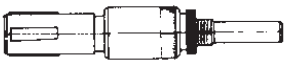
OPERATING INSTRUCTIONS

TOOLMAKERS SINCE 1914

COGSDILL TOOL products, inc.



STANDARD TOOL

MADISON Internal Microller® Burnishing Tools

Preparation for Burnishing

In general, successful roller burnishing depends on the essential factors which must be considered in preparation of the workpiece prior to burnishing. These factors are: (1) feed pattern; (2) cutting tool geometry; and (3) stock allowance.

Feed Pattern

The ideal surface for roller burnishing is the “peak and valley” feed pattern generated by a single-point cutting tool or a Madison-style reamer. A fine finish is obtained by simply displacing the peaks into the valleys. Ordinary fluted reamers can also be reground to produce the desired surface pattern. An extremely smooth bore prior to roller burnishing is not required, but it is important to have a uniformly machined peak and valley surface.

In reaming, it is desirable that gouges and tears be avoided, since they are difficult to roll out. In addition, multi-flute reamers may create work-hardened conditions by the scraping action of the blades. Roller burnishing will then require greater pressure.

The ductility of the workpiece material dictates the degree of surface preparation prior to roller burnishing. Ductile materials such as brass, aluminum, and annealed steels can have a rough-machined surface. Conversely, less ductile materials such as cast iron and heat-treated steels above 35 Rockwell C must have smoother machined surfaces and less stock allowance.

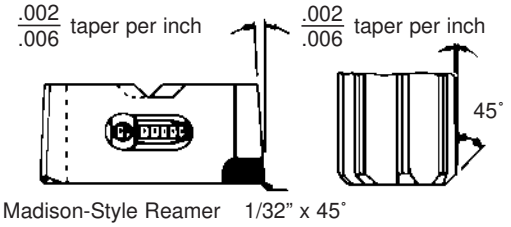
In choosing between a reamer and a single-point tool, remember that from 25% to 50% less material can be displaced from a reamed surface than from that prepared by a single-point tool.

Roller burnishing will maintain and usually improve the tolerance of a machined surface if this tolerance is within the stock allowance figure shown on the chart on page 2.

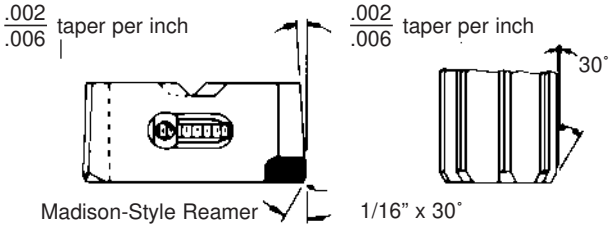
Cutting Tool Geometry

For the more ductile materials, it is advisable to use tool geometries that tend to increase the depth of the feed marks. On single-point tools, a 1/32” nose radius with a 5˚ back taper is recommended. Standard reamers with a 45˚ lead angle should be reground to increase the back taper to .004/.008” per inch on diameter. Fed at .015 to .020 inch per revolution, tools with these geometries will produce a surface finish in the 100 to 150 microinch range...ideal for burnishing.

For less ductile materials, increase the single-point tool radius to 1/16”. The reamer should be reground with a 30˚ lead angle. Use a feed rate about 50% less than for the more ductile materials. The resulting surface finish, in the 60 to 100 microinch range, is suitable for burnishing harder materials.



Tool Geometry for High-Ductility Materials



Tool Geometry for Low-Ductility Materials

Stock Allowance

When machining a surface prior to roller burnishing, stock must be allowed for metal displacement. The amount of stock allowance varies with job conditions, material properties, wall thickness of the part, nature of the machined surface, and the quality of surface finish desired.

The accompanying table shows typical stock allowances for burnishing OD’s and ID’s. However, because of the number of variables involved, these figures should be considered only approximate. An exact allowance can best be determined by roller burnishing an actual workpiece to the desired finish and measuring the amount of stock displaced.

Remember, you should displace only the amount of stock necessary for producing the desired surface finish. Excessive roller burnishing not only accelerates tool wear but also can produce flaking of the burnished surface.

