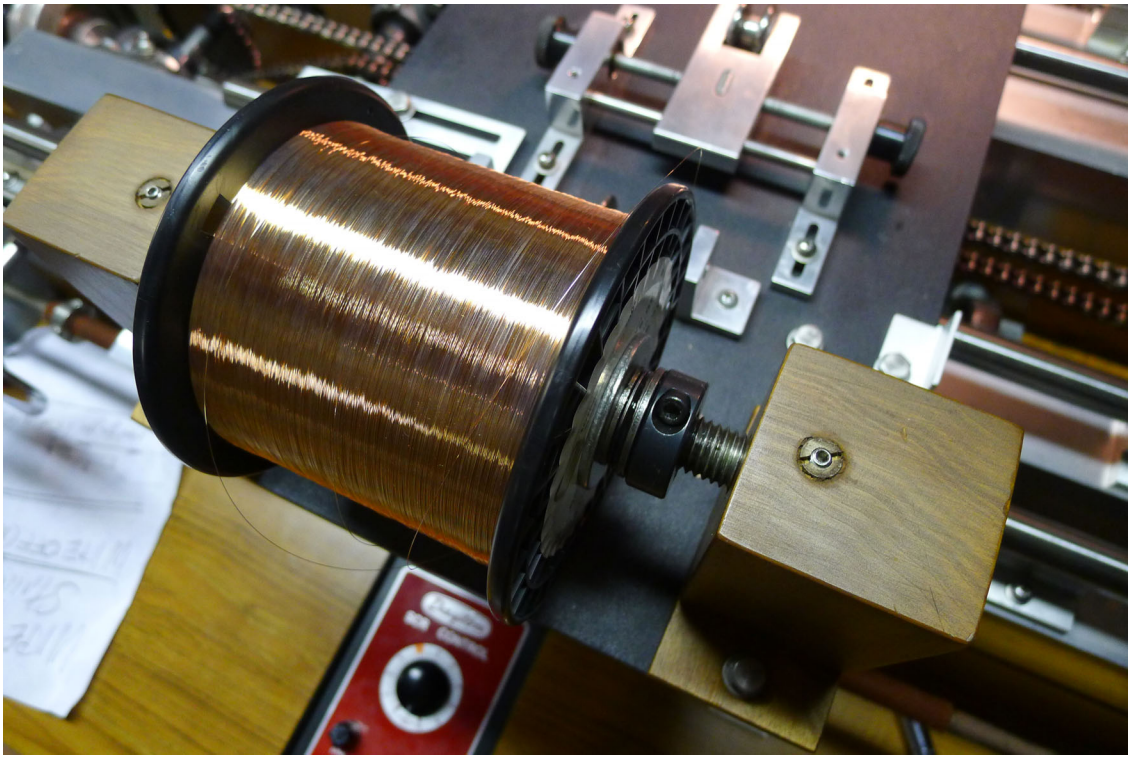
X. During the winding process, the wrap wire *back angle* — which produces tightly wound coils and, therefore, an evenly distributed mass — should be the same as the inside angle of the horizontally adjustable guide wheel.



XI. On the Bass Canon, the longest distance from hitch pin to tuning gear, plus 2.5 turns at the tuning gear post = 156 cm. Make all strings 160 cm. long. Mounting a string on the string winder requires left and right ball ends. After winding a string, cut off ≈ 6.0 cm. of the string required by the left ball end and the twisted length. So, to achieve a finished length of 160 cm., the distance between the left and right ball ends on the string winder = 166 cm. | Wound string diameter dimensions: 0.022 in. music wire 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 spool posts.



