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DC Motor
Variable Speed Modification
for the
Asian 920 Lathes

By: Cletus Berkeley

WARNING
YOU CAN BE KILLED

These instructions encompass working with LINE VOLTAGE. If you are unqualified or uncomfortable working with electricity:
SEEK PROFESSIONAL ASSISTANCE

This document is issued for INFORMATION PURPOSES ONLY. The author and/or Manufacturers mentioned herein assume no liability for damages, injury and/or loss of life from performing the procedures mentioned herein.

INTRODUCTION

The Asian 920 Lathe offers an inexpensive solution for persons wanting a capable machine without having to dip into “Johnny’s College Fund”.

These Asian Lathes readily lend themselves to a variety of useful modifications one of which is variable speed.

There are a number of ways in which variable speed may be accomplished and this document focuses on an inexpensive approach (<US$140.00) using readily available surplus components to accomplish the goal.

The modification suggested herein utilizes a surplus 2HP Permanent Magnet DC Treadmill Motor and a Regenerative Electronic Drive Circuit Board. Few additional parts and minor modifications are required to complete the project.

This document suggests utilizing such components to achieve simple, reliable and safe Spindle Speed Control. Further research into the design of the Drive Electronics would reveal that a more advanced control system may be implemented by those wishing to do so.

The modifications never stop!
A complimentary modification to this one would be the addition of a Digital Spindle Tachometer Display

http://www.littlemachineshop.com/products/product_view.php?ProductID=1684

Once you’ve experienced a Variable Speed Lathe… you’ll wonder how you survived without it!

I’ve tried to pack a lot of info into these few pages, Have fun and be safe!

Comments Welcome.

Cletus, 9Z4CLB

BITS AND PIECES

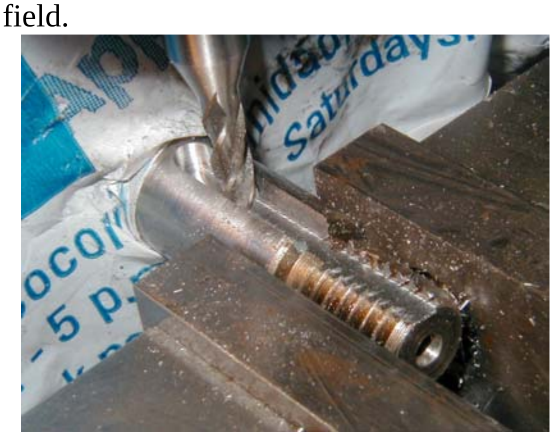
Here's the stuff you will need to acquire *(A number of whistles and bells may be added, I subscribe to the KISS (Keep It Simple Stupid) method and therefore documented only what is necessary to get it going safely and reliably)* ***{ I strongly recommend adding the Failsafe Option }*****:**

TIP: *Lots of stuff may already be in your junkbox*

1. 1 ea DC Motor
http://www.surpluscenter.com/item.asp?UID=2005012618452113&item=10-1906&catname=electric
2. 1 ea DC Speed Control Board
http://www.surpluscenter.com/item.asp?UID=2005012618452113&item=11-2434&catname=electric
3. 1 ea 10K Potentiometer (Speed Control)
http://www.surpluscenter.com/item.asp?UID=2005021309260284&catname=electric&item=11-2432
4. 1 ea Enclosure
5. 1 ea Knob
6. 1 ea Fan 12VDC
7. 1 ea Transformer 12V 500mA
8. 1 ea Diode 1A 50V
9. 1 ea Capacitor 250uf 50V
10. 1 ea LED (a color of your fancy)
11. 4 ea 100-Ohm 25W Wirewound Resistors
12. 1 ea Resistor 1K .25W
13. 1 ea DPDT Switch – 10A @ 125VAC
14. 2 ea SPST Toggle Switch
15. 1 ea SPST Momentary Pushbutton (NC) 0.5A @ 125VAC
16. 1 ea Power Cord With Plug
17. 1 ea Fuseholder
18. 1 ea 20A Fuse
19. 1 ea Enclosure and hardware to make it all nice and neat
20. 1 ea Weatherproof AC outlet Wallcover (Ace Hardware)   }
21. 1 ea Magnetic N/C Reed Switch (Mouser 507-AMS-17W) }   **FAILSAFE OPTION**
22. 1 ea Solid State Relay (Mouser 558-D2425)   }

CONSTRUCTION

(A) The first order of business is to mill a 0.125" keyway in the shaft (it all fits in the Mini-Mill). The motor does not have to be taken apart to do this, but be sure to encase the motor in a plastic bag or you will get all the crud pulled into the works by the magnetic field.