STOCK ALLOWANCE / SURFACE FINISH CHART

	Workpiece Size Range	Internal Surfaces			External Surfaces		
		Stock Allowance on Diameter (Inch)	Surface Finish		Stock Allowance on Diameter (Inch)	Surface Finish	
			Machined	Roller Burnished		Machined	Roller Burnished
High-Ductility	.125 to	.0004	80	8	.0004	80	8
	.484	.0007	125	8	.0006	100	8
	.500 to	.0007	60	8	.0005	60	8
	1.000	.0015	125	8	.001	180	8
	1.031 to	.001	60	8	.0007	100	8
	2.000	.002	125	8	.001	180	8
	2.031	.0015	60	8	.001	125	8
	to	.002	125	8	.0015	300	8
	6.500	.003	200	8	.002	500	8
Low-Ductility	.125 to	.0004	80	18	.0003	60	18
	.484	.0007	100	18	.0005	90	18
	.500	.0007	90	18	.0005	100	18
	1.000	.001	125	18	.0007	140	20
	1.031 to	.001	125	18	.0005	100	18
	2.000	.0015	180	20	.001	180	20
	2.031 to	.0015	120	18	.001	125	18
	6.500	.002	200	24	.0015	200	20

The chart is a guide only, derived from experiments. Under your own conditions, the results may be slightly different. The chart indicates that, in the .500 to 1.000 range, a hole machined in a high ductility material to 125 microinches and .0015” smaller than the burnishing tool size will be burnished to 8 microinches. If the hole is finished to 60 microinches before burnishing, only .0007 of stock need be left for burnishing to 8 microinches.

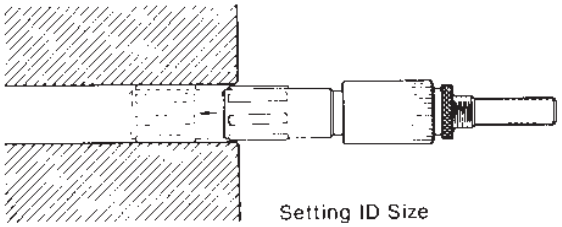
High-Ductility Materials have more than 18% elongation and less than Rc 32. They include: annealed steel, stainless steel, aluminum, brass, bronze, malleable iron.

Low-Ductility Materials have less than 18% elongation and a maximum hardness of RC 40. They include: gray cast iron, modular iron, heat-treated steel, magnesium alloys, hard copper alloys.

Tool Operation

Setting Tool Size

A Microller burnishing tool can easily be set to the desired part size. Simply adjust the tool to a size which will permit the cage and roll assembly to clear the diameter to be burnished. With the tool in this position, gradually change the tool diameter while slowly sliding the tool deeper into (or onto) the workpiece. When the rolls contact the diameter to be burnished, an increase in resistance to the sliding motion will be noticed. this is the approximate setting for the tool. The exact final setting can then be determined by test burnishing a workpiece. After examining the test piece with respect to size and surface finish, make a final adjustment of the tool to obtain the desired results. When setting up for size or finish, it is not advisable to burnish the part more than two or three times because work hardening of the surface can occur and flaking or incorrect adjustment can result.



Setting ID Size

Release Clearance

Clearance is required between the end of the tool and the face of the workpiece to allow the tool to release. When the forward feed of the tool is stopped while rotation continues, the tool will release and can be withdrawn. The tool feed can be stopped by the feed stop on the machine or by adding a stop-collar assembly to the tool. In either case, the clearance listed in the approach chart on page 4 must be considered when setting the feed stop or stop collar to assure proper release of the tool. The figures given allow .030” clearance for tool release, which is generally sufficient for most applications. However, if excessive stock is being burnished or appreciable spring-back is encountered in the part, additional release clearance length may be required.

Non feeding tools can be released by reversing the machine feed while rotation continues for a few revolutions, and then the tool can be rapidly retracted.

In all blind-type applications where close approaches are required, care should be used in setting and operating the tool to prevent the cage, tip, or rolls from contacting the bottom face. The rotation of the end of the tool creates a shearing action which will shave small metal flakes off the bottom face. Some of these flakes may be rolled in the surface of the part and, consequently, result in a marred surface. Damage to the tool could also occur.