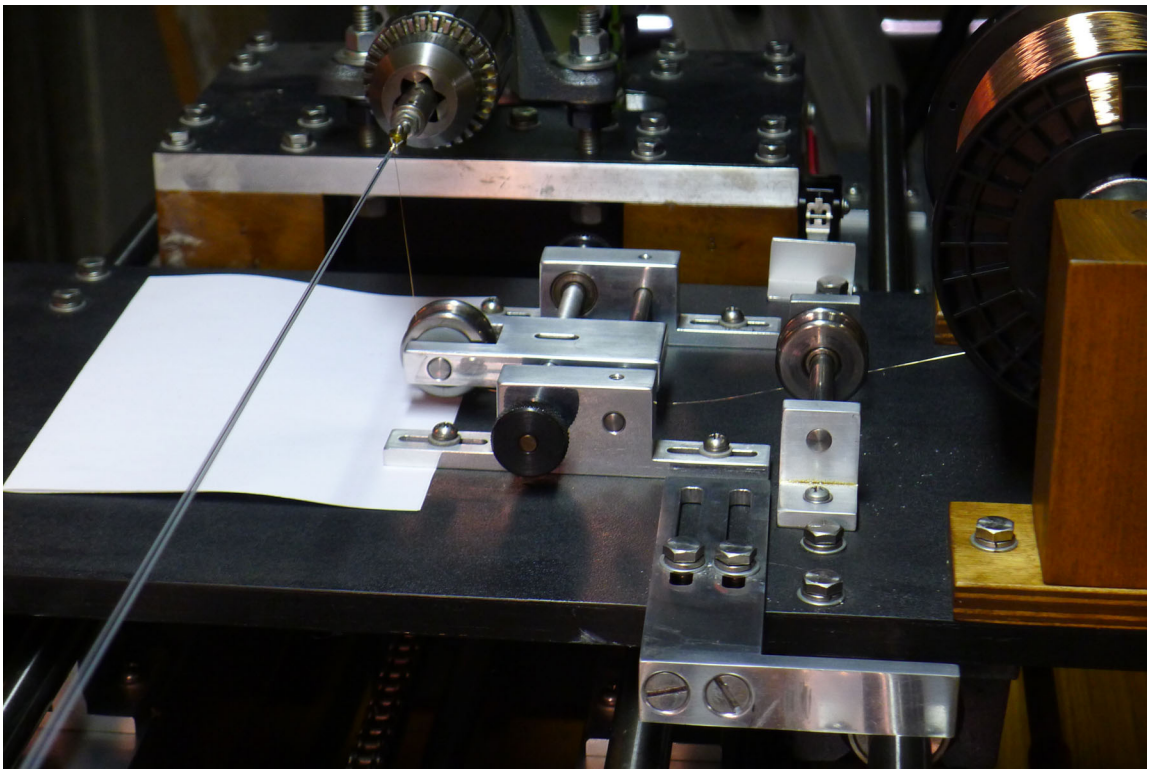
Located between a large washer next to the spool and a threaded shaft collar