TIP: *You can use a 12VDC supply to safely test run (no load) the motor on the bench (I was able to run mine with a bench power supply with as little as 5VDC @ 500mA) .*

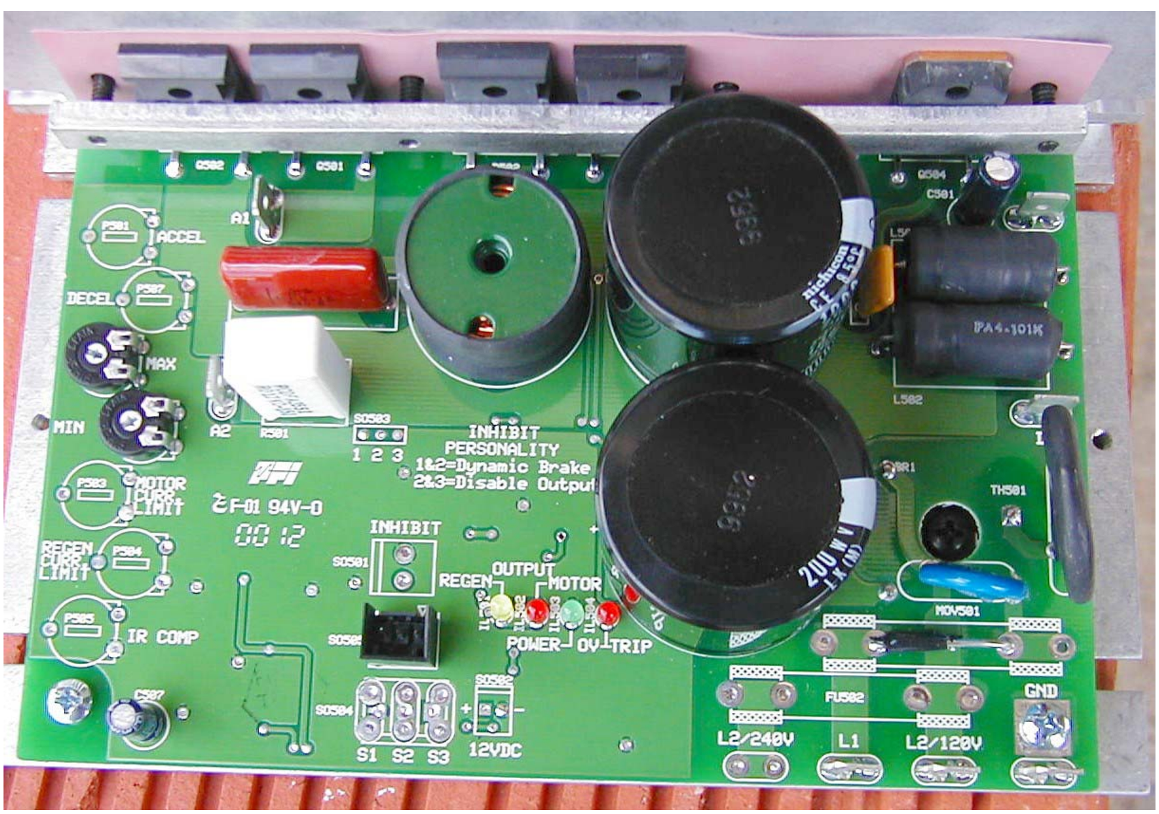
(B) Keeping the crud out of the motor is paramount to system longevity. There are three entry points (front, rear and side vents). You will want to use some type of mesh to keep the crud out and allow the passage of cooling air, such as Screen-Door mesh. I chose to use a combination of Screen-Mesh and 3M pot scrubbers stuck on with a Glue-Gun… the pot scrubbers form a fine filter and helps keep smaller chips out yet allows air into the motor.

