Catalog No. TDC-15

OPERATOR'S MANUAL

and

REPLACEMENT PARTS LIST

tri-D

MILLING HEAD

KEARNEY & TRECKER

MILWAUKEE

PATENT NO. 2,286,821 PAT PEND

K-482

KEARNEY & TRECKER CORPORATION

MILWAUKEE 14, WISCONSIN, U.S.A.

IMPORTANT

To insure maximum accuracy, the four pre-operational adjustments, pages seven through ten, must be performed each time this attachment is installed on the milling machine.

Any errors in the milling machine movements will reflect in the quality of the results of the TRI-D Milling Head. Be sure all machine lead screw adjustments are correct before using this attachment.

FOREWORD

This manual contains installation and operating instructions as well as a parts list for the KEARNEY & TRECKER—MILWAUKEE TRI-D Milling Head.

Figures 2 and 3 identify the units with which the operator should be familiar. Refer to these illustrations when studying the manual.

All references to the attachment, such as right and left, front and rear, etc., are made from the operator's normal position while facing the attachment.

In the purchase of this attachment you possess a guarantee of precision-built equipment—designed and manufactured so as to assure the greatest measure of long-life performance. The KEARNEY & TRECKER policy of insisting on sound engineering principles and superior standards of workmanship—in practice now for more than fifty years—backs up every TRI-D Milling Head and insures you of its high quality.

It is our intention to continually improve the service you receive from KEARNEY & TRECKER—MILWAUKEE milling machines and attachments and to make their operation as simple as possible. In accordance with this policy, we invite you to forward any questions and problems to the attention of the Service Department, KEARNEY & TRECKER Corporation, 6784 W. National Ave., Milwaukee 14, Wis. For service by telephone call Greenfield 6-8300.

One copy of this manual is furnished with each new attachment. Additional copies may be obtained by writing direct to Kearney & Trecker Corporation.

KEARNEY & TRECKER
CORPORATION
6784 W. NATIONAL AVENUE, MILWAUKEE 14, WISCONSIN

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LIST OF ILLUSTRATIONS

SECTION I

INSTALLATION

UNCRATING

Remove the crating being careful not to damage or scratch the attachment and its parts. If the attachment or any contents of the crate are damaged, contact the transportation company which made the delivery.

SHORTAGES

Carefully inspect the contents of the parts boxes to be certain that all parts checked on the packing list have been received in good condition. When more than one packing box is included in the shipment, the packing list will be found in the box marked "PACKING LIST INSIDE THIS BOX". Report shortages of parts checked on the packing list to the representative from whom the attachment was purchased.

CLEANING

Note: *Do not move any sliding unit until all exposed surfaces have been cleaned and oiled. Refer to Section II "Lubrication."*

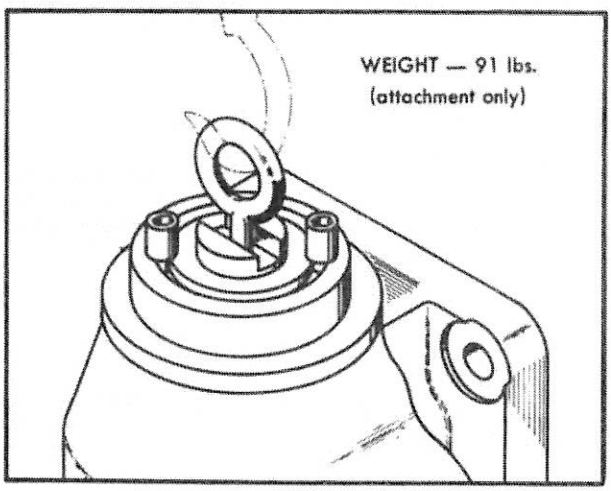


Fig. 1 Hoisting Attachment.

Remove all slush and grit from entire attachment with a suitable liquid cleaner. Release cross-slide clamp and move cross-slide by means of ballcrank to the extreme limit in each direction and clean and oil the contact surfaces.