Feeds

The standard-type roller burnishing tool is self-feeding; that is, the tool feeds itself into or onto the work. It will feed itself independently of machine feed or any external power. All that is required is rotation. The tool should be allowed to feed at its natural rate without being forced or retarded. On machines equipped with automatic feeds, the machine feed should be slightly more than the natural feed rate of the tool so that there will be no possibility of retarding the tool thereby causing it to release prematurely. In applications on automatic machines where the feed rate of the tool exceeds that of the machine, non-feed cages should be specified.

Full-bottoming burnishing tools are supplied with non-feed cages, and must be machine fed. With this non-feed design, minimum clearances are required to obtain the closest approach to bottom. The same feed rate as charted for the standard burnishing tools is generally satisfactory for all bottoming applications. The exact feed rate of the tool is, therefore governed by the specific machine set-up.

SPEED AND FEED RATE CHART

Workpiece Diameter (Inches)	Internal		External	
	Speed* (RPM)	Feed (in./rev.)**	Speed* (RPM)	Feed (in./rev.)**
.125 to .484	900-750	.004-.011	700-500	.002-.009
.500 to 1.500	750-300	.011-.045	500-300	.009-.034
1.531 to 2.625	300-160	.045-.070	300-100	.034-.062
2.625 to 3.750	270-140	.045-.070	200- 80	.062-.090
3.781 to 6.500	150- 90	.070-.115	100- 60	.090-.115

*Speed may be increased or decreased by 50% to suit special requirements
**Feed may be increased by 50% to suit special requirements.

Speeds

The tool is designed for conventional right-hand rotation, and either the tool or the workpiece can be rotated. Rotational speed is not critical, but higher than recommended speeds will reduce tool life. If long-length tools or tools with extension drives are used, speeds should be reduced to prevent excessive whip.

Machine Considerations

The Microller tool must be properly aligned with the part in the machine to facilitate the engagement of the tool with the work. A few thousandths misalignment (max. .005") does not produce any adverse effect on the tool or surface finish produced in the workpiece. However, excessive misalignment in a rigid setup between tool and workpiece will cause bending stress in the tool, resulting in fatigue failure of the mandrel tip. Proper alignment is more important when the tool is rotating because tool whip is more likely than part whip.

The tools should be rigidly mounted on the drive shank to prevent any axial movement during the release cycle. This is particularly important for large, heavy tools when operated in a
vertical position. A keeper key or binding screw also eliminates any possibility of the tool accidentally coming out of the spindle.

In using the tool on multiple spindle automatics, it is best to mount the tool in a top position to minimize chip contamination from the other cutting operations.

Lubrication

A filter in the lube system is recommended to prevent introduction of chips and grit to the tool. The tool requires lubrication, *not* cooling. Therefore, any light lubricating oil or a rich, soluble oil mixture is recommended. Lubricant should be fed to the tool in a steady stream of ample volume to provide flushing and cleaning action.

Adjustment Range: Tools in the 6618 series size range adjust from .003" below nominal size to .017" above, with the exception of the .187" and .193" nominal sizes which adjust from .003" below to .006" above and .003" below to .010" above nominal size, respectively. All other series adjust .004" below to .037" above nominal size.

Maximum Burnishable Bore Length: Tool housings in the 6618 through 6644 ranges (.187"-1.187") are larger than the tool size, and therefore, the "Maximum Burnishing Length" dimension "C" as shown in tool drawing and chart, page 4, determines the burnishable length. Tools with burnishing lengths up to 6" are listed, and longer ones can be supplied when needed.

The housing or larger tools (1.218" and up) is smaller than the tool size and will burnish any length of bore when extensions are added to the drive shank. Maximum burnishable lengths without extensions are as listed on page 4.

Clearance of .030" for release is included in the "Approach to Bottom" chart where needed. This .030" may be subtracted for the clearance dimension given, if necessary, for absolute minimum approach. If it is subtracted, accurate and positive reverse of the tool feed must be provided to prevent bottoming.