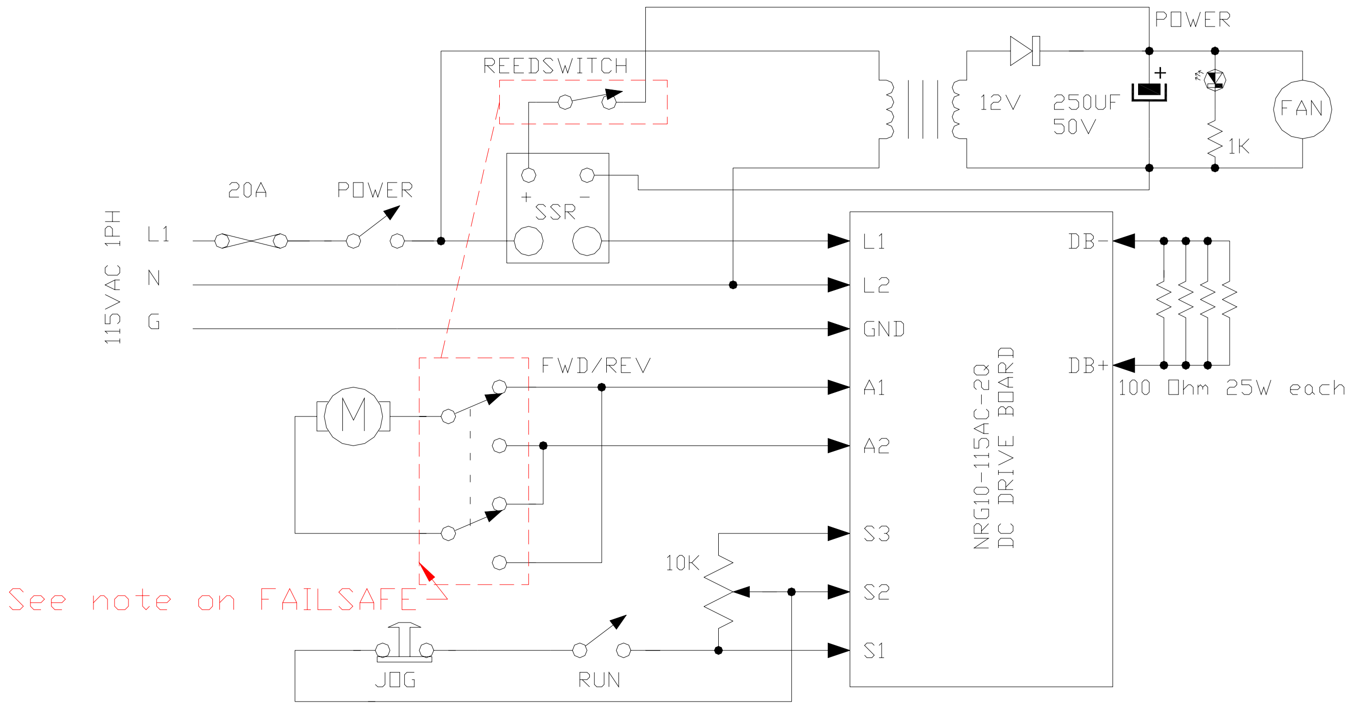

REAR FILTER


FRONT FILTER

(C) The DC Drive we are using is a proprietary derivative of Model NRG10-115AC-2Q manufactured by Minarik Automation and Control. This regenerative DC Drive was intended for use on Treadmills and a number of adjustment controls have been omitted from the board. These adjustments have been preset by the addition of discrete components. The board in its preset condition performs perfectly well for our intended purpose including its acceleration and deceleration timing. However, the electronics enthusiast may opt to upgrade the board with the necessary controls and further "fine-tune" the system… but that is beyond the scope of this document.

