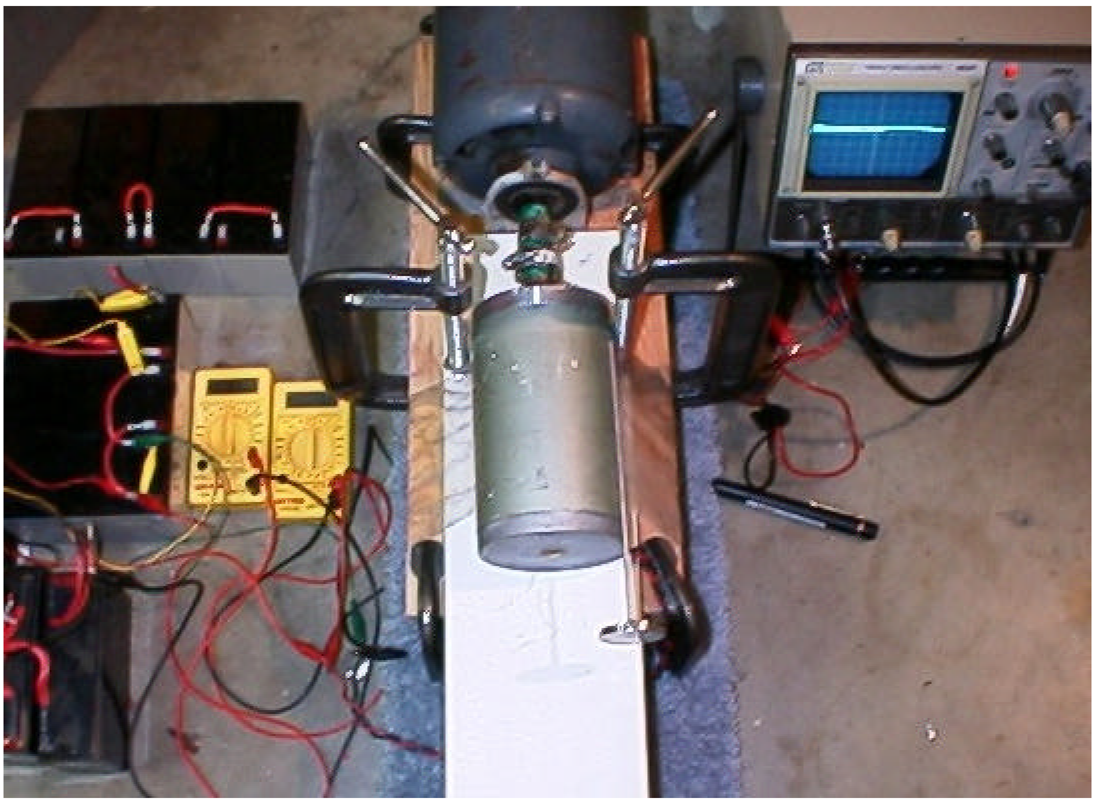
Subject: **1/2" tape drive motor-generator measurements**
Sent: 24 Oct 99

Background for those new to the subject: These motors were taken out of old Mainframe 1/2 inch reel to reel tape drives. Typical each reel of tape had 2400 ft of tape. A lot of slow motion starting and stopping was done. Because of the relatively low price and ease of availability I decided to test a few of these motors to determine their workability as a generator for hand crank or bicycle generator use.