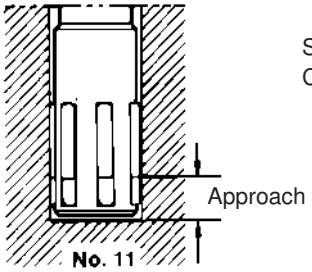
Mandrel Tip: Adjusting to any size larger than nominal brings the tip forward to extend beyond the end of the cage. This could prevent a close approach to bottom in a blind hole. When required Madison will provide the intermediate size tip needed for your specified bore diameter and change the digit to suit. Intermediate size tips limit total adjustment to about .004" for 6618 tool and .008" for all others without tip extending, more if tip is allowed to protrude.

Feeding: Standard tools are self-feeding for right-hand rotation. The bottoming tools (approach style #45) must be machine fed.

Release: Standard tools (both approach styles #11 and #31) will automatically release when feed is halted. The bottoming tools (approach style #45) must have the feed direction reversed to release. Smaller size tools (under 3" diameter) can also be withdrawn from the piece part by a rapid retraction without reversal of spindle.

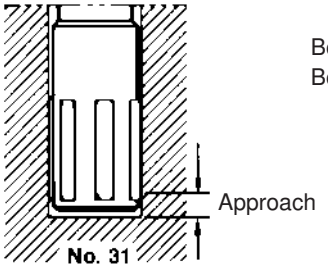
APPROACH TO BOTTOM OR SHOULDER

Standard Tool
Through Rolls



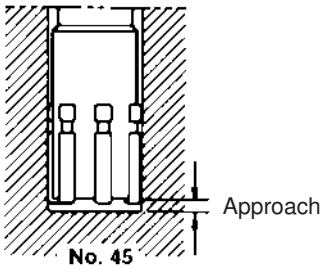
Through-hole style rolls and cage in a standard Microller burnishing tool. Effective burnishing take place further from bottom than other options. requires intermediate size tip for closer approach. See “Mandrel Tip” data, page 3.

Standard Tool
Close Approach



Close-approach style rolls with through-style cage. Effective burnishing takes place closer to bottom than with through-hole style rolls. Requires intermediate size tip for closer approach. See “Mandrel Tip” data, page 3.

Bottoming Tool
Bottoming Rolls

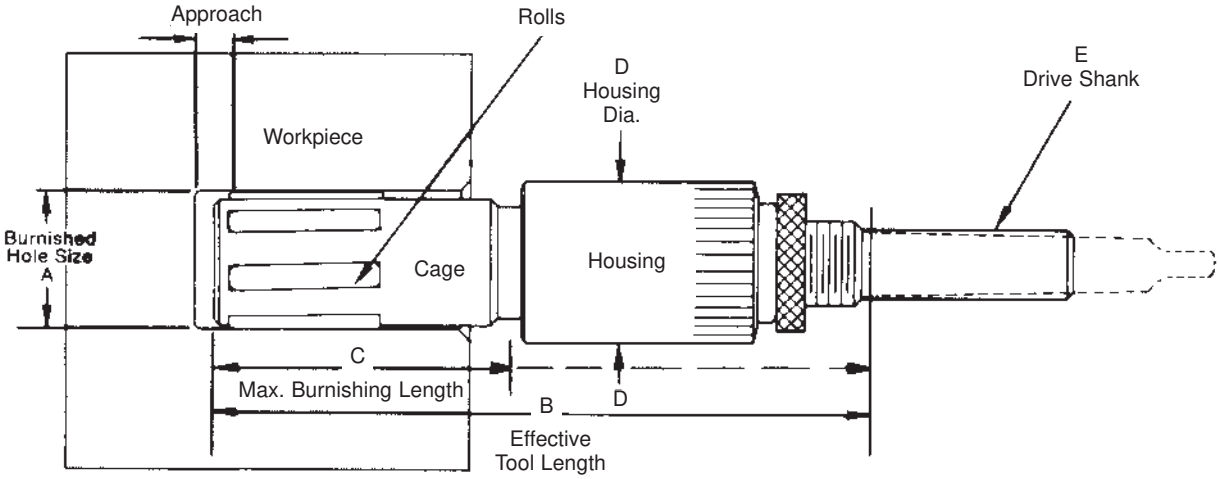


Bottoming-style rolls and cage for closest approach to bottom. Bottoming tools or conversion sets are supplied with intermediate size tips to achieve the minimum approach shown on chart. Bottoming cage, rolls, and tip conversion sets are interchangeable on standard tools.

