

JET[®]

Operating Instructions and Parts Manual Wood Lathe

Models: JWL-1642EVS and JWL-1642EVS-2



WALTER MEIER (Manufacturing) Inc.

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Warranty and Service

Walter Meier (Manufacturing) Inc., warrants every product it sells. If one of our tools needs service or repair, one of our Authorized Service Centers located throughout the United States can give you quick service. In most cases, any of these Walter Meier Authorized Service Centers can authorize warranty repair, assist you in obtaining parts, or perform routine maintenance and major repair on your JET® tools. For the name of an Authorized Service Center in your area call 1-800-274-6848.

MORE INFORMATION

Walter Meier is consistently adding new products to the line. For complete, up-to-date product information, check with your local Walter Meier distributor, or visit waltermeier.com.

WARRANTY

JET products carry a limited warranty which varies in duration based upon the product (MW = Metalworking, WW = Woodworking).

90 DAY WARRANTY	1 YEAR WARRANTY	Body Repair Kits Bottle Jacks Cable Pullers Cold Saws Hoists-Air Hoists-Electric Metal forming Mill/Drills Milling Machines MW Bandsaws MW Drill Presses MW Finishing Equipment MW Lathes MW Precision Vises	2 YEAR WARRANTY	Palet Trucks Rigging Equip. Service Jacks Stackers Surface Grinders Tapping Trolleys-Air Trolleys-Electric Web Slings Winches-Electric	3 YEAR WARRANTY	WW Benchtop Tools	5 YEAR WARRANTY	Beam Clamps Chain Hoist-Manual Lever Hoists Pullers-JCH Models Scissor Lift Tables Screw Jacks Trolleys-Geared Trolleys-Plain Winches-Manual WW Air Filtration WW Bandsaws WW Buffers	WW Drill Presses WW Dust Collectors WW Dust Filters WW Dust Fittings WW Jointers WW Lathes WW Planers WW Sanders WW Shapers WW Tablesaws	LIFE LIFETIME WARRANTY	Fastening Tools Mechanics Hand Tools Striking Tools Vises (no -precision) Clamps
Warranty reverts to 1 Year Warranty if woodworking (WW) products listed above are used for industrial or educational purposes.											

WHAT IS COVERED?

This warranty covers any defects in workmanship or materials subject to the exceptions stated below. Cutting tools, abrasives and other consumables are excluded from warranty coverage.

WHO IS COVERED?

This warranty covers only the initial purchaser of the product.

WHAT IS THE PERIOD OF COVERAGE?

The general JET warranty lasts for the time period specified in the product literature of each product.

WHAT IS NOT COVERED?

Five Year Warranties do not cover woodworking (WW) products used for commercial, industrial or educational purposes. Woodworking products with Five Year Warranties that are used for commercial, industrial or education purposes revert to a One Year Warranty. This warranty does not cover defects due directly or indirectly to misuse, abuse, negligence or accidents, normal wear-and-tear, improper repair or alterations, or lack of maintenance.

HOW TO GET SERVICE

The product or part must be returned for examination, postage prepaid, to a location designated by us. For the name of the location nearest you, please call 1-800-274-6848.

You must provide proof of initial purchase date and an explanation of the complaint must accompany the merchandise. If our inspection discloses a defect, we will repair or replace the product, or refund the purchase price, at our option. We will return the repaired product or replacement at our expense unless it is determined by us that there is no defect, or that the defect resulted from causes not within the scope of our warranty in which case we will, at your direction, dispose of or return the product. In the event you choose to have the product returned, you will be responsible for the shipping and handling costs of the return.

HOW STATE LAW APPLIES

This warranty gives you specific legal rights; you may also have other rights which vary from state to state.

LIMITATIONS ON THIS WARRANTY

WALTER MEIER (MANUFACTURING) INC., LIMITS ALL IMPLIED WARRANTIES TO THE PERIOD OF THE LIMITED WARRANTY FOR EACH PRODUCT. EXCEPT AS STATED HEREIN, ANY IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS ARE EXCLUDED. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG THE IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

WALTER MEIER SHALL IN NO EVENT BE LIABLE FOR DEATH, INJURIES TO PERSONS OR PROPERTY, OR FOR INCIDENTAL, CONTINGENT, SPECIAL, OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF OUR PRODUCTS. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

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Warnings

1. Read and understand the entire owner's manual before attempting assembly or operation.
2. This wood lathe is designed and intended for use by properly trained and experienced personnel only. If you are not familiar with the proper and safe operation of a wood lathe, do not use it until the proper training and knowledge have been obtained.
3. Always wear approved safety glasses/face shields while using this machine.
4. Make certain the machine is properly grounded.
5. Before operating the machine, remove tie, rings, watches, other jewelry, and roll sleeves up past the elbows. Remove all loose clothing and confine long hair. Do **not** wear gloves.
6. Keep the floor around the machine clean and free of scrap material, oil and grease.
7. Keep machine guards in place at all times when the machine is in use. If removed for maintenance purposes, use extreme caution and replace the guards immediately.
8. Do **not** over reach. Maintain a balanced stance at all times, so that you do not fall or lean against blades or other moving parts.
9. Make all machine adjustments or maintenance with the machine unplugged from the power source.
10. Use the right tool. Do not force a tool or attachment to do a job that it was not designed.
11. Replace warning labels if they become obscured or removed.
12. Make certain the switch is in the **OFF** position before connecting the machine to the power supply.
13. Give your work undivided attention. Looking around, carrying on a conversation and "horse-play" are careless acts that can result in serious injury.
14. Keep visitors a safe distance from the work area.
15. Use recommended accessories; improper accessories may be hazardous.
16. Read and understand warnings posted on the machine and in this manual. Failure to comply with all of these warnings may cause serious injury.
17. Some dust created by power sanding, sawing, grinding, drilling and other construction activities contain chemicals known to cause cancer, birth defects or other reproductive harm. Some examples of these chemicals are:
 - Lead from lead based paint.
 - Crystalline silica from bricks, cement and other masonry products.
 - Arsenic and chromium from chemically treated lumber.Your risk of exposure varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: work in a well ventilated area, and work with approved safety equipment, such as face or dust masks that are specifically designed to filter out microscopic particles
18. Do not operate this lathe while under the influence of drugs, alcohol or any medication.
19. Keep tools sharp and clean for safe and best performance. Dull tools can grab in the work and be jerked from the operators hands causing serious injury.
20. Check the condition of the stock to be turned. Make sure it is free of knots, warpage, checked ends, improperly made or cured glue joints and other conditions which can cause it to be thrown out of the lathe.
21. Securely fasten spur/live centers to the material being used.
22. Check centers and center sockets in the headstock and tailstock to be sure they are free of dirt or rust and oil lightly before inserting centers.
23. Test each set-up by revolving the work by hand to insure it clears the tool rest and bed. Check the setup at the lowest speed before increasing it to the operating speed.
24. Use the correct cutting tool for the operation to be performed and keep all tools sharp.
25. Use low speeds for roughing and for long or large diameter work. If vibration occurs, stop the machine and correct the cause. See the speed recommendation chart on the next page.



Warnings

SPEED RECOMMENDATIONS			
Diameter of Work	Roughing RPM	General Cutting RPM	Finishing RPM
Under 2"	1500	3000	3000
2 to 4"	600	1500	2300
4 to 6"	450	1100	1500
6 to 8"	450	600	1100
8 to 10"	450	600	850
10 to 12"	450	600	850
12 to 14"	450	450	600

26. When sanding, remove the tool rest from the machine, apply light pressure and use a slow speed to avoid heat build up.
27. When turning large diameter pieces, such as bowls, always operate the lathe at low speeds. See the speed recommendation chart.
28. Do not attempt to engage the spindle lock pin until the spindle has stopped. If leaving the machine area, turn it off and wait until the spindle stops before departing.
29. Make no adjustments except speed changes with the spindle rotating and always disconnect the machine from the power source when performing maintenance to avoid accidental starting or electrical shock.
30. Provide for adequate space surrounding work area and non-glare, overhead lighting.
31. When stopping the lathe, never grab the part or faceplate to slow it down. Let the work coast to a stop.
32. Use only JET factory authorized replacement parts and accessories; otherwise, the warranty and guarantee are null and void.
33. Do not use this JET wood lathe for other than its intended purpose. If used for other purposes, Walter Meier (Manufacturing) Inc., disclaims any real or implied warranty and holds itself harmless from any injury that may result from that use.

Grounding Instructions

CAUTION This tool must be grounded while in use to protect the operator from electric shock.

In the event of a malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electric shock. This tool is equipped with an electric cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into a matching outlet that is properly installed and grounded in accordance with all local codes and ordinances.

Do not modify the plug provided. If it will not fit the outlet, have the proper outlet installed by a qualified electrician.

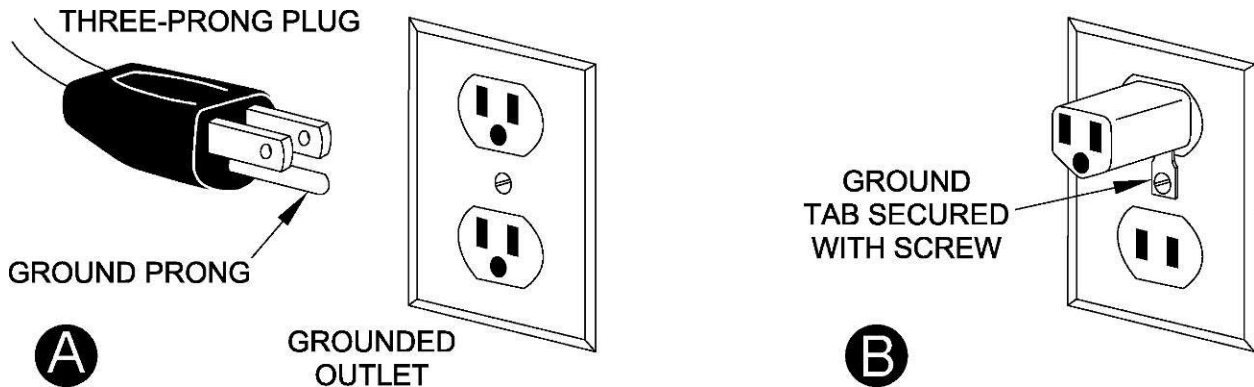
Improper connection of the equipment-grounding conductor can result in a risk of electric shock. The conductor, with insulation having an outer surface that is green with or without yellow stripes, is the equipment-grounding conductor. If repair or replacement of the electric cord or plug is necessary, do not connect the equipment-grounding conductor to a live terminal.

Check with a qualified electrician or service personnel if the grounding instructions are not completely understood, or if in doubt as to whether the tool is properly grounded. Use only three wire extension cords that have three-prong grounding plugs and three-pole receptacles that accept the tool's plug.

Repair or replace a damaged or worn cord immediately.