HOISTING

Best hoisting results may be obtained by using a suitable hoisting device to lift the attachment into position on the milling machine.

Remove the travel limit block, screw and washer, and insert a ⅜"-16 eye bolt in place of the limit block screw. Be sure to have at least ½" of thread engagement. The attachment can now be lifted and a fair level maintained. See Fig. 1.

INSTALLATION

The attachment is supported on a mounting bracket attached to the machine overarms or ram as the case may be. Since the mounting bracket is peculiar only to the machine on which the attachment is to be used, individual mounting instructions are contained with each type of bracket. Initial installation of attachment and bracket should be separate, thereafter attachment and bracket should be removed and reinstalled as a complete unit. A centering plug, used with the attachment and bracket, maintains a constant axial relationship between both units, and aids in tramming the attachment into position.

Using the hoisting recommendations described in paragraph "HOISTING", lift attachment to approximate installation height. Thoroughly clean contacting surfaces of attachment, bracket and centering plug of any foreign matter which may tend to nullify the accuracy of the attachment. Position the attachment on the bracket and its four studs, engaging the aperture in the attachment over the centering plug in the bracket. Secure the attachment to the bracket with the four ⅝"-11 hex nuts and washers provided. Before any operations can be performed, the attachment must be trammed into position. Refer to Section III, "OPERATION".