is a needle thrust bearing assembly

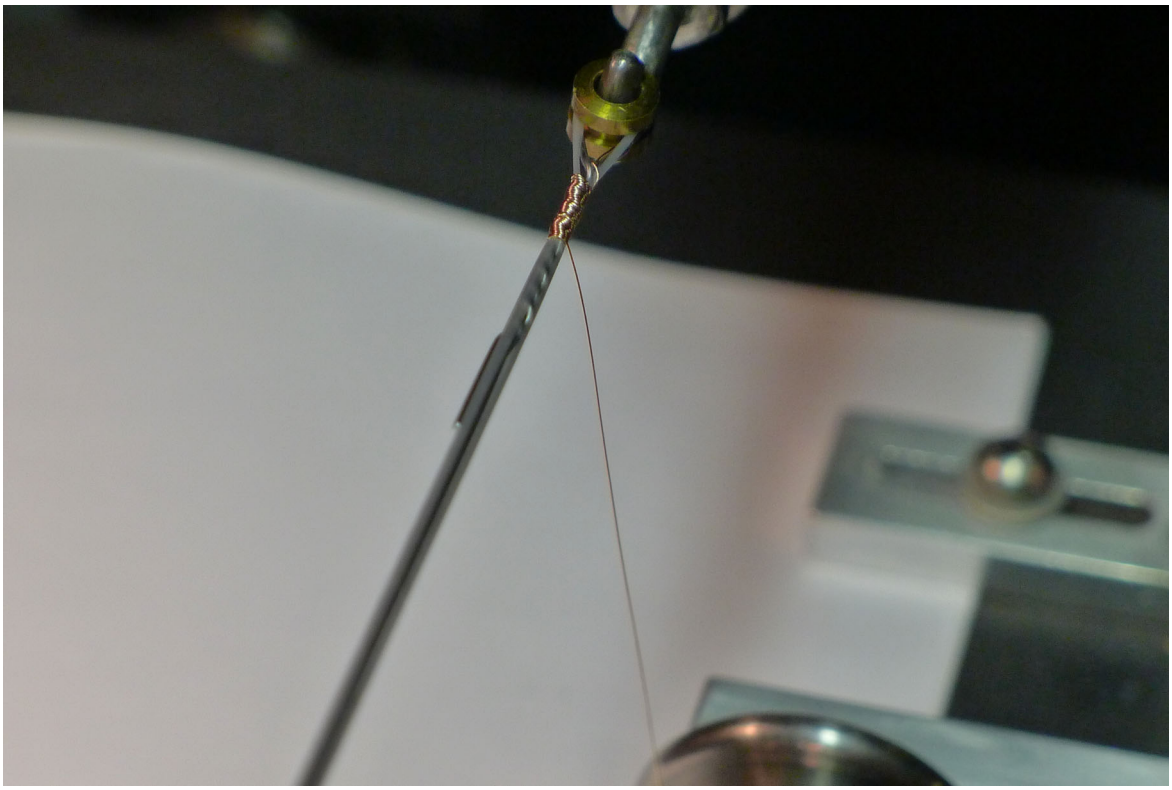
that enables the spool to rotate smoothly. However, to prevent the spool from unwinding too rapidly, it must *also* rotate with a maximum amount of friction or drag. To produce the right amount of friction that will *not* break the bronze wire, first tighten and then lock