115 Volt Operation (Model JWL-1642EVS only)

As received from the factory, your JWL-1642EVS is ready to run at 115-volt operation. This lathe is intended for use on a circuit that has an outlet and a plug that looks the one illustrated in Figure A. A temporary adapter, which looks like the adapter as illustrated in Figure B, may be used to connect this plug to a two-pole receptacle, as shown in Figure B if a properly grounded outlet is not available. The temporary adapter should only be used until a properly grounded outlet can be installed by a qualified electrician. **This adapter is not applicable in Canada.** The green colored rigid ear, lug, or tab, extending from the adapter, must be connected to a permanent ground such as a properly grounded outlet box, as shown in Figure B.



The use of an extension cord is not recommended. However, if you must use one make sure your extension cord is in good condition. Be sure to use one heavy enough to carry the current your machine will draw. An undersized cord will cause a drop in the line voltage resulting in power loss and overheating. The following table shows the correct size to use depending on the cord length needed and the nameplate ampere rating. If in doubt, use the next heavier gauge. Remember, the smaller the gauge number, the heavier the cord.

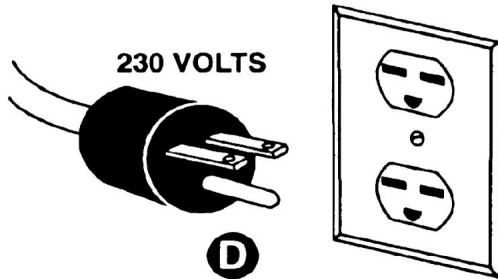
Volts	Total Length of Cord in Feet			
	25	50	100	150
120V				
AWG				
12-16 Amps	14	12	Not Recommended	

230-Volt Operation (Model JWL-1642EVS-2 only)

1. A plug with a UL/CSA listing suitable for 230V operation (Figure D) must be connected to the power cord. Contact your local authorized Walter Meier (Manufacturing) Inc., service center or qualified electrician for proper procedures to install the plug. The lathe must comply with all local and national codes after the 230V plug is installed.
2. The lathe with a 230V plug should only be connected to an outlet having the same configuration (Figure D). There is no adapter available nor should one be used with the 230V plug.

IMPORTANT In all cases (115 or 230 volts), make certain the receptacle in question is properly grounded. If you are not sure, have a registered electrician check the receptacle.

FIGURE B



Note: The JWL-1642EVS-2 lathe requires a 230-volt single-phase input. It is equipped with a power inverter, located between the power cord and the drive motor. The inverter takes the 230V 1-phase input from the power cord and converts it to the 230V 3-phase output required by the drive motor.

Introduction

This manual is provided by Walter Meier (Manufacturing) Inc., covering the safe operation and maintenance procedures for Models JWL-16423EVS and JWL-1642EVS-2 Wood Lathes. This manual contains instructions on installation, safety precautions, general operating procedures, maintenance instructions and parts breakdown. These machines have been designed and constructed to provide years of trouble free operation if used in accordance to the instructions set forth in this manual. If there are any questions or comments, please contact either your local supplier or Walter Meier. Walter Meier can also be reached at our web site: www.waltermeier.com.

Table of Contents

Warranty	2
Warnings	3
Grounding Instructions	5
115V Operation	5
230V Operation	6
Introduction	7
Table of Contents	7
Specifications	8
Contents of the Shipping Container	9
Unpacking and Cleanup	9
Assembly	9
Stand Shelf	10
Tool Basket	10
Guard	11
Controls and Features	11
Speed Change	13
Lathe Tools	13
Mounting the Workpiece Between Centers	14
Stock Selection	15
Roughing Out	15
Coves, "V" Cuts, Parting and Beads	16
Sanding and Finishing	17
Face Plate or Bowl Turning	17
Mounting Stock	17
Face Plate or Chuck	18
Wood Selection	18
Checks and Cracks	18
Distortion	18
Tools for Bowl Turning	18
To Shape the Outside of a Bowl	19
To Shape the Interior of a Bowl	20
Sanding and Finishing a Bowl	20
Adjusting the Clamping Mechanism	21
Changing the Belt and Bearings	21
Troubleshooting	22
Part Breakdowns and Parts List	23
Wiring Diagram for JWL-1642EVS	28
Wiring Diagram for JWL-1642EVS-2	29
Indexer Positions	30

Specifications

JWL-1642EVS

JWL-1642EVS-2

Stock Number	708359	708360
Over Bed.....	16"	16"
Swing Over Tool Rest Base.....	12"	12"
Distance Between Centers	42"	42"
Speeds (RPM).....	50-1200 and 120-3200	50-1200 and 120-3200
Spindle Thread, Inboard	1-1/4" x 8 T.P.I.	1-1/4" x 8T.P.I.
Spindle Thread, Outboard	M22 x 2.5P	M22 x 2.5P
Drive Spindle Through Hole.....	3/8"	3/8"
Tailstock Spindle Through Hole	3/8"	3/8"
Tailstock Spindle Travel	4"	4"
Tool Rest	14"	14"
Face Plate.....	6"	6"
Headstock Taper	MT-2	MT-2
Tailstock Taper	MT-2	MT-2
Spindle Center to Floor (approx.).....	44-1/2"	44-1/2"
Motor	1-1/2 HP, 3Ph, 230V	2HP, 3PH, 230V
.....	Input Power 115V <u>Only</u>	Input Power 230V <u>Only</u>
Net Weight (approx.).....	440 Lbs	440Lbs.
Shipping Weight (approx.).....	475 Lbs	475Lbs.



The above specifications were current at the time this manual was published, but because of our policy of continuous improvement, Walter Meier (Manufacturing) Inc., reserves the right to change specifications at any time and without prior notice, without incurring obligations.

WARNING

Read and understand the entire contents of this manual before attempting assembly or operation. Failure to comply may cause serious injury.

Contents of the Shipping Containers

1. Lathe
2. Cast Legs
1. Tailstock
1. Headstock
1. Tool Rest Body
1. Tool Basket
1. Guard Assembly
1. Accessory Package
1. Owner's Manual & Warranty Card

Accessory Package Box

1. Live Center
1. Rod for Live Center
1. Spur Center
1. Index Pin
1. Face Plate
1. Rod for Face Plate
1. Knockout Rod Headstock
1. Tool Rest
4. Adjustable Feet

Tool Basket Bracket Hardware

2. Hex Sckt Cp Screws 5/16"-18 x 1-1/2"
4. Flat Washers 5/16"
2. Set Screws 1/4"-20 x 1/4"
3. Hex Nuts 5/16"
1. Set Screw 5/16"-18 x 5/8"



Contents of Accessory Package

Unpacking and Clean-Up

1. Remove the shipping container. Do not discard any shipping material until the lathe is set up and running properly.
2. Remove hex cap bolts from skid bottom and move the lathe off the skid and into position.
3. Clean all rust protected surfaces with a cleaner degreaser. Clean thoroughly under the headstock, tailstock and tool rest body.

Assembly

1. Secure tool rest (A, Fig. 1) to tool rest body (B, Fig. 1) by tightening handle (C, Fig. 1).
2. Slide the tailstock and tool rest to the headstock end of the lathe bed. See "Controls and Features" section of this manual on how to move the tailstock and tool rest.



Fig. 1

3. Lift the tailstock end of the lathe up far enough to slide a few pieces of scrap wood under the leg, see Figure 2.
4. Thread adjustable feet (A, Fig. 2) into stand leg (B, Fig. 2). There is a flat spot on the shaft near the foot that will accommodate a wrench. Thread a hex nut (C, Fig. 2) onto shaft and leave loose for now.
5. Remove the scrap pieces of wood and slide the tailstock, tool rest and headstock down to the tailstock end of the late bed.
6. Mount the two adjustable feet in the same manner as above and move the headstock, tool rest and tailstock into their normal positions.
7. Adjust the feet so that the lathe rests evenly on the floor, and tighten the nuts.

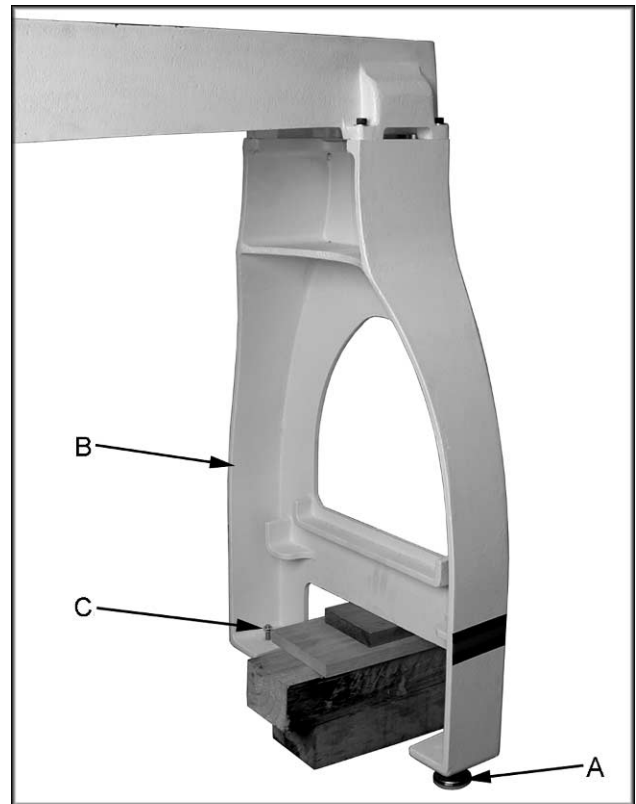


Fig. 2

Stand Shelf

You can make an extra shelf that rests between the legs if you wish, see Figure 3. It will be useful for storing lathe accessories, or adding sand bags for some extra weight. The two 2x4's should be 55-3/4" long. The plywood should be ripped into two equal pieces 27-13/16"L x 17"W so that it can be assembled between the legs. Use screws to attach the plywood to the 2x4 supports.

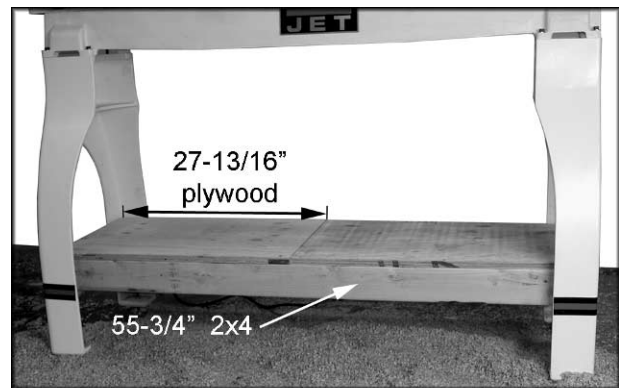


Fig. 3

Tool Basket

1. Mount the bracket (D, Fig. 4) to the inside of the lathe leg with two 5/16"-18 x 1-1/2" hex socket cap screws, four 5/16" flat washers and two 5/16" hex nuts (E, Fig. 4).
2. The two setscrews, on the bracket should be below the bolts and accessible from the backside for adjustment.
3. Place the arm of the tool basket into the bracket and secure with a 5/16"-18 x 5/8" set screw and tighten the 5/16" hex nut (F, Fig. 4). Line up the notch in the arm with the setscrew so the tool basket can pivot.
4. Adjust the setscrews on the bracket so that the tool basket swings in a level manner. Tighten the two hex socket cap screws.