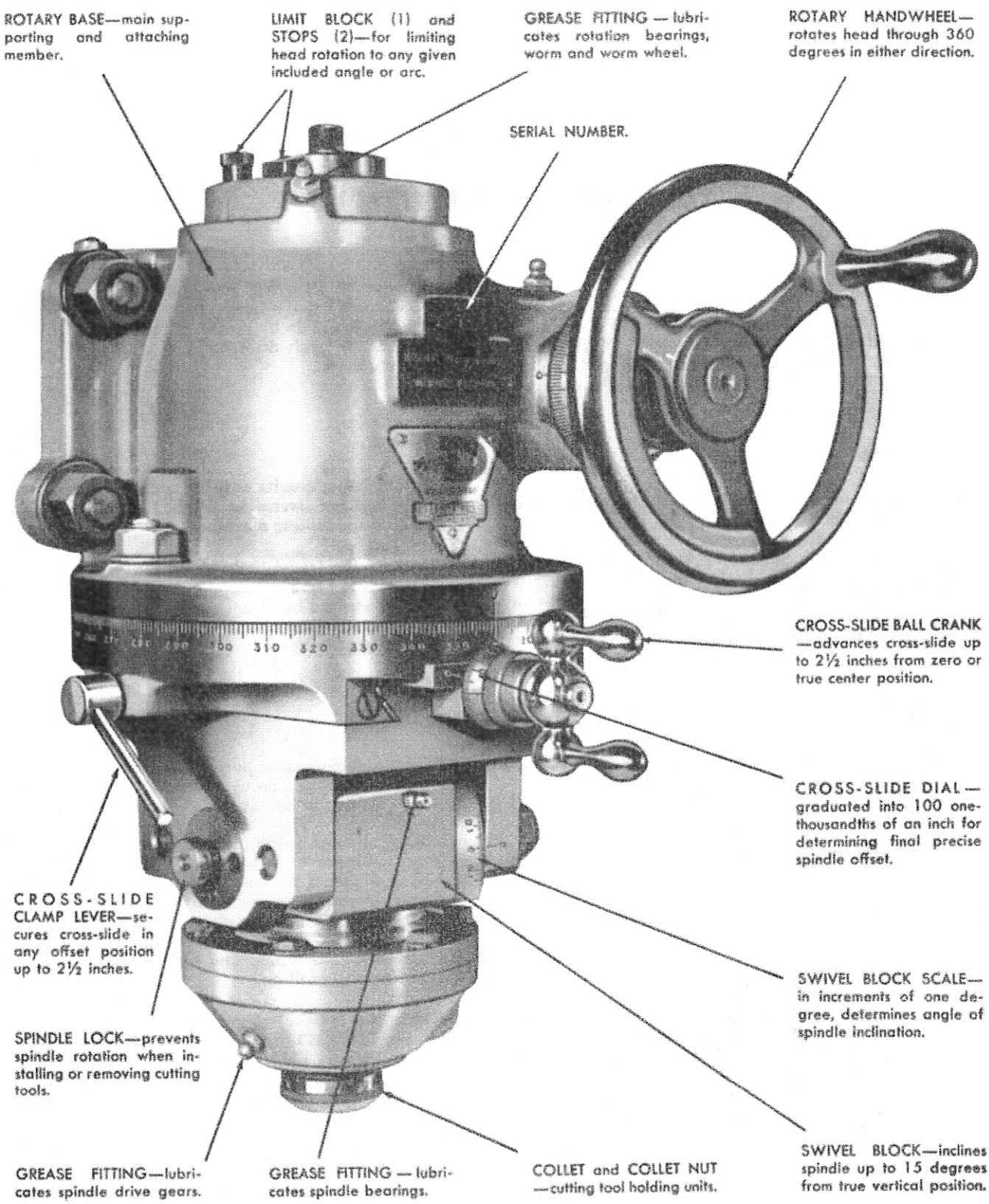
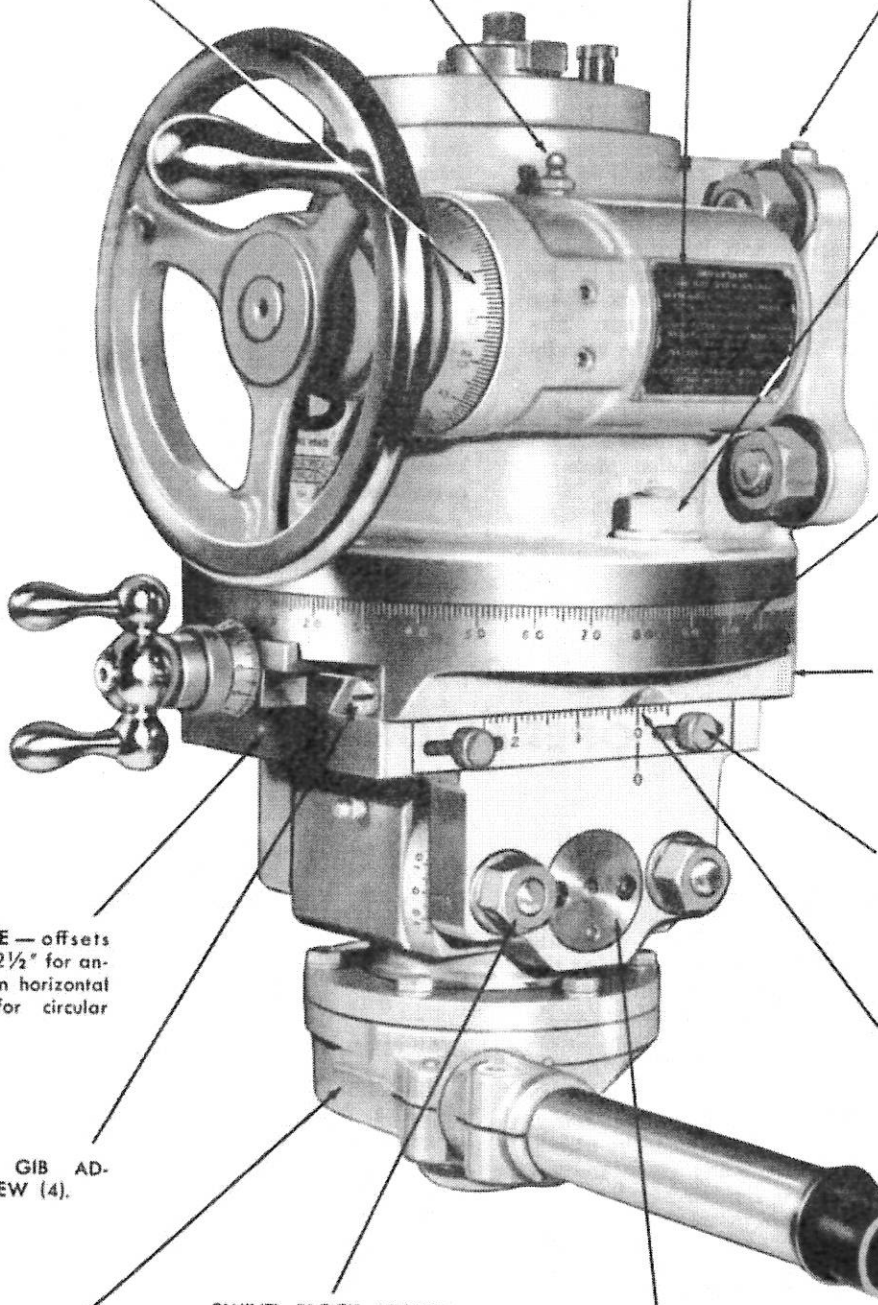