See picture http://home1.gte.net/mikelob/ro300962.jpg



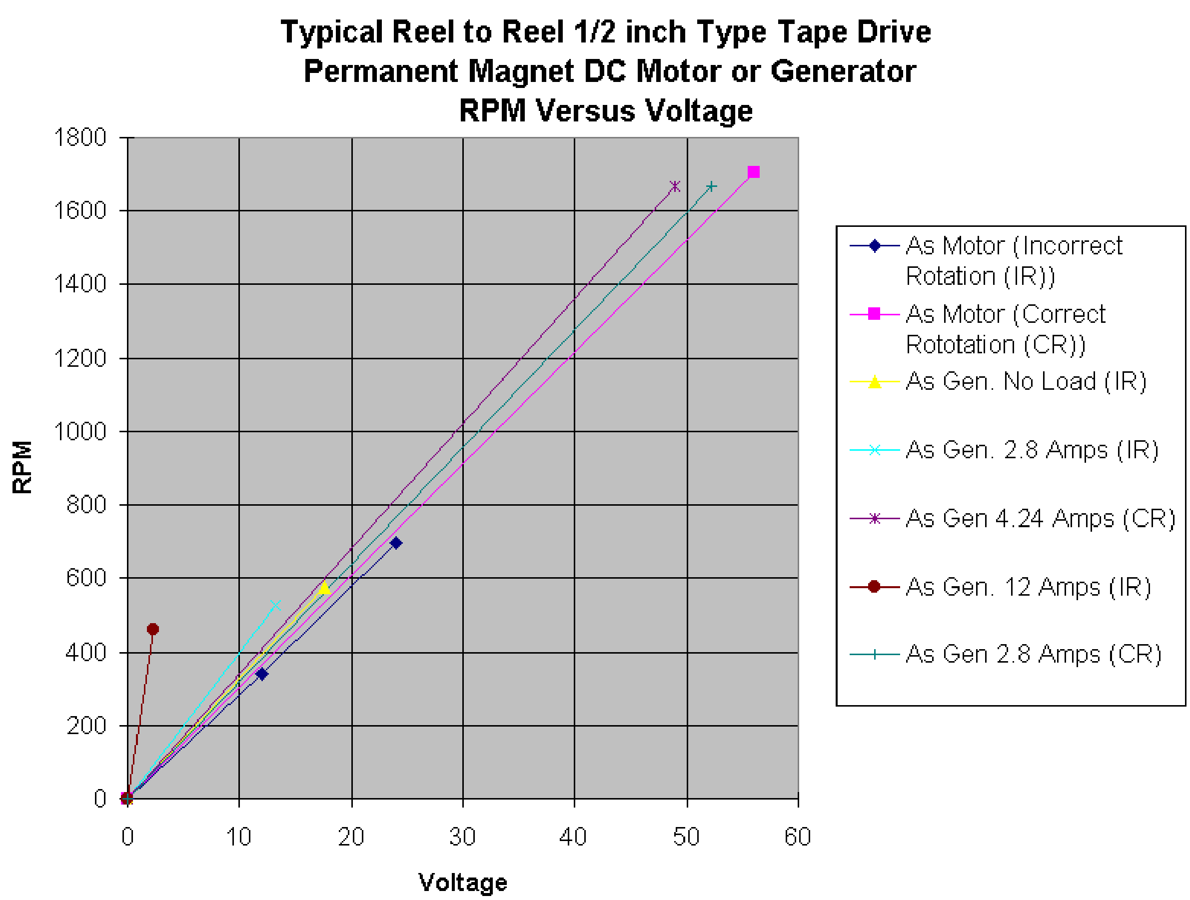
My current tests used a 1/3 hp 1725 RPM 115 V AC motor to turn the PM DC motor as a generator. A short section of garden hose with hose clamps were used as a flex shaft to couple both AC Motor and generator together. An oscilloscope, laser pointer, and solar cell was used to measure the RPM. Digital voltmeters were used to measure amperage and current. The motor was taped to a board using clear 2" wide tape.