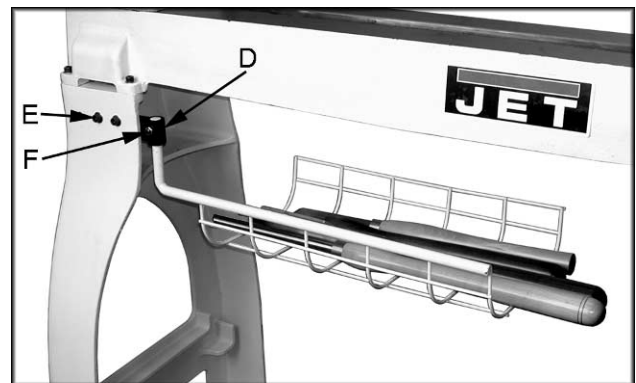


Fig. 4

Guard

1. Attach guard to the bracket by inserting the rod and lifting up on the plunger (A, Fig. 5).
2. There are two detents that will hold the guard in place. One is for turning and the other is for when you need the guard up and out of the way.
3. Tighten the bushings (B, Fig. 5) against the bracket with two setscrews (C, Fig. 5).

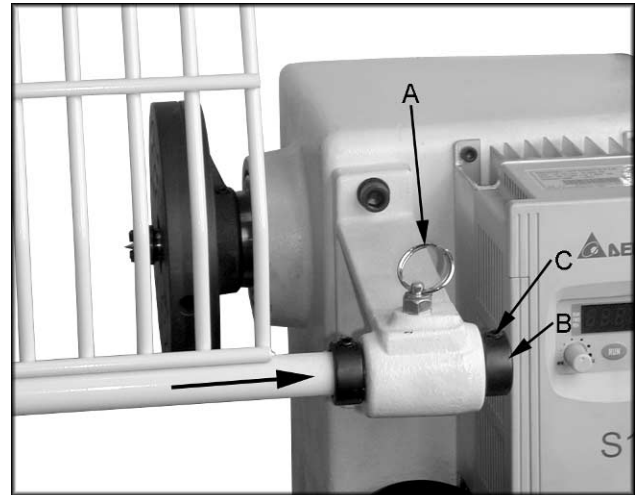


Fig. 5

Controls and Features

1. **Headstock Lock Handle:** (D, Fig. 6) Locks head in position. Unlock handle to position the head along lathe bed. Tighten handle when properly positioned.
2. **Headstock Spindle Lock:** (E, Fig. 6) Push pin in to keep the spindle from turning. **CAUTION!** Never press the headstock spindle lock while the spindle is turning!
3. **Headstock On/Off Button:** (F, Fig.6) Pull the button out to turn "ON" the lathe. Push the button in to turn the lathe "OFF".
4. **Headstock RPM Knob:** (G, Fig. 6) Turn knob to desired RPM. There are two speed ranges offering "speed" (0-3200) and "torque" (0-1,200).
5. **Headstock For/Rev Switch:** (H, Fig. 6) Use the toggle switch to change the direction the spindle turns. Only change direction when the spindle has stopped.
6. **Headstock RPM Readout:** (I, Fig. 6) Displays the spindles RPM, see Figure 7.
7. **Headstock Spur Center:** (J, Fig. 8) Used for turning between centers. Spindle taper is MT-2. Remove spur center by inserting drift rod through the opposite end of the spindle and knocking spur center out.

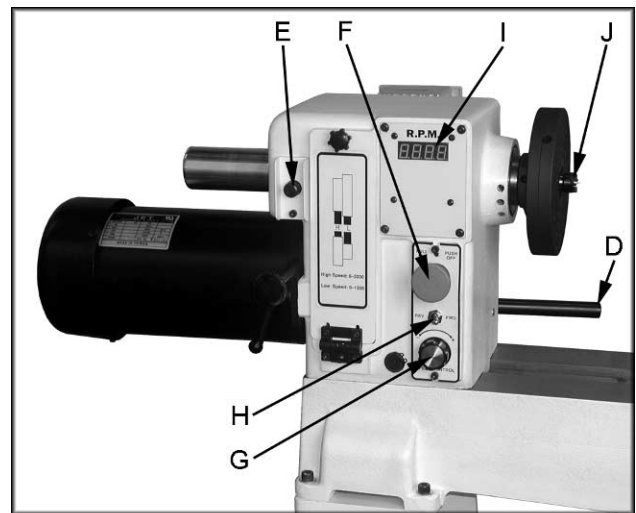


Fig. 6

Diameter of Work	Roughing RPM	General Cutting RPM	Finishing RPM
Under 2"	1520	3200	3200
2 to 4"	760	1600	2480
4 to 6"	510	1080	1650
6 to 8"	380	810	1240
8 to 10"	300	650	1000
10 to 12"	255	540	830
12 to 14"	220	460	710
14 to 16"	190	400	620

Fig. 7

8. **Headstock Faceplate:** (K, Fig. 8) Used for turning bowls and plates. There are a number of screw holes for mounting the workpiece. Thread the faceplate onto the spindle in a clockwise direction, and tighten two setscrews. Remove the faceplate by loosening two setscrews. Push in headstock spindle lock and use the provided rod in faceplate holes to unthread the faceplate.

center's shaft. Unscrew the tip and change as needed.

9. **Headstock Indexing Hole:** (L, Fig. 8) Thread indexing pin into the indexing hole making sure that it locates in the spindle hole. There are 12 holes in the spindle 30° apart. Three holes in the headstock casting accept the indexing pin. These holes are 20° apart. The combination of holes will allow you to mark your workpiece for evenly spaced features. See chart on page 30.



Fig. 8

CAUTION! Never start the lathe with the index pin engaged in the spindle!

10. **Tool Rest Body Lock Handle:** (M, Fig. 9) Locks the tool rest body in position. Unlock handle to position the tool rest in any location along lathe bed. Tighten handle when properly positioned.

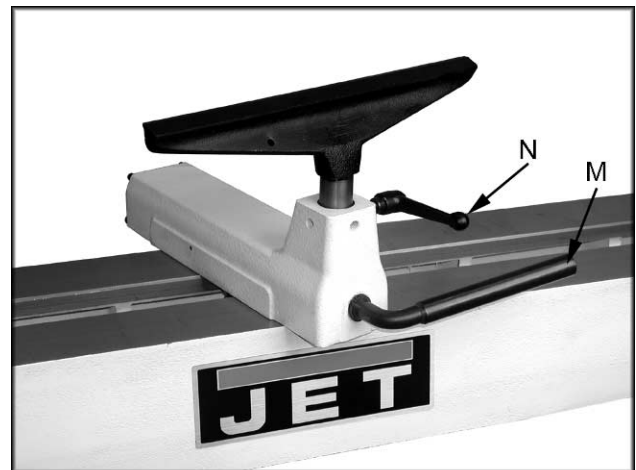


Fig. 9

11. **Tool Rest Lock Handle:** (N, Fig. 9) Locks the tool rest in position. Unlock the handle to position tool rest at a specific angle, or height. Tighten handle when properly positioned.

12. **Tailstock Lock Handle:** (O, Fig. 10) Locks the tailstock in position. Unlock handle to position the tool rest in any location along lathe bed. Tighten handle when properly positioned.

13. **Tailstock Quill Lock Handle:** (P, Fig. 10) Locks the tailstock quill in position. Unlock handle to position the quill. Tighten handle when properly positioned.

14. **Tailstock Quill Handwheel:** (Q, Fig. 10) Turn the handwheel to position the quill. The tailstock quill lock handle must be loose to position quill.

15. **Tailstock Live Center:** (R, Fig. 10) Used for turning between centers. Quill taper is MT-2. Remove live center by retracting the quill until live center loosens. Remove, or add different tips to the live center by inserting the provided rod through the holes in the

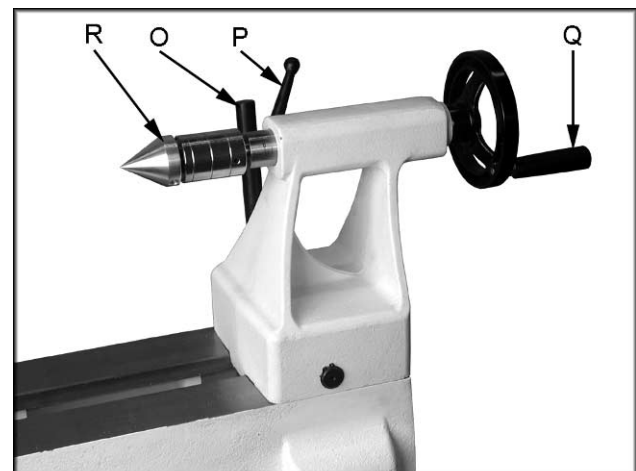


Fig. 10

Speed Change

1. **Disconnect the machine from the power source!**
2. Loosen the locking handle (A, Fig. 11).
3. Lift up on the tensioning handle (B, Fig. 11) to remove tension from the poly v-belt. You can now position the belt in the desired speed range. It is pictured in the low speed pulley range. **Note:** The “High” speed range (120-3200) provides maximum speed, where as the “Low” speed range (50-1200) will provide maximum torque.
4. Lower the tensioning handle so that the weight of the motor provides the needed tension and tighten the locking handle.

AC Inverter does not require any programming. It is pre-programmed from the factory. The buttons and knob on the face of inverter should not be changed. Use only controls on the front of headstock. Refer to Inverter manual.

Lathe Tools

If possible, select only high quality, high-speed steel turning tools with long handles. As one becomes proficient in turning, a variety of specialty tools for specific applications can be acquired. The following tools provide the basics for most woodturning projects. See your JET distributor for a wide variety of JET woodturning tools.

Roughing Gouge — used for rapidly cutting raw wood into round stock, see Figure 12.

Deep Fluted Bowl Gouge — used for turning bowls and plates, see Figure 12.

Spindle Gouge — used for turning beads, coves and other details, see Figure 12.

Spear — fine scraping and delicate operations, such as the forming of beads, parallel grooves and shallow vees, etc, see Figure 12.

Skew — used to make vees, beads, etc., see Figure 12.

Square Scraper — used for diameter scraping and featureless scraping, etc, see Figure 12.

Large Domed Scraper — used to reduce ridges on the interior of bowls, round edges of bowls, etc, see Figure 12.

Parting Tool — used to cut directly into the material, or to make a cut off. Also used for scraping and to set diameters, see Figure 12.

For safety and best performance, **keep tools sharp**. If a tool stops cutting, or requires excessive pressure to make a cut, it needs to be sharpened. A number of brand name sharpening jigs and fixtures are available, however, a woodturner should learn to sharpen tools freehand.