TIP: *Whistles and bells: Feel free to carefully remove the PCB LED's and remount them to your front panel if you desire (not necessary)*

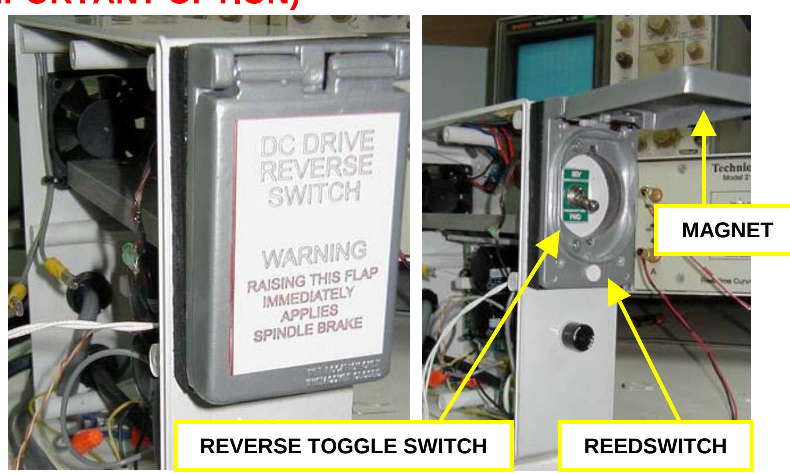




TIP: *I chose to mount the Speed Control Pot, Run Switch and Jog Pushbutton on a sub-panel on the front of the lathe. If you chose to do so, use shielded cable leading to S1,S2, S3.*

FAILSAFE
(NOTE IMPORTANT OPTION)

It is recommended that the reverse switch be mounted under a safety access flap, so that to initiate spindle reverse the flap must first be raised. Further there shall be mounted to the flap arrangement, a magnetic reedswitch, such that when the flap is raised the magnet (epoxied in the cover) shall separate from the reedswitch and thereby open the control circuit of the Solid State Relay.



This will essentially initiate an emergency stop by removing power to the drive thus causing the spindle to coast to a stop, thereby preventing the operator from initiating a spindle reverse command with the drive running.

ADJUSTMENTS

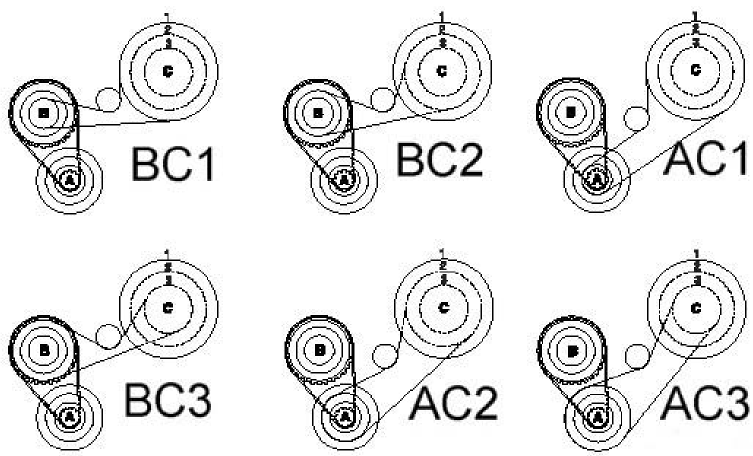
There are only two electronic adjustments that need to be set, these are the Minimum and Maximum Speed trimpot adjustments. These two adjustments interact with each other so you need to go back and forth a couple of times to get it right. Here's what we're trying to achieve:
1) We need the spindle to respond from standstill to a RUN or JOG command with little or no delay. This is achieved with the Minimum Speed Trimpot.
2) We need the spindle to respond from rotating to deceleration with little or no delay when the toggle switch is reset from run to jog or the jog button is released. This is achieved with the Maximum Speed Trimpot.

Here we go:

1. Set the Toggle to JOG, SPEED control to zero, Minimum trimpot adj to full CCW, Maximum adj trimpot to full CW.
2. MINIMUM ADJUST - Toggle to RUN and adjust the Minimum adj trimpot to just start the motor rotating and back off the adjustment to where it just stops the rotation.
3. MAXIMUM ADJUST – With the toggle still at RUN, advance the SPEED control from zero to full, the motor should accelerate smoothly from zero to full speed. Once at full speed, reduce the Maximum adj trimpot from full CW to a point just before the motor starts to decelerate.
4. At this point, if you return the SPEED control to zero, you will probably find that you have lost the "zero setting". If so repeat steps two and three.