For rough order power capabilities of a PM DC motor, do a resistance test. If one uses an Ohmmeter across the leads, the brush resistance will make it higher than it really is. The best way is to clamp the shaft so that it doesn't rotate and measure the current with some amount of voltage applied say 12-Volts DC. Using ohms law the resistance then is voltage divided by current. I now have 4 different types of these tape drive motors:

Ohms	Diameter Shaft	lbs	Case length	Volts	Amp	Air Vent	Color	Manufacture
.677	1/2"	15	9"	60	1	yes	Black	Unknown(EC 54312)
.795	5/8"	11	7"	36	1	yes	Gray	Indiana General (4030D-95)
.839	1/2"	11	7"	50	1	no	Green	Ametek (E56617) (plotted data on)
2.04	5/8"	9	6"	?	?	no	Black	Electro-Craft (E722)

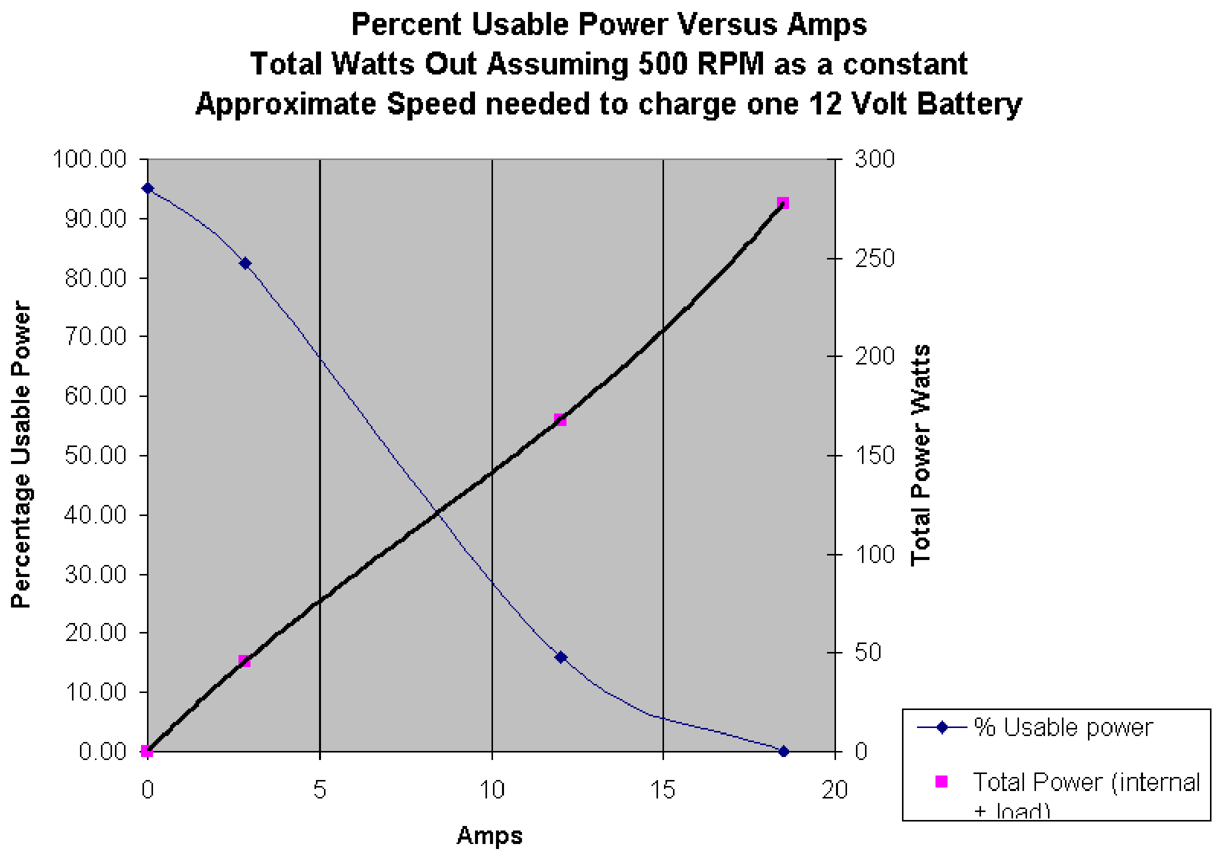
The unit that gives the lowest resistance will give the most power. I choose the Green Ametek as typical and plotted electrical data on it.