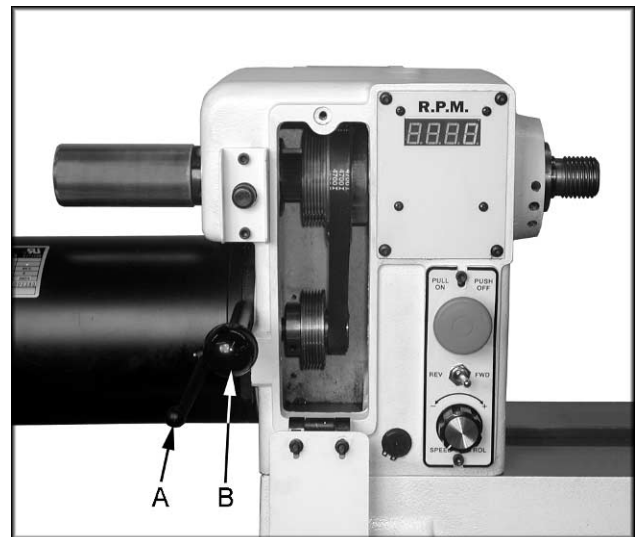


Fig. 11

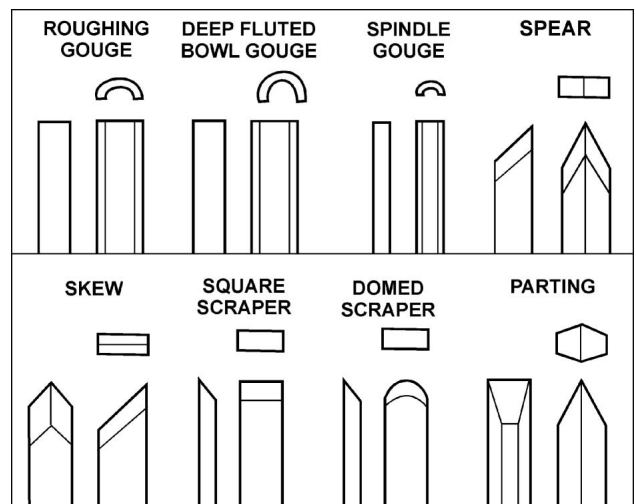


Fig. 12

Mounting Workpiece Between Centers

Spindle turning takes place between the centers of the lathe. It requires a spur center in the headstock and a live center in the tailstock.

1. With a ruler locate and mark the center on each end by going corner to corner, see Figure 13. Accuracy is not critical on full rounds but extremely important on stock where square sections are to remain. Put a dimple in each end of the stock with an awl, or nail.
2. Extremely hard woods may require kerfs cut into the spur drive end of stock, see Figure 13. You may need to drive the spur center into the stock with a wood mallet. **Note:** Never drive stock onto spur while it is mounted in the lathe spindle.
3. Install workpiece by inserting the attached spur center into the spindle taper on the headstock.
4. Bring tailstock into position, lock it to the bed, and advance quill with the handwheel in order to seat the live center into the workpiece. Lock the quill in place. Make sure the live center point is centered on your mark.
5. Move tool rest into position. It should be parallel to workpiece, approximately at the centerline and approximately 1/8" from the closest part of the workpiece. Lock tool rest body and tool rest in place.
6. Rotate workpiece by hand to check for proper clearance from tool rest. **Note:** You may want to trim off the corners of a square workpiece to make turning a little easier, see Figure 14.
7. Start lathe at the **lowest** speed and bring it up to the appropriate RPM for the size of stock, see Figure 7 page 10.

The position of the tool rest can be varied to suit the work and operator. After you become experienced with setting the tool rest changing the position will become second nature for the workpiece and comfort of the user.

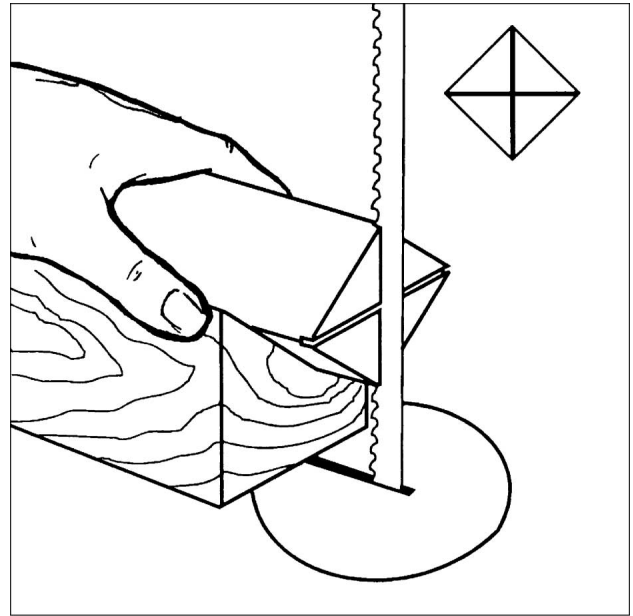


Fig. 13

Stock Selection

Stock for spindles should be straight grained and free of checks, cracks, knots and other defects. It should be cut 1/8" to 1/4" larger than the finished diameter and may require additional length to remove ends if required. Larger stock should have the corners removed to produce an octagon making the piece easier to rough down to a cylinder, see Figure 14.

Roughing Out

1. Use a large roughing gouge and begin cutting about 2" from the tailstock end of the workpiece. Place the tool on tool rest with heel of the tool on surface to be cut.
2. Slowly and gently, raise tool handle until cutting edge comes into contact with the workpiece. Work to the right towards the end of the workpiece. You never want to start at the end of a workpiece.
3. Now continue to work the rest of the workpiece. Roll the flute (hollowed-out portion) of the tool in the direction of the cut; see Figure 15. Make long sweeping cuts in a continuous motion to rough the piece down to a cylinder. Keep as much of the bevel of tool as possible in contact with workpiece to ensure control and avoid catches. **Note:** Always cut downhill, or from large diameter to small diameter. Always work *toward* the end of a workpiece, never start cutting at the end.
4. Once the workpiece is roughed down to a cylinder, smooth it with a large skew. Place the cutting point near the center of the chisel and high on the workpiece, see Figure 16. Touching one of the points of the skew to the spinning workpiece may cause a catch and ruin the workpiece.
5. Add details to the workpiece with the skew, spindle gouge, etc.



Fig. 14



Fig. 15



Fig. 16

Coves

1. Use a spindle gouge. With the flute of the tool at 90 degrees to the workpiece, touch the center of the cutting edge to the workpiece and roll in towards the bottom of the cove. **Stop at the bottom;** attempting to go up the opposite side may cause the tool to catch.
2. Move tool over the desired width of cove.
3. With the flute facing the opposite direction, repeat step 1 for other side of cove. Stop at the bottom of the cut; see Figure 18.

"V" Cuts

1. Use the long point of the skew. **Note:** Do not press the long point of the skew directly into the workpiece to create the "V"; this will result in a burned or burnished "V" with fibers being rolled up at both sides.
2. Lightly mark the center of the "V" with the tip of the skew.
3. Move the point of skew to the right half of the desired width of your cut, see Figure 19.
4. With the bevel parallel to the right side of the cut, raise the handle and push the tool in to the desired depth.
5. Repeat from the left side. The two cuts should meet at the bottom and leave a clean "V" cut.
6. Additional cuts may be taken to add to either the depth or width of the cut.

Parting

1. Place the parting tool on the tool rest and raise the handle until it starts to cut and continue to cut to the desired depth.
2. If the cut is deep a clearance cut should be made along side the first cut to prevent the tool tip from burning.

Beads

1. Place the parting tool on the tool rest and move it forward to allow the full bevel of the tool to contact the workpiece. Gently raise

the handle to make the cut to the appropriate depth.

2. Repeat for the other side of the bead.
3. Using a small skew or spindle gouge, start in the center between the two cuts and cut down each side to form the bead. Roll the tool in the direction of the cut.

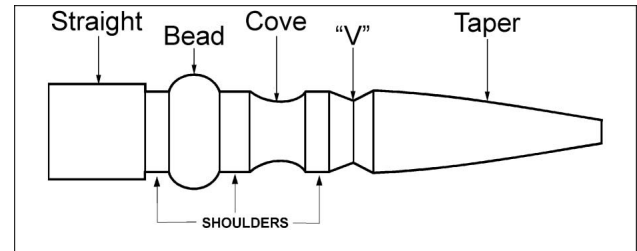


Fig. 17

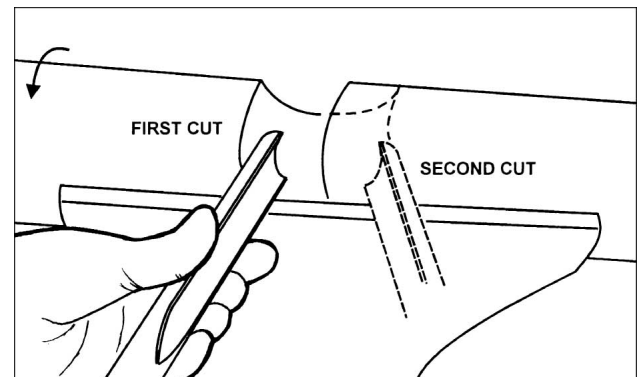


Fig. 18

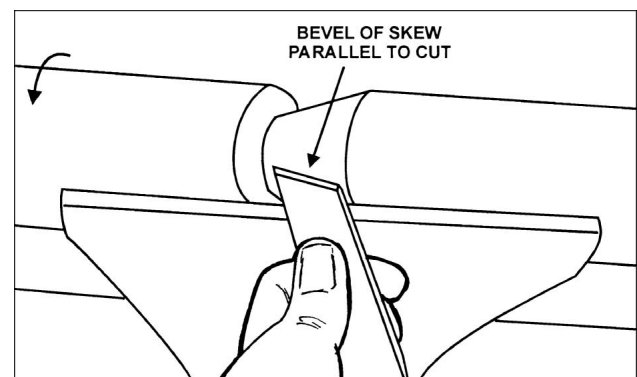


Fig. 19

Sanding and Finishing

Leaving clean cuts will reduce the amount of sanding required. Adjust the lathe to a finishing speed, and begin with fine sandpaper (120 grit or finer). Coarser sandpaper will leave deep scratches that are difficult to remove, and dull crisp details. Fold the sandpaper into a pad; do not wrap sandpaper around your fingers or the workpiece.

To apply a finish, the workpiece can be left on the lathe. Turn the lathe off and use a brush, or cloth to apply the finish. Remove excess finish before restarting lathe. Allow it to dry and sand again with 320 or 400 grit sandpaper. Apply additional coats of finish and buff.

Face Plate and Bowl Turning

Faceplate turning is normally done on the inboard side of the headstock over the bed; see Figure 20. You must move the headstock to the end of the lathe bed for larger workpieces.

Mounting Stock

Use of a faceplate is the most common method for holding a block of wood for turning bowls, and plates, see Figure 21.