APPROACH TO BOTTOM CHART

Tool Size Range	Standard Tool Through Rolls	Standard Tool Close Approach Rolls	Bottoming Tool Bottoming Rolls
.187- .359	*	.093	--
.375- .593	*	.093	.045
.625-1.093	.218	.125	.060
1.125-3.312	.375	.156	.060
3.343-6.500	.406	.187	.060

*In tool sizes .593 and smaller, close approach rolls are furnished for both open-end and blind-end applications.
NOTE: Approaches shown above include a release clearance of .030” which may be subtracted from these figures to obtain absolute minimum approach.



A Size (1)	Tool Series	B Effective Tool Length C Max. Burnishing Length						D. Housing Dia.	E Drive Shank	
		Stub		Regular		Long				
		B	C	B	C	B	C		Straight	Morse Taper
.187- .484	6618	5-1/8	1-5/8	7-1/8	3-5/8	9-1/8	5-5/8	1-3/16	1/2 x1-1/2	No. 1
.500- .625	6619		1-7/8		3-7/8		5-7/8			
.656- .937	6633		1-5/8		3-5/8		5-5/8			
.968-1.187	6644	5-1/8	2	7-1/8	4	9-1/8	6	1-3/16	1/2 x 1-1/2	No. 1
1.218-1.375	6605	5-3/16	Housing smaller than hole. Max. burnishing length controlled by tool length or shank extensions.					1-3/16	3/4 x 1-1/2	No. 2
1.406-1.812	6606									
1.843-2.187	6607	7-3/16						1-3/4	1 x 2-1/2	No. 3
2.218-2.687	6608									
2.718-3.312	6609									
3.343-4.062	6610	9-1/8						2-15/16	1-1/2 x 5	No. 4
4.093-5.000	6611									
5.031-5.875	6612									
5.906-6.500	6613									

(1) 6618 tools are in 1/64” increments. All other tools are in 1/32” increments. Tools with metric adjustment are available as standard.
Smaller or larger size burnishing tools are available and will be quoted on request.

MADISON MICROLLER©
TOOL ADJUSTMENT INSTRUCTIONS

How To Adjust Tool

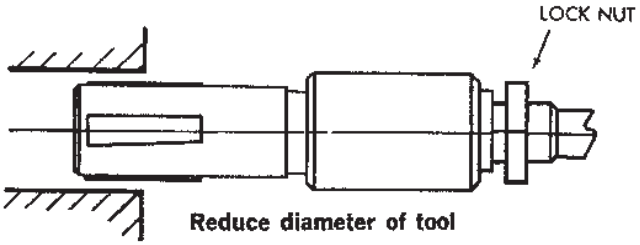
A. Loosen adjustment lock nut and back it away from the housing.

B. With the shank stationary., move the tool housing, against spring pressure, toward the shank to disengage internal serrated teeth then rotate for size changes.

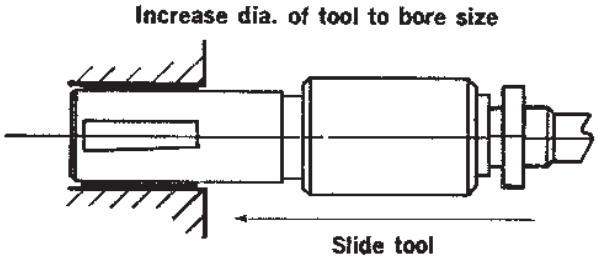
C. Markings on the housing passing guide line in ascending order indicates increase in size. When adjustment is complete, be sure serrations are reseated before returning lock nut to lock position

How To Set Tool To Your Bore Size

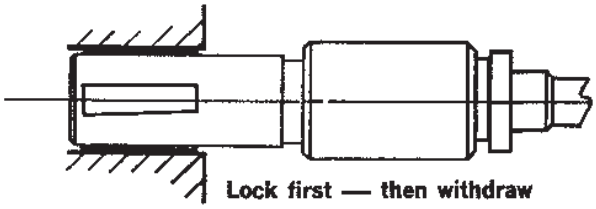
1. Reduce tool size until rolls enter freely into the bore.