Chart1 shown at http://home1.gte.net/mikelob/DCmotorPM1.gif



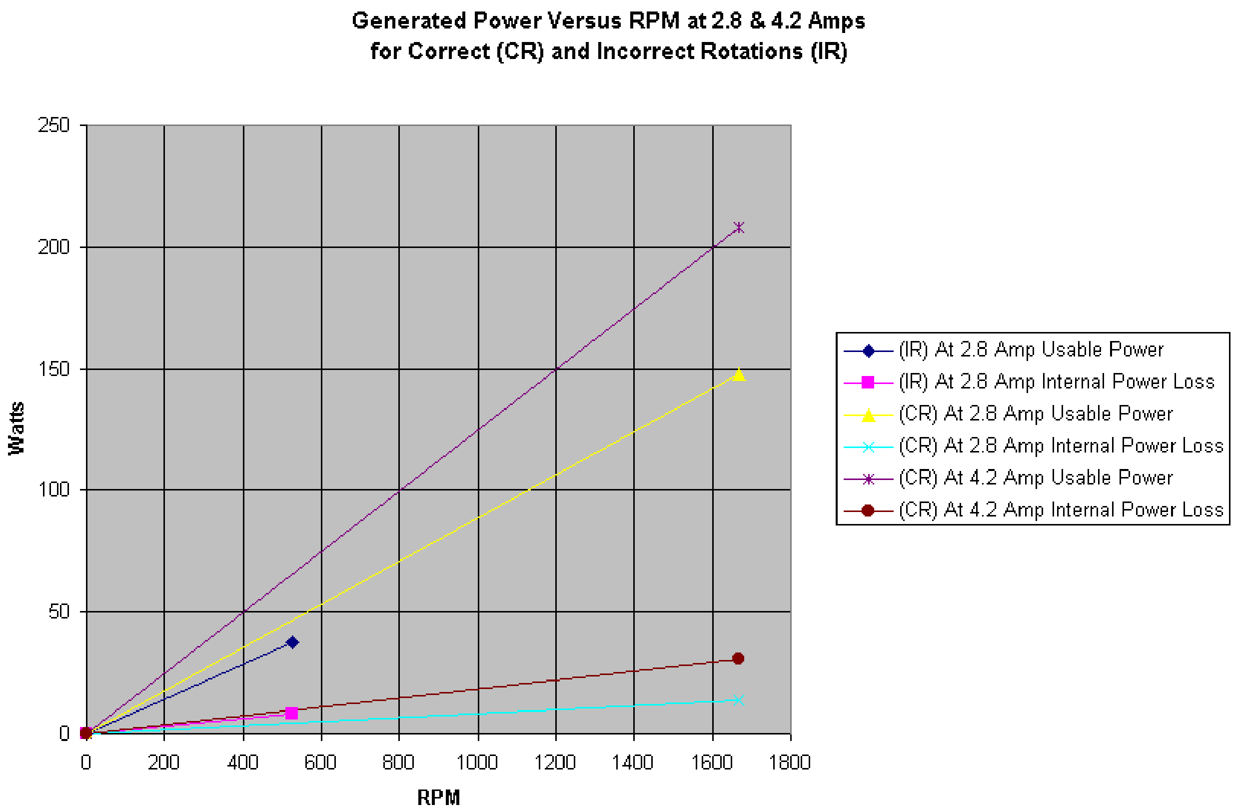
shows that as voltage increases the RPM increases. This chart compares running as a motor and running as a generator or running in reverse direction as motor and generator. The brushes are slightly offset for optimum power in one direction. As current generation increases the voltage goes down causing a new curve to be drawn.

Chart2 shown at http://home1.gte.net/mikelob/DCmotorPM2.gif



presents the relationship of percent usable power versus amps assuming we are running at about 500 RPM. This is the speed needed to optimally charge one 12-volt battery. Note that as the amperage goes up the percent usable power goes down. Also, note that as the amperage goes up the total power consumed goes up. Most of it is being wasted.