1. Select stock at least 1/8" to 1/4" larger than the dimension on the desired finished workpiece.
2. True one surface of workpiece for mounting against the faceplate. It is best to leave extra stock against the faceplate that can be cut off when the workpiece is finished.
3. Using the faceplate as a template, mark the location of the mounting holes, and drill pilot holes of the appropriate size. If the mounting screws on the faceplate interfere with the workpiece, a waste block can be mounted to the faceplate and then the waste block mounted to the workpiece by gluing or screwing, see Figure 21.
4. Both waste block and workpiece should have good flat surfaces.
5. Push in the spindle lock and thread faceplate and workpiece onto spindle. Tighten setscrews in faceplate when secure.

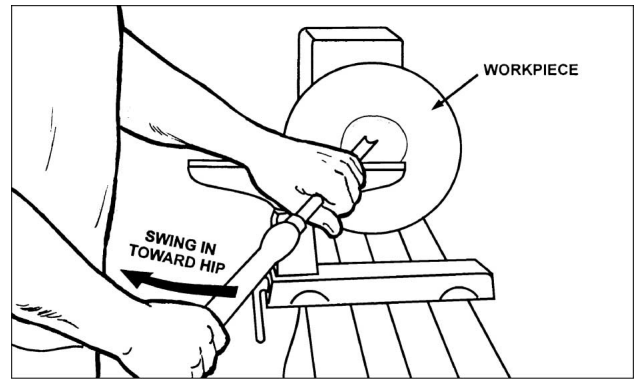


Fig. 20

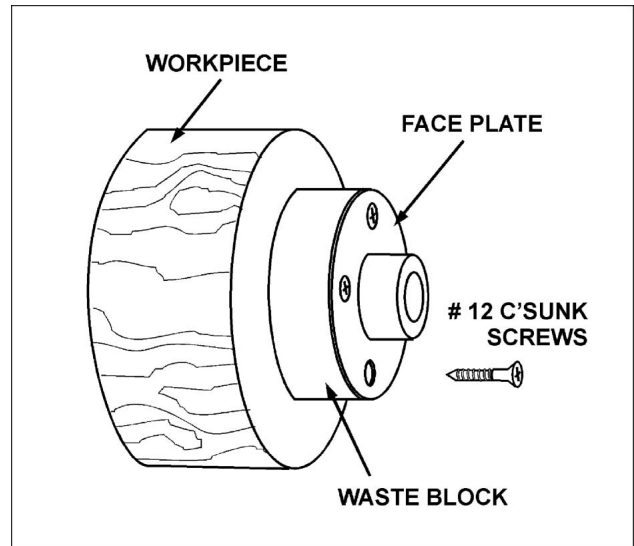


Fig. 21

Face Plate or Chuck

While faceplates are the simplest, most reliable method of holding a block of wood for turning, chucks can also be used. A chuck is not a requirement but is handy when working on more than one piece at a time. Rather than removing screws, you simply open the chuck and change workpieces. The most popular ones are four jaw scroll chucks with a variety of jaws to accommodate different size tenons. Most also come with a screw chuck as well.

Wood Selection

Firewood is the cheapest, most widely available stock to use while learning to turn bowls. Develop skill with each tool before attempting to make a finished piece. It is best to start with dry wood, without worrying about drying or distortion. Once turning becomes comfortable, try green wood, which cuts very easily. As the turner gains experience, he or she will find extraordinary grain and figure in the form of burls, crotches and bark inclusions.

Checks and Cracks

Green wood will check and crack. For best results, leave logs in as long lengths as you can handle. As the material starts to dry, surface cracks will develop on the ends of the log. Cut off two to three inches and you should find good, sound wood. Also, cut the log in half along the pith to avoid having it in the finished piece. Most checks radiate from the pith. As you turn bowls from green wood, make sure you maintain a consistent wall thickness throughout the piece. Leaving a piece thick in some areas and thin in others will cause the wood to dry unevenly and promote checks and cracks.

Distortion

Distortion is a problem associated with turning green wood. It will vary from one type of wood to the next. Typically, fruitwoods tend to distort more than others do. It also varies with the time of year the tree was cut and how the logs are stored.

Tools for Bowl Turning

The deep fluted bowl gouge is the most essential and versatile tool for most bowl and faceplate style turning. The bowl gouge is heavier and easier to control than other types of

gouges. It also allows removal of wood much faster and with less vibration than other gouges. Most average sized bowl work can be accomplished with a 3/8" or 1/2" bowl gouge. A 1/4" bowl gouge is best suited for smaller bowls and light finishing cuts. Larger 3/4" and 1" bowl gouges are only used for extremely large pieces.

Large domed scrapers can also be used to help clean up the interior surfaces of bowls. A light touch with the scraper slightly tilted will eliminate some of the ridges left by a bowl gouge.

To Shape the Outside of a Bowl

1. Odd shaped burls, crotches and other irregular shaped blanks require special preparation before mounting in a chuck, or onto a faceplate. Remove the bark, if there is any, from what appears to be the center of the top of workpiece.
2. Drive the spur center into the top of workpiece with a wood mallet.
3. Slip the spur center into the headstock taper and bring the tailstock, with a live center, into position. Lock the tailstock to the bed and advance the spindle in order to seat the cup center into the workpiece, see Figure 22. Tighten the quill lock.
4. Position the tool support just below the centerline and about 1/4" from the workpiece. **Note:** For larger outboard turning, an optional outboard turning stand is used to place the tool support, see your JET distributor.
5. Turn the workpiece by hand to ensure proper clearance.
6. Start the lathe at the lowest speed and bring it up to the maximum safe speed for the size of work to be turned, see Figure 7 on page 10. If the machine starts to vibrate, lower the speed until the vibration stops.
7. Rough out the outside of the bowl with the 1/2" deep fluted bowl gouge, holding the tool firmly against your hip. For best control, use your whole body to move the gouge through the workpiece.
8. As the bowl takes shape, work on the bottom (tailstock end) to accommodate attaching a faceplate, see Figure 22.
9. Turn a short tenon (about 1/8" long) the size of the hole in the faceplate, see Figure 22. This will allow centering the workpiece when the faceplate is attached. **Note:** If you plan to use a chuck, turn a tenon of appropriate length and diameter to fit your chuck.
10. Stop the lathe, remove the workpiece and attach the faceplate, or chuck.

11. Finish turning the outside of the bowl with a 1/2" or 3/8" bowl gouge. Leave additional material at the base of the bowl for support while turning the interior. This will be removed later.

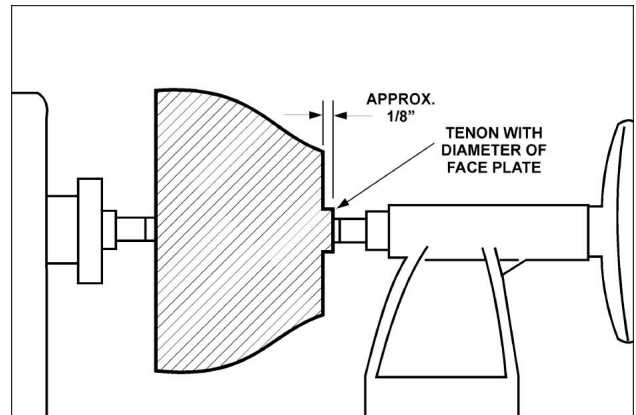


Fig. 22

To Shape the Interior of a Bowl

1. Stop the lathe and move the tailstock away. Remove the center from the tailstock to prevent bumping it with your elbow.
2. Adjust the tool support in front of the bowl just below the centerline, at a right angle to the lathe bed.
3. Rotate the workpiece by hand to check the clearance.
4. Face off the top of the bowl by making a light shearing cut across the workpiece, from rim to center.
5. Place the 1/2" bowl gouge on the tool rest at the center of the workpiece with the flute facing the top of the bowl. The tool handle should be level and pointed toward four o'clock, see Figure 23.
6. Use left hand to control the cutting edge of the gouge, while the right hand swings the tool handle around toward your body, see Figure 23. The flute should start out facing the top of the workpiece, and rotate upward as it moves deeper into the bowl to maintain a clean even curve. As the tool goes deeper into the bowl, progressively work out toward the rim. It may be necessary to turn the tool rest into the workpiece as you get deeper into the bowl. **Note:** Try to make one, very light continuous movement from the rim to the bottom of the bowl to ensure a clean, sweeping curve through the workpiece. Should there be a few small ridges left, a light cut with a large domed scraper can even out the surface.
7. Develop the wall thickness at the rim and maintain it as you work deeper into the bowl. When the interior is finished, move the tool support to the exterior to re-define the bottom of the bowl. A general rule of thumb: the base should be approximately 1/3 the overall diameter of the bowl.
8. Work the tight area around the faceplate or chuck with 1/4" bowl gouge.

High speed can build friction while sanding and cause heat check in some woods.

2. Begin with fine sandpaper 120 grit and progress through each grit, using only light pressure. Coarser sandpaper tends to leave deep scratches that are hard to eliminate. Use power-sanding techniques to avoid concentric sanding marks around your finished piece. Avoid rounding over the rim and foot with sandpaper. Try to keep details crisp. Finish sanding with 220 grit.
3. Remove the sanding dust with tack rags, or compressed air and, with the lathe turned off, apply the first coat of finish. Let it stand for several minutes then wipe off the excess. Allow it to dry before sanding again with 320 or 400 grit sandpaper.
4. Turn lathe back on and make a separation cut through the base. Stop at about 3" and use a small fine tooth saw to separate the bowl from the waste.
5. Apply additional finish coats and allow them to dry before buffing.

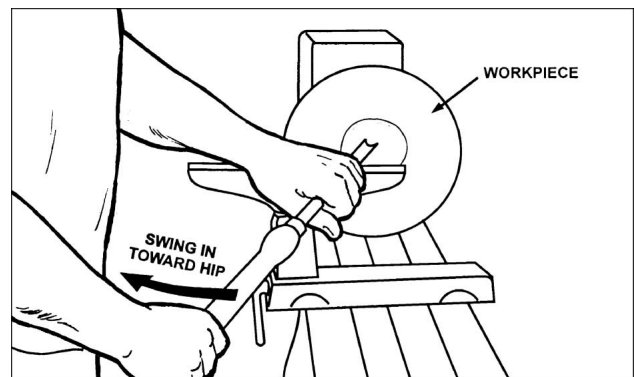


Fig. 23

Sanding and Finishing a Bowl

1. Remove the tool rest and adjust the lathe speed to the appropriate finishing speed.

Adjusting the Clamping Mechanism

The clamps are pre-set at the factory and should not need any adjustment. However, if adjustment is needed remove the stud (A, Fig. 24). Loosen the locking handle and slide the headstock, tailstock or tool rest to the edge of the bed and slightly turn the hex nut (B, Fig. 24). Slide back into position and test the handle to make sure it securely locks.

Changing the Belt and Bearings

Changing the belt and bearings can be a difficult task, and should be performed by a JET authorized repair station. Remove the headstock and take it into a repair station for servicing.