Fig. 2 TRI-D Milling Head—Left Front View.



ROTARY MINUTE DIAL—graduated into 150 two degree increments for rapid setting of head in degrees.

GREASE FITTING — lubricates worm shaft bearing.

LUBRICATION PLATE — contains pertinent lubricating recommendations and precautions.

ADJUSTING SCREW (2)—for tramming head into position.

ROTARY HEAD CLAMP NUTS (2)—secure rotary head in any radial position throughout 360°.

ROTARY HEAD DEGREE SCALE — graduated into 360 degrees by one degree increments to determine angular setting of head in degrees.

ROTARY HEAD—360 degree rotation for circular milling and angular positioning in horizontal plane.

CROSS-SLIDE SCALE THUMB SCREW (2).

CROSS-SLIDE — offsets spindle up to 2½" for angular milling in horizontal plane and for circular milling.

CROSS-SLIDE SCALE — graduated in tenths of an inch for rapid spindle offset.

CROSS-SLIDE GIB ADJUSTING SCREW (4).

INPUT BASE—houses spindle drive gears.

SWIVEL BLOCK ADJUSTING NUTS—secure angle of inclination of swivel block.

SWIVEL BLOCK TRUNNION (2)—supports swivel block in cross-slide.

FLEXIBLE SHAFT — transmits power from motor source to spindle.

Fig. 3 TRI-D Milling Head—Right Front View.

SECTION II

LUBRICATION

Exclusive of the flexible drive shaft and power take-off, there are four principle points of lubrication on the TRI-D Milling Head. The grease fitting in the rotary base cover lubricates the rotary base upper and lower bearings and the rotary base worm and worm wheel. The rotary base worm shaft bearing is lubricated by the fitting on the horizontal contour of the base, above the worm shaft. The swivel block fitting lubricates the upper and lower spindle bearings. The fitting in the power input base lubricates the spindle and power drive gears.

Caution: Over-lubricating can cause damage just as lack of lubrication does. Apply grease only as indicated on lubrication instruction plate attached to the rotary base.

The flexible shaft should be lubricated approximately every 200 hours of operation. Use Socony extra heavy adhesive pressure grease No. 897 or equivalent. A light coating applied to the shaft core only is sufficient.

Caution: Never fill entire casing with grease.

Since the power take-off is peculiar only to the machine the attachment is used on, refer to the special lubricating instructions contained with the individual power take-off.

Oil can points include the cross-slide ways and feed screw. Apply a few drops of oil at these points each normal working day.

SECTION III

OPERATION

INTRODUCTION

The TRI-D Milling Head is functionally designed to accurately finish mill straight lines, radii, tangents and angles or combinations thereof without removing the workpiece from the machine table or disturbing the setup. Within limits of its range of movements is found the means of duplicating in metal the movements made by the engineer or draftsman in making a working drawing with the T-square, triangle, compass and protractor.