Here's the link to the DC Controller Manual:
http://www.minarikcorp.com/PDFs/250-0246.pdf

SPEED CHART



Belt/Pulley Configuration	RPM Range	RPM Stock Speed
BC1	5-300	130
BC2	10-720	300
AC1	10-860	400
BC3	40-1380	600
AC2	60-2300	1000
AC3	100-4100	2000

Spindle Speeds RPM

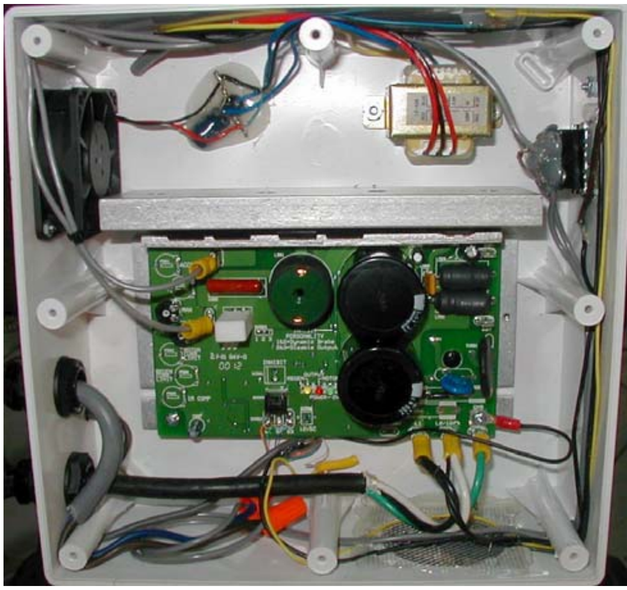
Job Diameter	Cast Iron, Brass & Stainless			Steel			Aluminum		
S.F.P.M.” ➔	40	50	60	70	80	90	100	110	120
0.016	9779	12223	14668	17113	19558	22002	24447	26892	29336
0.031	4889	6112	7334	8556	9779	11001	12223	13446	14668
0.063	2445	3056	3667	4278	4889	5501	6112	6723	7334
0.125	1222	1528	1834	2139	2445	2750	3056	3361	3667
0.187	817	1021	1226	1430	1634	1838	2043	2247	2451
0.250	611	764	917	1070	1222	1375	1528	1681	1834
0.312	490	612	735	857	979	1102	1224	1347	1469
0.375	407	509	611	713	815	917	1019	1120	1222
0.437	350	437	524	612	699	787	874	962	1049
0.500	306	382	458	535	611	688	764	840	917
0.625	244	306	367	428	489	550	611	672	733
0.750	204	255	306	357	407	458	509	560	611
0.875	175	218	262	306	349	393	437	480	524
1.000	153	191	229	267	306	344	382	420	458
1.125	136	170	204	238	272	306	340	373	407
1.250	122	153	183	214	244	275	306	336	367
1.375	111	139	167	194	222	250	278	306	333
1.500	102	127	153	178	204	229	255	280	306
1.625	94	118	141	165	188	212	235	259	282
1.750	87	109	131	153	175	196	218	240	262
1.875	81	102	122	143	163	183	204	224	244
2.000	76	95	115	134	153	172	191	210	229
2.250	68	85	102	119	136	153	170	187	204
2.500	61	76	92	107	122	138	153	168	183
2.750	56	69	83	97	111	125	139	153	167
3.000	51	64	76	89	102	115	127	140	153
3.250	47	59	71	82	94	106	118	129	141
3.500	44	55	65	76	87	98	109	120	131
3.750	41	51	61	71	81	92	102	112	122
4.000	38	48	57	67	76	86	95	105	115
4.500	34	42	51	59	68	76	85	93	102
5.000	31	38	46	53	61	69	76	84	92
5.500	28	35	42	49	56	63	69	76	83
6.000	25	32	38	45	51	57	64	70	76
6.500	24	29	35	41	47	53	59	65	71
7.000	22	27	33	38	44	49	55	60	65
7.500	20	25	31	36	41	46	51	56	61
8.000	19	24	29	33	38	43	48	53	57