Chart3 shown at http://home1.gte.net/mikelob/DCmotorPM3.gif



gives the generated power versus RPM for typical amperage produced. If a reverse polarity direction is chosen one can expect more power loss. Rotation in the opposite direction from what the motor was designed for causes brush noise (I found it harder to measure correct voltage with a digital meter) and more internal power loss. At higher amperage we have again more internal power loss and a new curve showing this. The usable power one can expect at about 500 RPM (charging one 12-Volt battery) is about 40-60 watts depending on the current (2.8 to 4.2 amps). The usable power at about 1800-RPM (to optimally charge at 48 volts or 4 batteries in series) is about 150-210 watts depending on the current (2.8 to 4.2 amps). This allows for charging at about 14 volts for each 12-volt battery.

After running continuously at an average of 3.6 amps for 42 minutes the 1/3 hp drive motor got hotter than the test DC motor-generator which measured 52 degrees Centigrade. The test motor-generator was sealed and had no forced airflow around the armature. It had to heat up the internal air and the air then would heat the aluminum and steel casing. If one were to drill holes in it for forced air cooling it could be used at a bit higher amps. Some of these units can be purchased with forced air cooling holes. See "Air Vent" column in the table above.

The lower the current used the longer the brushes will last. Assuming forced air-cooling, just a guess at this time, but I would plan on running continuously at less than 4 amps. Under non-continuous operation one may be able to go to 8 amps occasionally.

Subject: Computer reel to reel tape drive PM DC motors
Sent: 25 Sep 99

Ameterk (Lamb Electric Division) Kent, Ohio 44240: 40-50 VDC Nominal 01A. Cost $5 as a used surplus reel to reel tape drive motor. 1.5 ohm to 3.8 ohm dc measured resistance. Measures 7" long by 4" in diameter not including the shaft. Weight is 10 lbs. Has 2 internal carbon brushes, a wire wound armature with commentator and two sets of permanent magnet fields. No air vents to the inside. Shaft typically bigger than .5".

Electrical measurements as a motor: At 12 volts it draws .2-.3 amp while free running at 340 RPM with no load using about 2.4-3.6 watts. At 24 volts it draws .29-.67 amp while free running at 697 RPM with no load using about 7-16 watts. With shaft clamped and not turning I measure at 8.4 volts a 10 amp draw or 84 watts and at 14.6 volts a 18 amp draw or 263 watts.

Electrical measurements as a generator: At no-load 577 RPM I measure 17.6 volts. Charging a 12 V battery at 13.2 Volts at 2.85 amps and was running 526 RPM for a wattage of 37.6 watts. I ran it for a time like this and it didn't get warm at all. Shorted across a low voltage load measured 12 amps at 2.27 volts and 461 RPM to result in 27 watts. After about 5-6 minutes running at this load my flex shaft that ran to a 1/2 in drill broke (was a short section of water hose) from too much flexing and twisting torque. The generator-motor after waiting for the temperature to stabilize was warm approaching hot to the touch.

Second type of PM DC tape drive reel to reel motor:

Electro-craft Corp model E722, 4 brushes externally accessible. It is 6" long by 4" diameter weighting 9 lbs. Internal resistance 3.2 ohms measured. Cost surplus used at about $7.50/each. No air vents to the inside. Shaft typically bigger than .5".

Electrical measurements as a motor: At 12 volts it draws .27 amp while free running at 273 RPM with no load using about 3.2 watts. At 24 volts it draws .32 amp while free running at 576 RPM with no load using about 7.7 watts.

Conclusion: At 13 volts and 530 RPM can expect about 37 watts or about 2.8 amps. Higher voltage is possible up to about 40-50 volts. The current would need to go down proportionally. These units may work for exercise cycles and hand crank units. Need to get the shaft speed ratio correct for optimum performance. May need to use more than one generator on each exercycle.

Jay, these look too small power wise and need too much RPM to make a wind mill. What do you think?

MikeL

Measurements as generator:
The latest were done counter clockwise facing motor. Which give proper polarity as per color on wires coming from motor. The first were done clockwise facing motor.