2. With head of tool (cage & rolls) in the bore, adjust to increase the diameter of the tool while sliding it forward into bore.



3. The tool has been adjusted to approximately the size of the bore when it contacts the I.D. very lightly and all the rolls drag as the as the tool is advanced deeper into the bore.



4. Initial adjustment complete. Return lock nut to lock position. Withdraw tool from bore.

5. Test burnish a piece-part and check size and finish.

IMPORTANT

"DO NOT OVER-ROLL"

Over-setting will result in excessive burnishing pressures causing flaking or spalling of the work piece.

This over-rolling condition will cause rapid wera of parts or breakage of complete tool.

6. If finish is not improved, make minor adjustment of setting to get results desired.

SERVICE INSTRUCTIONS

Internal Microller tools, through and bottoming style, sizes from 1.218” and larger.

To remove the rolls and cage:

1. Loosen the three screws in cage. (Fig. A)

2. Remove cage. (Fig. B)

3. Remove rolls. (Fig. C)

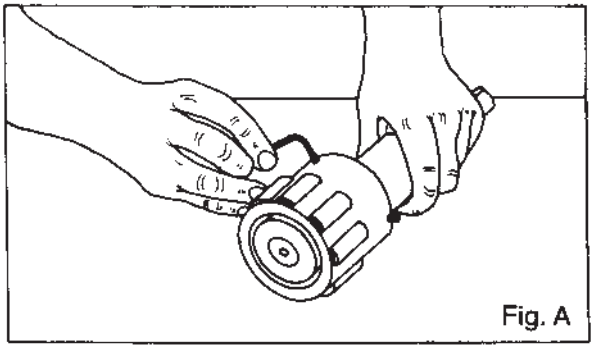


Fig. A

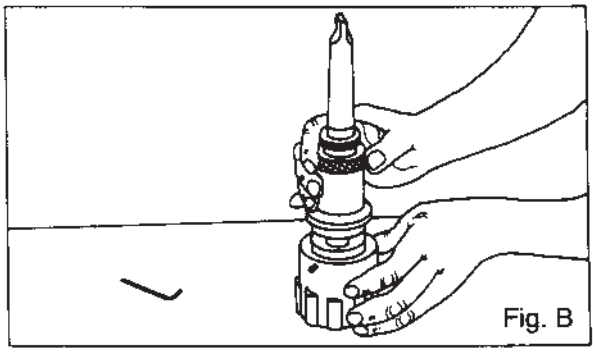


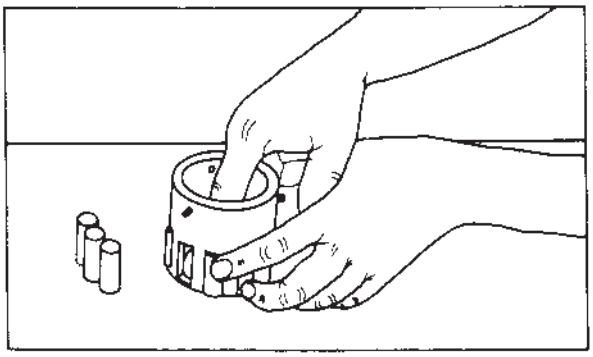
Fig. B

To remove the mandrel tip:

1. Remove the cage and rolls as above.

2. Loosen the screw in the tool center. (Fig. D)

3. Remove the mandrel tip. (Fig. E)



Assembling:

Assemble the tool in the opposite way. When assembling the rolls, for ease in assembly apply grease to each roll.