1. **Disconnect the machine from the power source!**
2. Loosen the locking handle (C, Fig. 25), and lift up on the tensioning handle (D, Fig. 25) to remove tension from the poly v-belt.
3. Open the door (E, Fig. 25), and remove the belt (F, Fig. 25) from the lower pulley.
4. Loosen the two setscrews in the handwheel (G, Fig. 25) and remove.
5. Loosen the socket head cap screw enough to unthread the clamping nut (H, Fig. 25).
6. Loosen the two setscrews in the right hand pulley (I, Fig. 25).
7. Loosen the setscrew in the collar (J, Fig. 26)
8. Use a wood dowel, or aluminum stock to knock the spindle towards the tailstock. *Use a material that is softer than the spindle so you do not mushroom the end of the spindle.* Only go far enough to remove the belt from the spindle; see Figure 26.
9. Now you can replace the belt or bearings. There are two bearings, #5 and 10, that can be seen in "Headstock Assembly" on page 24.
10. To reassemble, reverse the procedure.
Note: When reinstalling the clamping nut, thread it onto the spindle until its snug. Then back it off slightly and tighten the socket head cap screw.

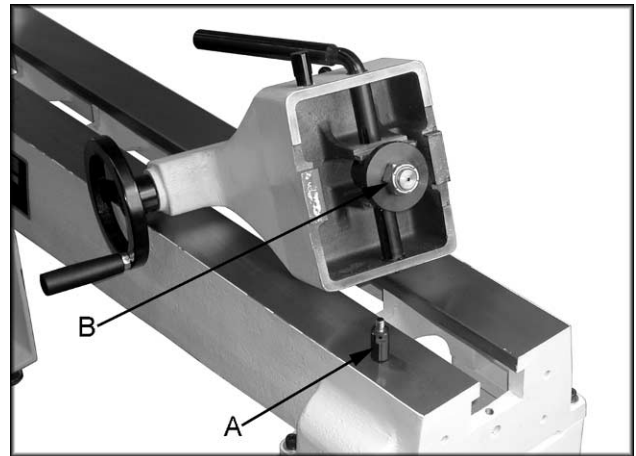


Fig. 24

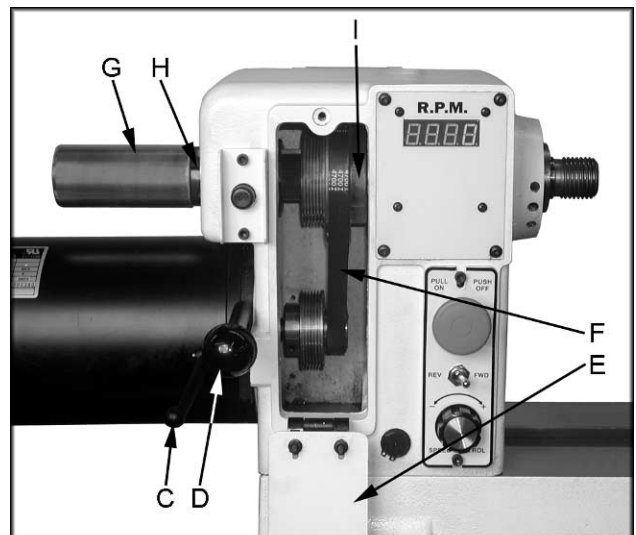


Fig. 25

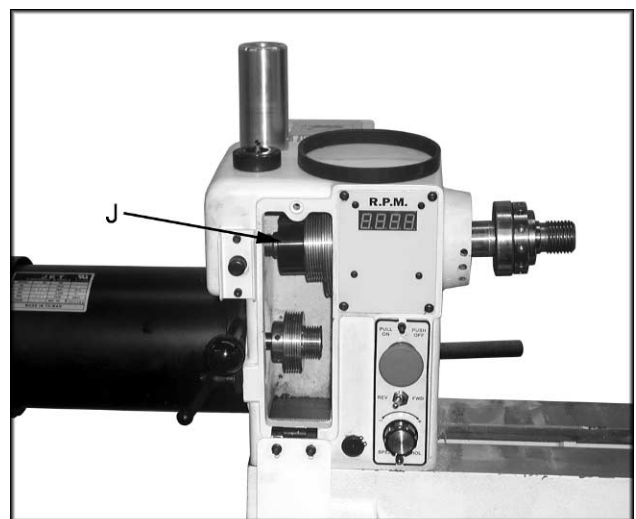
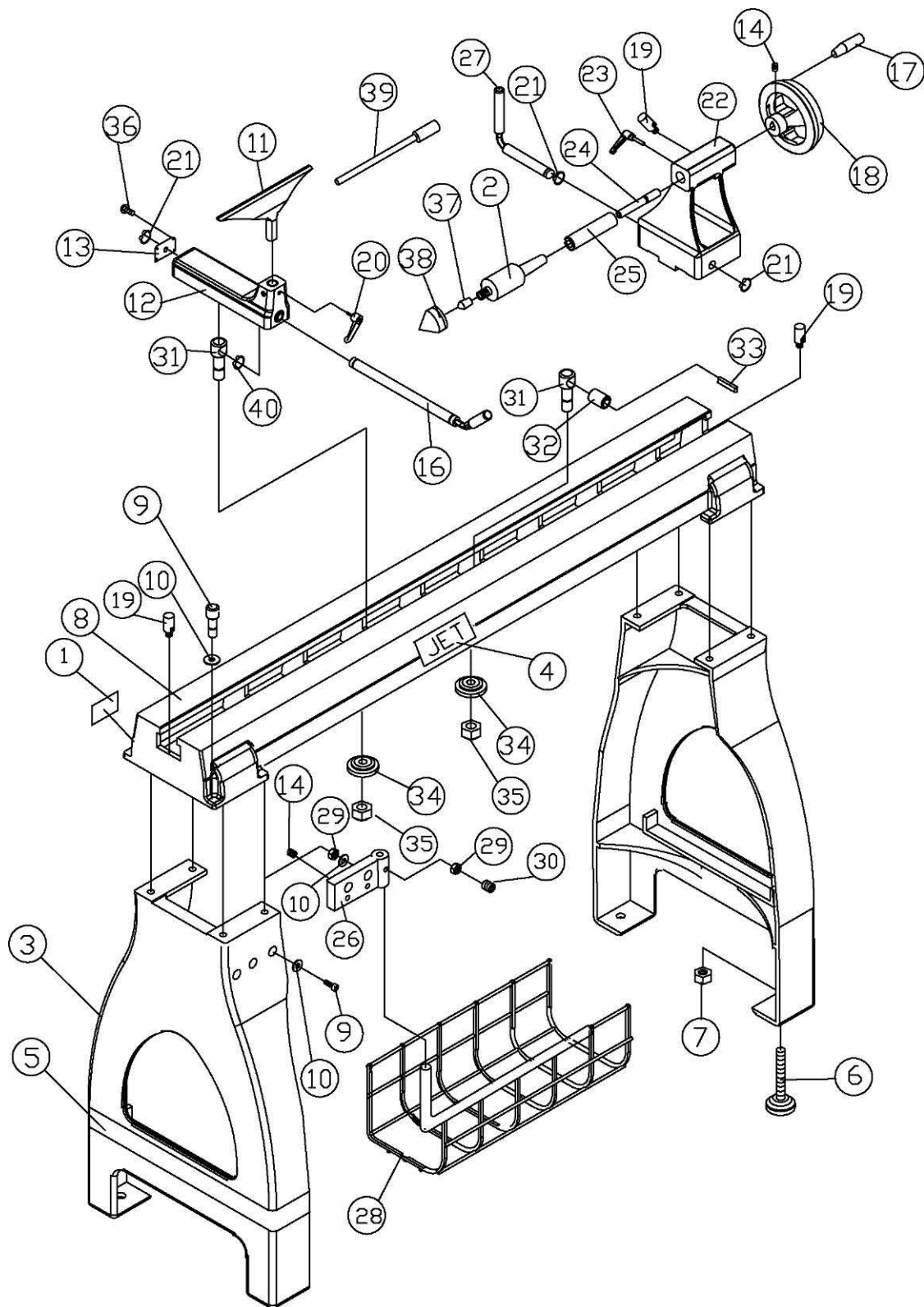


Fig. 26

Troubleshooting

Problem	Possible Cause	Solution
Excessive vibration.	<ol style="list-style-type: none"> 1. Workpiece warped, out of round, has major flaw, or was improperly prepared for turning 2. Worn spindle bearings 3. Worn belt 4. Motor mount bolt or handle loose 5. Lathe on uneven surface 	<ol style="list-style-type: none"> 1. Correct problem by planing, bandsawing, or scrap the workpiece all together 2. Replace bearings 3. Replace belt 4. Tighten bolt or handle 5. Shim lathe bed, or adjust feet on stand
Motor or spindle stalls or will not start	<ol style="list-style-type: none"> 1. Excessive cut 2. Worn motor 3. Broken belt 4. Worn spindle bearings 5. Improper cooling on motor 	<ol style="list-style-type: none"> 1. Reduce cut depth 2. Replace motor 3. Replace belt 4. Replace bearings 5. Clean sawdust from motor fan
Motor fails to develop full power.	<ol style="list-style-type: none"> 1. Power line overloaded 2. Undersize wires in supply system 3. Low voltage 4. Worn motor 	<ol style="list-style-type: none"> 1. Correct overload condition 2. Increase supply wire size 3. Request voltage check from power company and correct low voltage condition 4. Replace motor
Tools tend to grab or dig in.	<ol style="list-style-type: none"> 1. Dull tools 2. Tool support set too low 3. Tool support set too far from workpiece 4. Improper tool being used 	<ol style="list-style-type: none"> 1. Sharpen tools 2. Reposition tool support height 3. Reposition tool support closer to workpiece 4. Use correct tool for operation
Tailstock moves when applying pressure	<ol style="list-style-type: none"> 1. Excessive pressure being applied by tailstock. Note: The screw action of the tailstock is capable of applying excessive pressure to workpiece and headstock. Apply only sufficient force by tailstock to hold workpiece securely in place. Excessive pressure can cause damage to machine. 2. Lathe bed and tailstock mating surfaces are greasy or oily. 	<ol style="list-style-type: none"> 1. Slide tailstock down to the right side of the lathe against the stop. Move headstock into position and apply pressure to workpiece with tailstock. 2. Remove and clean surfaces with a cleaner degreaser
Digital readout does not work	<ol style="list-style-type: none"> 1. Digital readout sensor out of position 	<ol style="list-style-type: none"> 1. Open the belt access and position the sensor so that it reads the bolts