the threaded shaft collar against 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^{o} turn and passes up and over the steel core wire. When one faces the right chuck, as in the

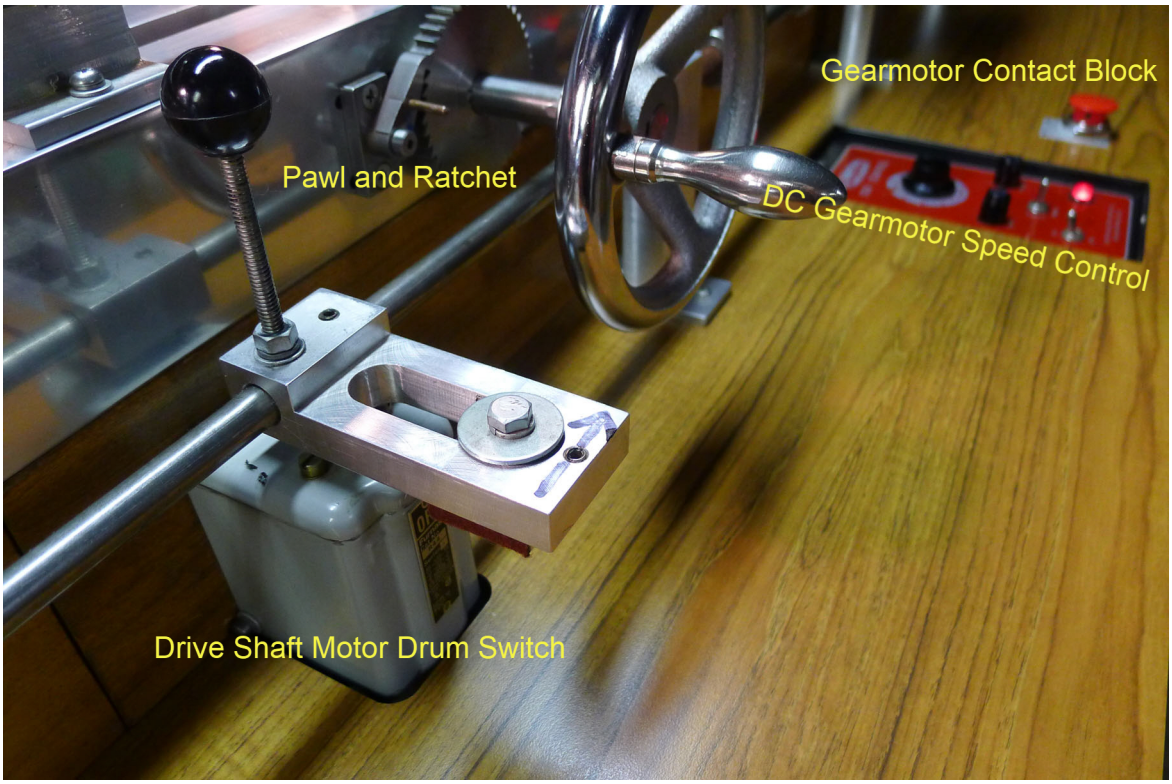
graphic below, the chuck and the core wire must rotate in a counterclockwise direction to pull the wrap wire from the spool.