Formula $RPM = SFPM * (12 / \pi) / d$

SFPM = Surface Feet Per Minute
d = Job Diameter

TIP: *The above chart should be considered a starting point and is based on HSS tooling. For Carbide tooling, multiply the speeds twofold. Remember this is merely a starting point guide, you now have variable speed and lots of power to back it, experiment and apply common sense liberally, vary the speed, you will soon find a speed that matches the job, tooling and machine. But don’t over do it!*

Here are some pictures of my Grizzly G4000 modification:



FWD/REV
Switch

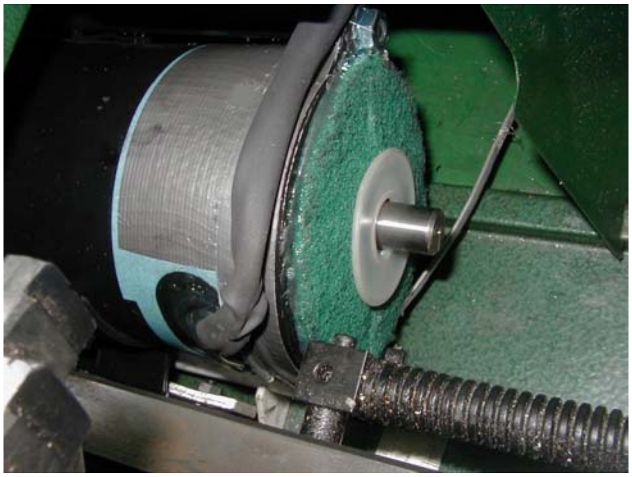
A view inside the DC Drive Box

Close-up of Control Panel (made on my CNC Engraver/Router)

Lathe-Mounted Control Panel

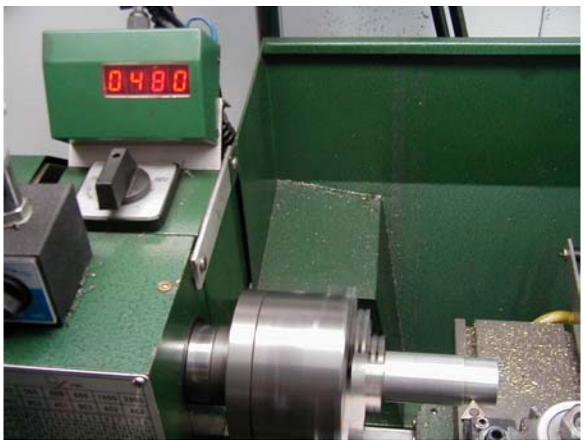
DC Drive Box tucked away under the bench.
(note the Spindle Reverse Switch mounted on the box)
{Shown without safety-flap}

TIP: With this Motor/Drive combination there's more torque available at the motor than can be delivered to the spindle due to Belt Slippage. Belt Slippage is a good thing, as it prevents things from otherwise breaking. Keeping the Belts and Pulleys clean and free from oil,(wiping with Isopropyl or Rubbing Alcohol) will allow more efficient torque transfer to the spindle. Let common sense prevail!



The motor is mounted (note filter)

The pulley arrangement (note filter)



The tach says 480 RPM …and 480 RPM it is

4" dia CRS in the chuck and the motor runs cool

TEST RUN OBSERVATIONS

1. How did I function without variable speed?
2. Much improved surface finish with the DC Motor.
3. Can change speeds at will, nice when doing facings.
4. Can get real slow, nice for threading and winding coils.
5. Jog button is useful when setting up the job.
6. No need to jockey the belt tension lever on startup when I have a heavy job in the chuck or whe n I am using my massive 4-jaw. The acceleration/deceleration timing takes care of it.
7. Lots of torque from a much more powerful motor.
8. No mods to the lathe. I can revert to the stock motor in 20-minutes.
9. Have machined some 4" dia CRS for about two hours and the motor has only barely gotten w arm..

The speed changes and ramping are very smooth and acceleration/deceleration time is approximately 8-seconds. There is virtually no response delay from standstill to start of rotation and same from rotation to start of deceleration. This DC motor produces lots more torque over the stock motor and is very silent apart from the characteristic whine of a DC Motor at full RPM.