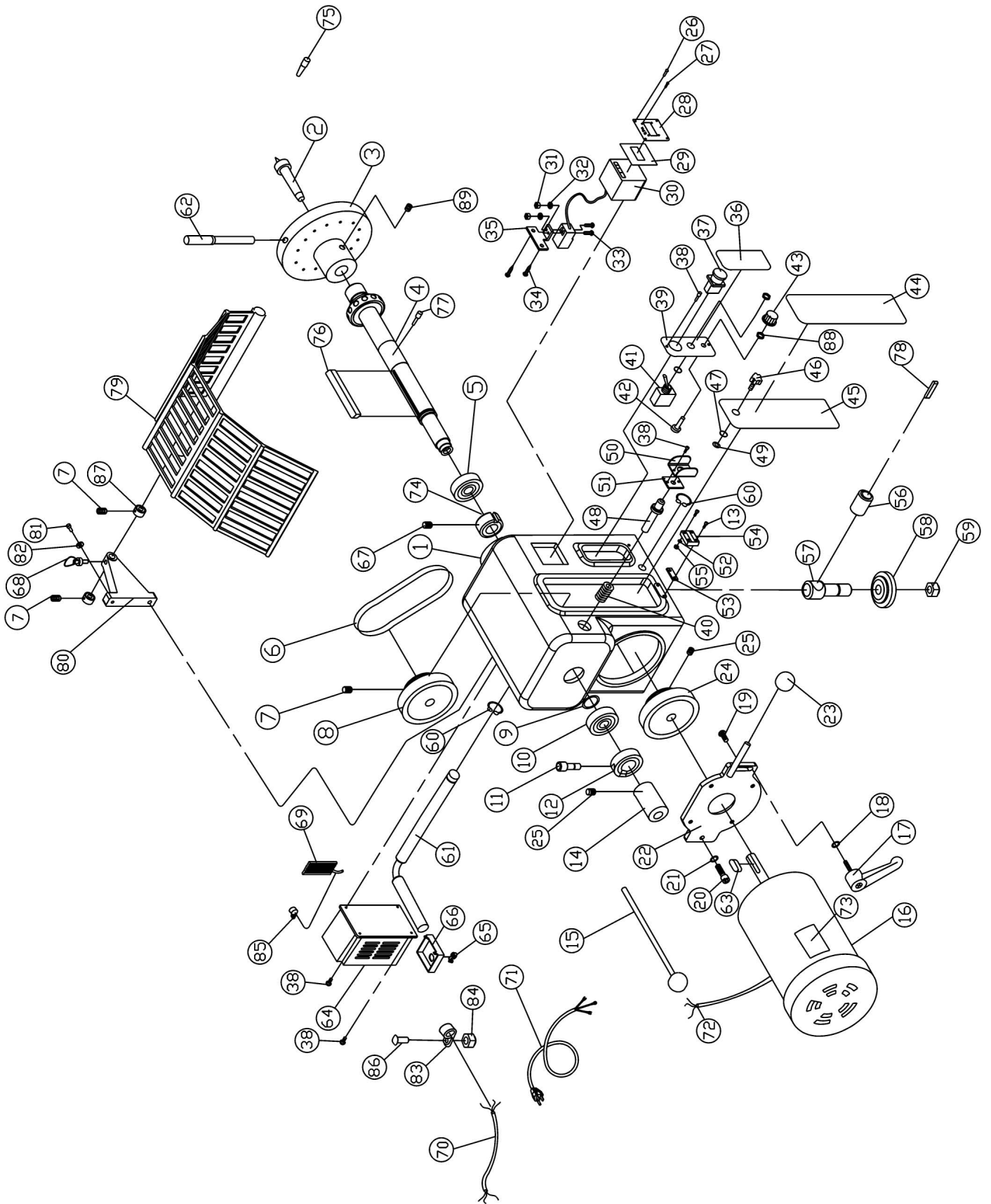
Stand and Bed Assembly



Stand and Bed Assembly

Index No.	Part No.	Description	Size	Qty.
1	JWL1642-201	I.D. Label	JWL-1642EVS	1
	JWL-1642-201A	I.D. Label	JWL-1642EVS-2	1
2	JWL1642-202	Live Center	MT2	1
3	JWL1642-203	Stand		2
4	JWL1442-219	JET Label		1
5	JWL1642-205	JET Stripe		1
6	JWL1642-206	Adjustable Foot	3/8"	4
7	TS-0561031	Hex Nut	3/8"	4
8	JWL1442-201	Bed		1
9	TS-0208081	Hex Socket Cap Screw	5/16"-18 x 1-1/2"	10
10	TS-0680032	Flat Washer	5/16"	12
11	JWL1642-211	Tool Rest		1
12	JWL1442-207	Tool Rest Base		1
13	JWL1442-208	End Cover		1
14	TS-0267021	Set Screw	1/4"-20 x 1/4"	6
15	JWL1442-129	Support Bracket		1
16	JWL1442-210A	Tool Support Rod		1
17	JWL1442-211	Handle		1
18	JWL1442-212	Handwheel		1
19	JWL1442-202	Stud		3
20	JWL1442-206	Tool Support Handle	3/8"	1
21	JWL1442-124	C-Ring	S19	3
22	JWL1642-222	Tailstock		1
23	JWL1442-218	Tailstock Quill Handle	5/16"	1
24	JWL1442-214	Lead Screw		1
25	JWL1442-215	Quill		1
26	JWL1642-226	Bracket		1
27	JWL1442-217	Tailstock Rod		1
28	JWL1642-228	Storage Basket		1
29	TS-0570021	Hex Nut	5/16"	3
30	TS-0270061	Set Screw	5/16"-18 x 5/8"	1
31	JWL1442-128	Clamp Bolt		2
32	JWL1442-127	Bushing		1
33	JWL1442-126	Key	5 x 5 x 30	1
34	JWL1442-154	Clamp		2
35	TS-0561081	Hex Nut	3/4"-10	2
36	TS-0206011	Hex Socket Cap Screw	#10-24 x 3/8"	4
37	JWL1642-237	Tip		1
38	JWL1642-238	Cap		1
39	JWL1642-239	Knockout Rod		1
40	JWL1442-228	C-Ring	S25	1
	JWL1642-TCA	Tailstock Complete Assembly (not shown)		1
	JWL1642-TRCA	Tool Rest Complete Assembly (not shown)		1