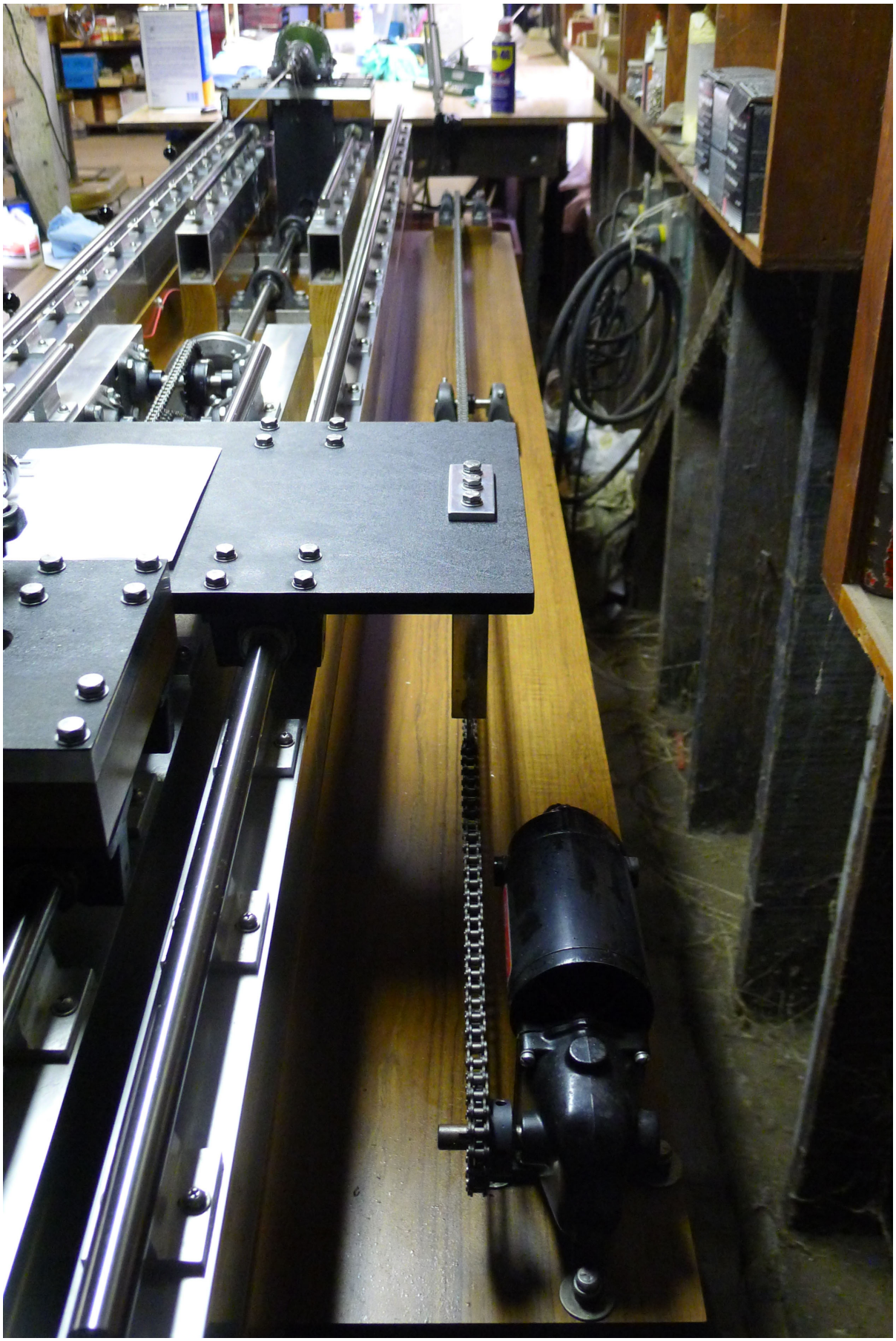
This detailed graphic shows the counterclockwise rotation of the right chuck and core wire:



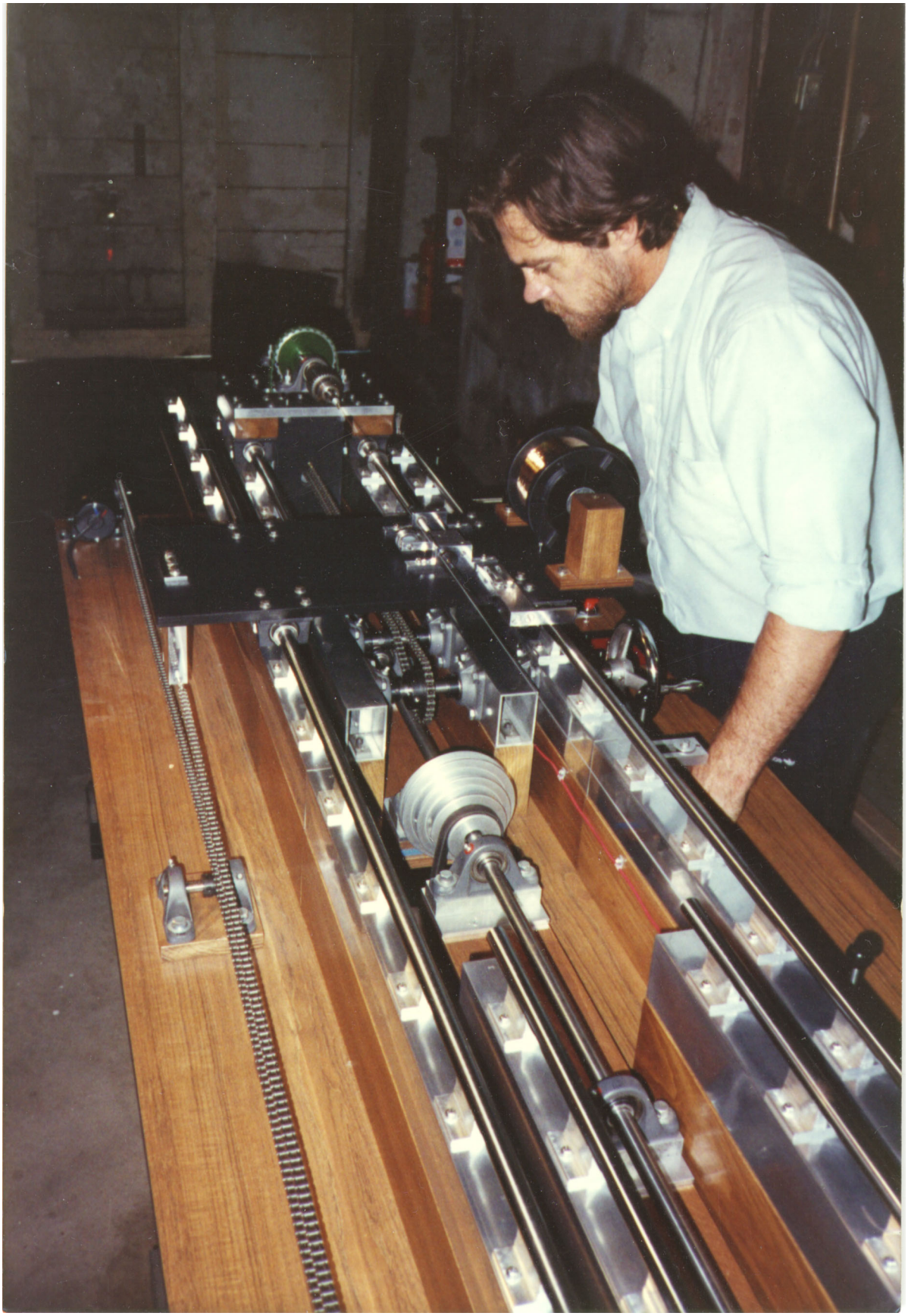
To produce the required counterclockwise rotation, throw the drum switch of the drive shaft motor in the direction of the arrow, or to the right.