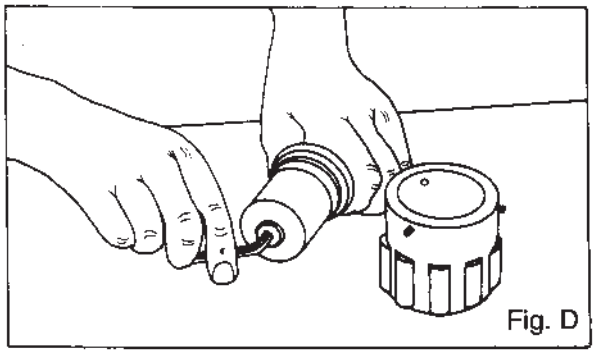


Fig. D

SERVICE INSTRUCTIONS

Internal Microller tools, through and bottoming style, sizes up to 1.187 inch.

To remove the rolls and cage:

1a. Loosen the three screws in either cage or cage sleeve

for
tool diameters from .187” to 1.187”. (Fig. A)

1b. Unscrew cage from cage sleeve for tool diameters from .500” to .625”.

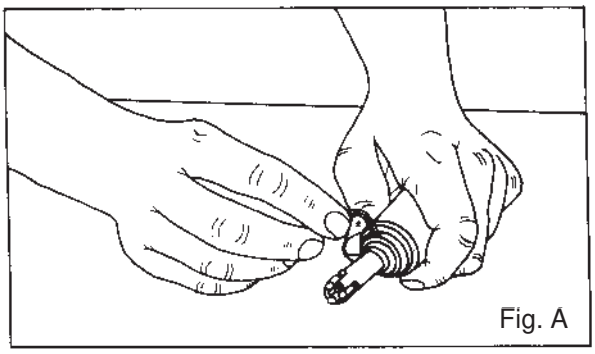


Fig. A

2. Remove rolls. (Fig. B)

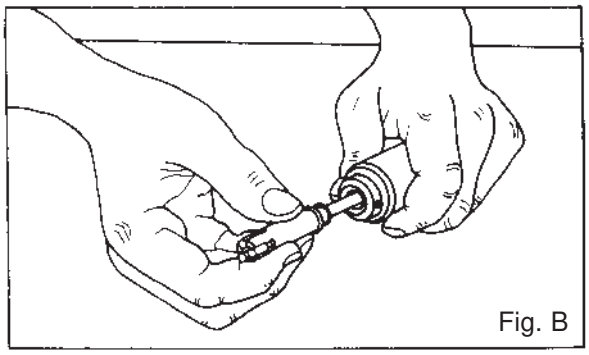


Fig. B

3. Remove rolls. (Fig. C)

To remove the mandrel tip:

1. Remove the cage and rolls as described above.

2. Unscrew the mandrel tip with a wrench using flats on mandrel tip.

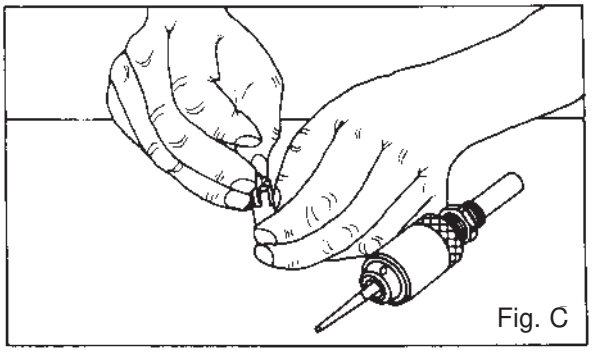


Fig. C

Assembling:

Assemble the tool in the opposite way. When assembling the rolls, for ease in assembly apply grease to each roll. (Fig. D)

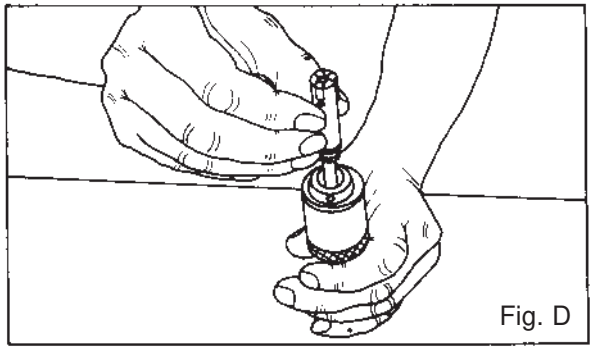


Fig. D

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