Headstock Assembly



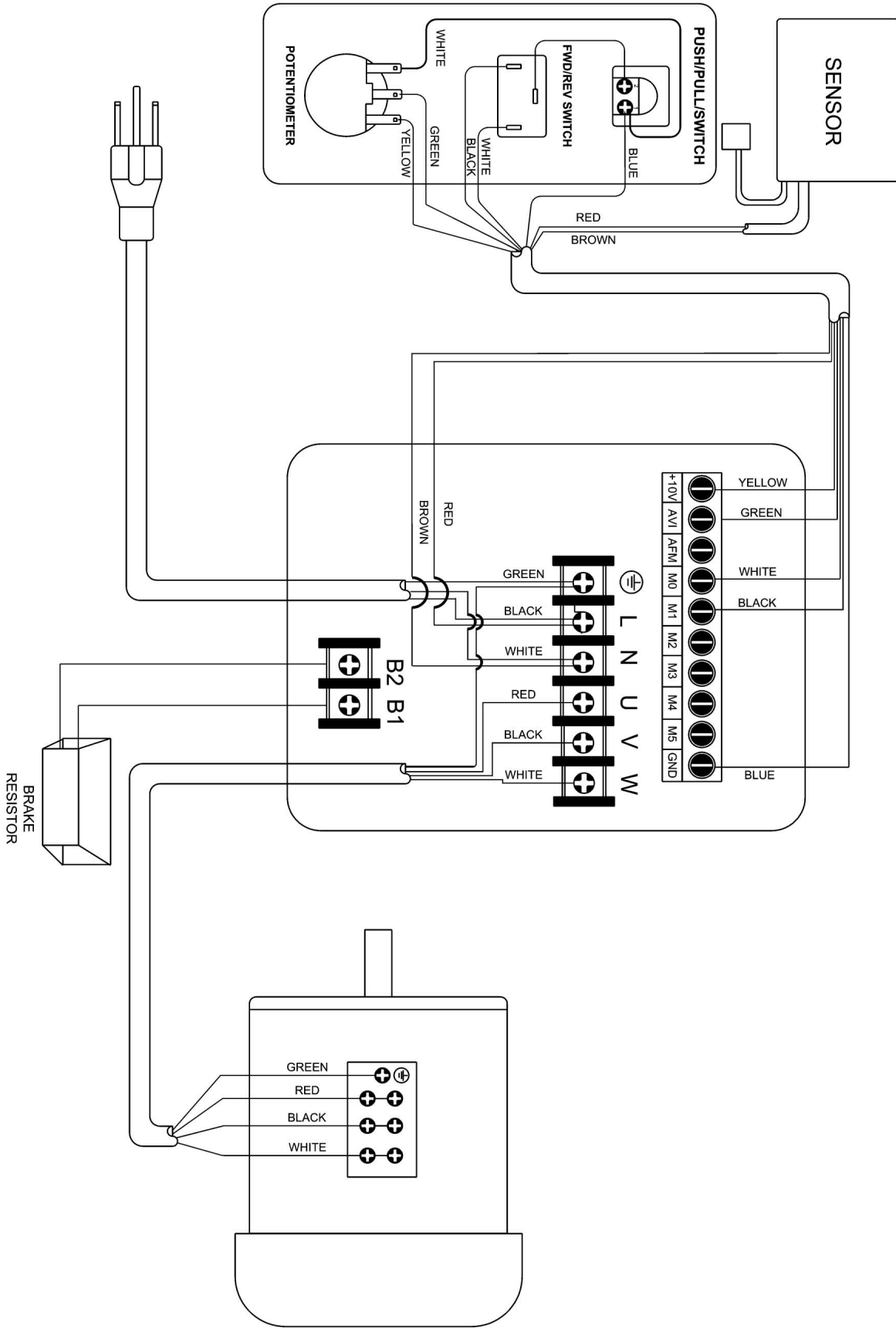
Headstock Assembly

Index No.	Part No.	Description	Size	Qty.
1	JWL1642-101	Headstock		1
2	JWL1642-102	Spur Center	MT2	1
3	JWL1642-103	Face Plate	6"	1
4	JWL1642-104	Spindle		1
5	BB-6207ZZ	Ball Bearing	6207ZZ	1
6	VB-180J	Poly-V Belt	180J	1
7	TS-0270011	Set Screw	5/16"-18 x 1/4"	4
8	JWL1642-108	Spindle Pulley		1
9	JWL1642-109	Wave Washer	ø49	1
10	BB-6205ZZ	Ball Bearing	6205ZZ	1
11	TS-0207041	Hex Socket Cap Screw	1/4"-20 x 3/4"	1
12	JWL1642-112	Lock Nut	M22	1
13	TS-0207021	Hex Socket Cap Screw	1/4"-20 x 5/8"	4
14	JWL1642-114	Hand Wheel		1
15	JWL1442-164	Knockout Rod		1
16	JWL1642-116	Motor	1.5 HP	1
	JWL1642-116A	Motor	2 HP	1
	JWL1642-MFC	Motor Fan Cover (not shown)		1
	JWL1642-MF	Motor Fan (not shown)		1
17	JWL1642-117	Handle	3/8"-16 x 1"	1
18	TS-0680042	Flat Washer	3/8"	1
19	TS-228820	Flat Head Screw	M8 x 20	4
20	TS-0209051	Hex Socket Cap Screw	3/8"-16 x 1"	1
21	TS-0720091	Lock Washer	3/8"	1
22	JWL1642-122	Motor Assembly Plate		1
23	JWL1642-123	Knob		1
24	JWL1642-124	Motor Pulley		1
25	TS-0267021	Set Screw	1/4"-20 x 1/4"	4
26	TS-0206031	Socket Head Cap Screw	#10-24 x 5/8"	4
27	JWL1642-127	Tap Screw	M3x10	4
28	JWL1642-128	DRO Cover		1
29	JWL1642-129	Plate		1
30	JWL1642-130	Digital Readout	JWL-1642EVS	1
	JWL1642-130A	Digital Readout	JWL-1642EVS-2	1
31	TS-1540011	Nut	M3	2
32	TS-236103	Lock Washer	M3	2
33	TS-2283202	Round Head Screw	M3 x 20	2
34	JWL1642-134	Tapping Screw	1/4" x 1/2"	2
35	JWL1642-135	Bracket		1
36	JWL1642-136	Label Control Panel		1
37	JWL1642-137	Push/Pull Switch		1
38	TS-0206011	Socket Head Cap Screw	#10-24 x 3/8"	8
39	JWL1642-139	Panel Cover		1
40	JWL1442-116	Spring		1
41	JWL1642-141	Fwd/Rev Switch		1
42	JWL1642-142	Variable Speed Control		1
43	JWL1642-143	Variable Speed Knob		1
44	JWL1642-144	Speed Label		1
45	JWL1642-145	Belt Door		1
46	JWL1642-146	Knob		1

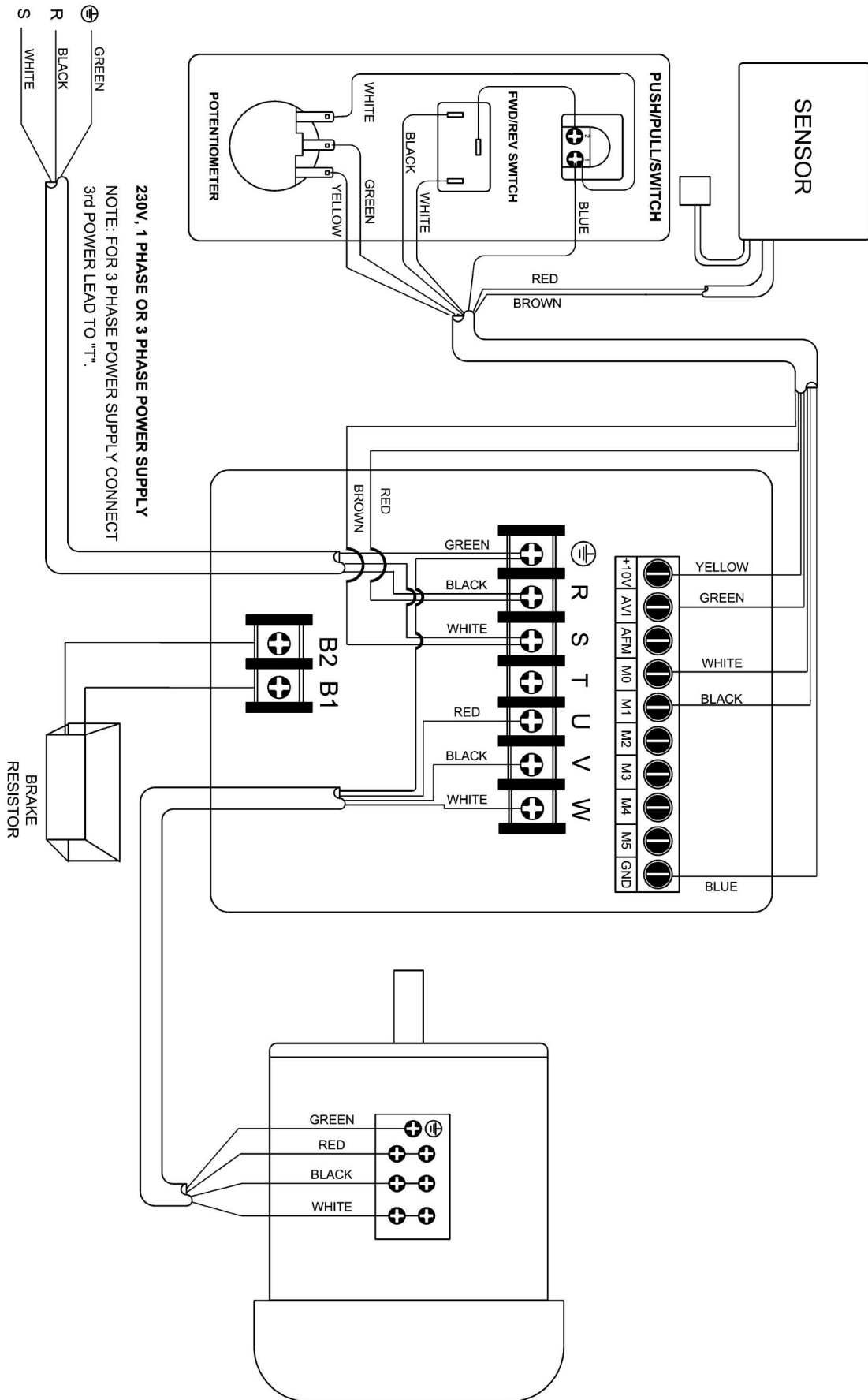
Headstock Assembly (continued)

Index No.	Part No.	Description	Size	Qty.
47	JWL1642-147	O-Ring		1
48	JWL1442-122	Spindle Lock Pin		1
49	JWL1642-149	Retaining Washer		1
50	JWL1442-121	Bracket		1
51	JWL1442-153	Plate		1
52	TS-0720041	Lock Washer	#8	2
53	JWL1642-155	Pad		1
54	JWL1642-154	Door Hinge		1
55	TS-056006	Hex Nut	#8-32	2
56	JWL1442-127	Bushing		1
57	JWL1442-128	Clamp Bolt		1
58	JWL1442-154	Clamp		1
59	TS-0561081	Hex Nut	3/4"-10	1
60	JWL1442-124	C-Ring	S19	2
61	JWL1642-161	Lever		1
62	JWL1642-162	Handle		1
63	JWL1642-163	Key	5 x 5 x 40	1
64	JWL1642-164	Inverter	JWL-1642EVS	1
	JWL1642-164A	Inverter	JWL-1642EVS-2	1
65	JWL1642-165	Strain Relief		3
66	JWL1642-166	Bracket		1
67	TS-0270011	Set Screw	5/16"-18 x 1/4"	1
68	JWL1642-168	Plunger		1
69	JWL1642-169	Braking Resistor	JWL-1642EVS	1
	JWL-1642169A	Braking Resistor	JWL-1642EVS-2	1
70	JWL1642-170	Signal Cord		1
71	JWL1642-171	Power Cord	JWL-1642EVS	1
	JWL1642-171A	Power Cord	JWL-1642EVS-2	1
72	JWL1642-172	Motor Cord		1
73	JWL1642-173	Motor Label	JWL-1642EVS	1
	JWL1642-173A	Motor Label	JWL-1642EVS-2	1
74	JWL1642-174	Collar		1
75	JWL1442-169	Index Pin		1
76	JWL1642-176	Key	8 x 8 x 90	1
77	TS-0051021	Hex Head Bolt	5/16"-18 x 5/8"	4
78	JWL1442-126	Key	5 x 5 x 30	1
79	JWL1642-179	Guard		1
80	JWL1642-180	Guard Bracket		1
81	TS-0209071	Hex Socket Cap Screw	3/8"-16 x 1-1/2"	2
82	TS-0720091	Lock Washer	3/8"	2
83	JWL1642-183	Cable Clamp		1
84	TS-056007	Hex Nut	#10	1
85	JWL1642-185	Cable Clamp		1
86	TS-0206021	Hex Socket Cap Screw	#10-24 x 1/2"	1
87	JWL1642-187	Collar		2
88	JWL1642-188	Hex Nut		2
89	TS-1524031	Set Screw	M8x12	2

Wiring Diagram for JWL-1642EVS



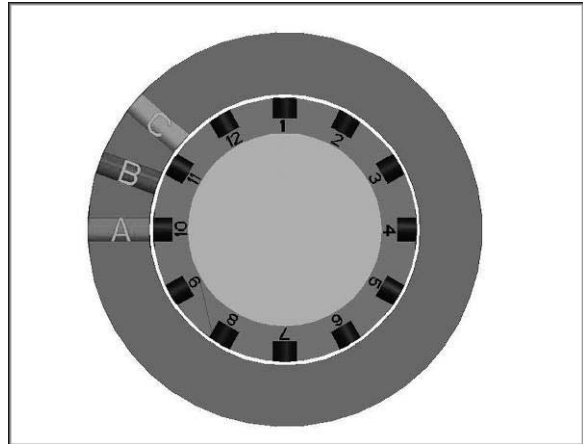
Wiring Diagram for JWL-1642EVS-2



Indexer Positions

How to use the chart

A diagram of the indexer is shown at right, as viewed from the tailstock end of the Lathe. Points A, B and C are the holes in the head casting. The holes in the spindle collar may be considered as numbered 1 through 12.



Example: You wish to rout 9 flutes on your spindle blank. Locate the “9” in the “No. of Flutes” column; each flute angle will be 40°. The index pin should first be inserted into hole combination “A-1”. Make your first flute at this position. Back off the index pin and rotate the spindle until the index pin can be inserted into hole combination “A-5”; this will be followed by “A-9”. Succeeding flutes will be made with the index pin in the B position: “B-3”, “B-7” and so on.

No. of Flutes 360° divided by...	Angle	Letter	#	Letter	#	Letter	#
1	360.00	A	1				
2	180.00	A	1,7				
3	120.00	A	1,5,9				
4	90.00	A	1,4,7,10				
5	72.00	-----					
6	60.00	A	1,3,5,7,9,11				
8 *	45.00	A	1,4,7,10				
9	40.00	A	1,5,9	B	3,7,11	C	1,5,9
10	36.00	-----					
12	30.00	A	1 to 12				
15	24.00	-----					
16	22.50	-----					
18	20.00	A	1,3,5,7,9,11	B	1,3,5,7,9,11	C	1,3,5,7,9,11
20	18.00	-----					
24 *	15.00	A	1 to 12				
30	12.00	-----					
36	10.00	A	1 to 12	B	1 to 12	C	1 to 12
<i>other interesting patterns....</i>							
9	-----	A	1,5,9	B	1,5,9	C	1,5,9

NOTES:

A dashed line indicates that particular set of angles is not possible with the indexer.

** For 8 or 24 flutes, perform the first sequence, then rotate the workpiece by hand to the needed position and repeat the same sequence.*

Notes:



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