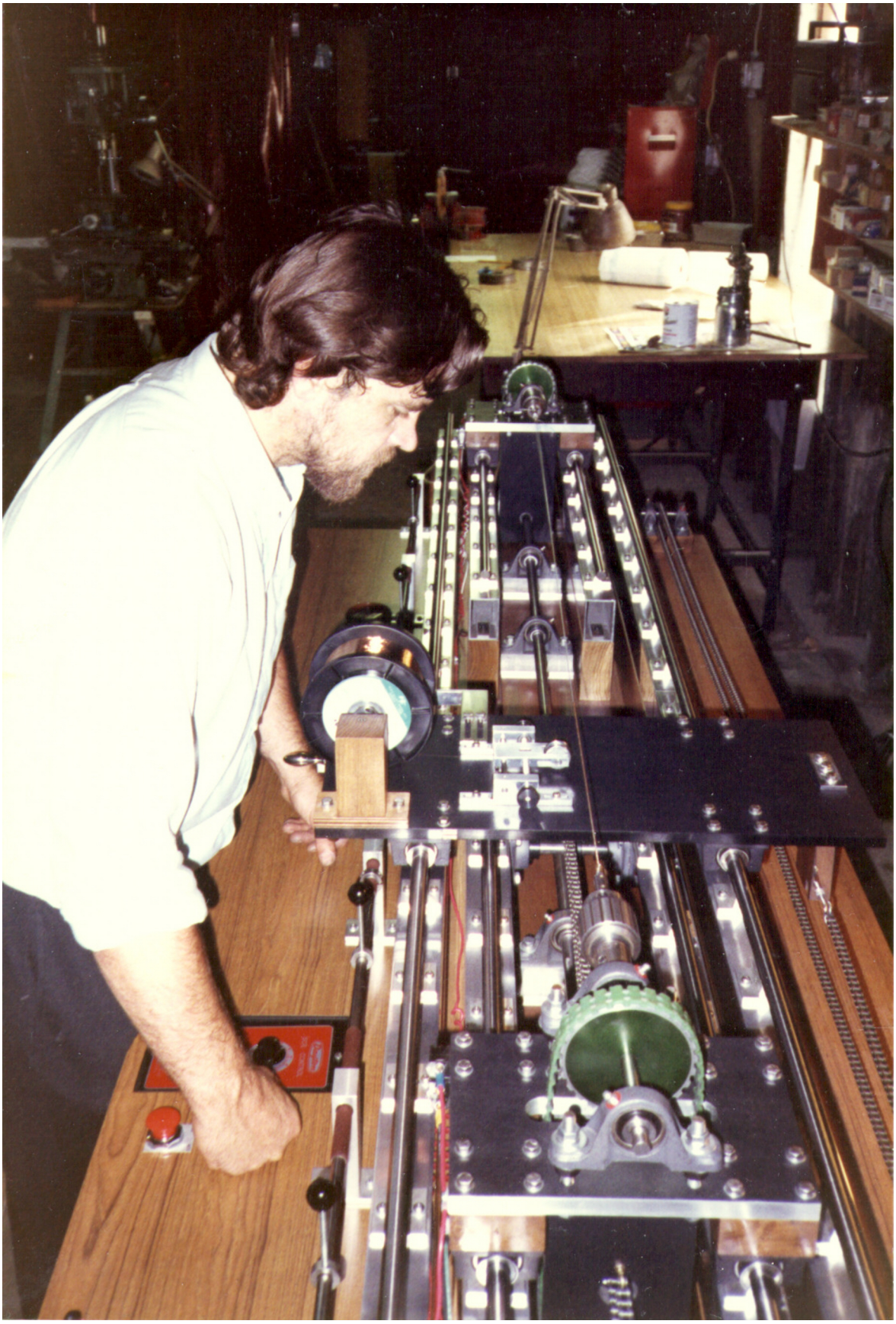


Variable speed DC gearmotor and chain that drive the spool carriage.



Winding a Bass Canon string, 1988.





Phosphor Bronze Wire: Strings-to-Weight Ratio

November, 2012

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

Material and Product Specs:

Phosphor Bronze, Alloy: C510
Diameter: 0.007 in.
Spring tempered and anti-tarnish coating
5 in. × 4 in. spool with $\frac{5}{8}$ in. diameter hole

* * *

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.

* * *

March 2023

One backup set of 72 Bass Canon wound strings + 8 extra strings = 80 strings total.
Stored in eight zip lock plastic bags inside a Rubbermaid Brilliance No. 2024351 airtight container.

One backup set of 89 music wire cores assembled with two brass ball ends per wire.
Stored with eight parchment paper separators inside a Rubbermaid Brilliance No. 2024351 airtight container.

W.M. Berg Inc. Components

4 @ 36 in. × ¾ in. linear bearing shafts: LMS-13-36 (C1060 Steel) that support two chuck carriages with custom #10-32 tapped holes to secure shaft support rails.

2 @ 108 in. × ¾ in. linear bearing shafts: LMS-13-108 (special length cut to 9 ft.) that support one spool carriage with custom #10-32 tapped holes to secure shaft support rails.

6 @ 24 in. shaft support rails: LMR-2 for ¾ in. linear bearing shafts. Cut these into smaller sections for intermittent support of linear bearing shafts.

12 @ ¾ in. diameter linear pillow blocks: LMP-OPN12 (linear bearings) that support two chuck carriages and one spool carriage.

2 @ timing belt pulleys: 50TP8-26, with 26 teeth each, and ***standard*** ½ in. bores for two chuck carriage shafts.

2 @ timing belt pulleys: 50TP10-26, with 26 teeth each, and ***custom-machined*** ¾ in. bores, and ¼ in. keyways for the drive shaft.

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

1 ratchet: R16S20-48 with pinned hub: PH1-33, which has a ⅝ in. bore and a 3⁄16 in. keyway. | 1 pawl: RP-375.

Maintenance

1. Grease eight drive 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 ¼ in. keyway of the ¾ in. drive shaft at the right end of the shaft; that is, grease the keyway that holds the ¼ in. 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 of the solid aluminum block that holds the ends of the spool carriage chain. Now, 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, clean the ⅝ in. threaded shaft, 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.