Machine longitudinal table motion corresponds to horizontal lines produced with the T-square. Similarly, vertical lines on the drawing are reproduced by saddle cross motion, offsetting the spindle any given amount with the cross-slide and rotating the head replaces the engineer's compass to duplicate in metal the same arcs, radii and circles. Spindle cross-slide motion, in conjunction with angular settings of the rotary head, provide for angular cuts which correspond to the development of angles produced with the engineer's protractor.

These movements enable the operator to generate in metal practically any geometric figure in plane geometry that can be constructed with drafting instruments, necessarily limited of course, to the ranges of the attachment and machine.

The spindle and cutter can be inclined at any angle up to 15 degrees from a true vertical position. Thus, without using special angle cutters, such operations as milling draft angles on molds, die clearances on blanking dies and relief angles on form cutters are easily accomplished on the TRI-D.

LEARNING THE TRI-D AND ITS CONTROLS

The TRI-D Milling Head is comprised of three basic units: 1. A stationary rotary base which is the main supporting and attaching member. 2. A rotary head and cross-slide which rotate and offset the spindle. 3. A swivel block and spindle unit which holds and inclines the cutter up to 15 degrees from the true vertical position. See Figs. 2 and 3.

ROTARY BASE

The rotary base supports the rotary head and shaft in two opposed Timken preloaded tapered roller bearings and also houses the rotary worm and worm wheel, with a rotary handwheel and dial located on the worm shaft, at the right front of the rotary base.

ROTARY HEAD

The rotary head is the rotating member of the attachment and supports the cross-slide and swivel block units. The head is rotated manually by turning the rotary handwheel. Clockwise rotation of the handwheel causes the head to rotate clockwise. The amount of rotation can be determined by the graduations on the periphery of the head which is graduated into 360 degrees by one degree increments. Finer settings are made with the rotary dial which is graduated into 150 two minute increments, permitting the head to be set to angular positions in degrees and minutes. Rotary worm and worm wheel have a 72:1 ratio, and one turn of the rotary handwheel will rotate the head 1/72 of 360 degrees or 5 degrees. One revolution of the handwheel dial advances the head 150 x 2 minutes or 5 degrees. Rotary head travel can be limited to any included angle by use of the travel limit block and stops located at the extreme top of the attachment. The rotary head can be clamped in any angular position with the two equally spaced clamp nuts, one on either side of the base.

OPERATION CHECK NO. 1 — To make a rotary head setting of 78° 22′:

1. Loosen limit block screw and center travel limit block so it will not engage the limit stops when head is rotated. Tighten screw after centering block.
2. Loosen the rotary head clamp nuts to release head.
3. Turn handwheel clockwise until 78 degree graduation on head is aligned with zero line on base.
4. Continue handwheel rotation until 22 minute graduation is shown on handwheel dial.
5. Tighten the clamp nuts to secure angular setting.

OPERATION CHECK NO. 2 — To establish a rotary head travel of 45° between 39° and 84° positions using the travel limit block and stops:

1. Loosen rotary head clamp nuts.
2. Loosen limit block screw and center limit block. Tighten screw.
3. Turn rotary handwheel clockwise and align 39° graduation on head with zero line on base.
4. Loosen limit block screw and extend limit block full distance. Tighten screw.
5. Loosen both stop screws and locate on one either side of limit block.
6. Bring the left stop flush against the left or counterclockwise side of the limit block and tighten stop screw.
7. Turn rotary handwheel clockwise and align 84° graduation on head with zero line on base.
8. Bring right limit stop screw flush against right or clockwise side of limit block and tighten stop screw.
9. Recheck settings by rotating head in both directions until limit block strikes stop screws, and observing readings on head scale and dial. If any error occurs, repeat steps 3 through 8.

Caution: *Never attempt head rotation unless both clamp nuts are loosened. Always tighten both clamp nuts before performing cutting operation.*

SPINDLE CROSS-SLIDE

The spindle cross-slide moves on dovetail ways on the rotary head. Adjustable gibs provide for accuracy of cross-slide travel. The cross-slide can be offset 2½″ from zero or true center position. Cross-slide travel is manually controlled by the cross-slide ball crank. The amount of travel is determined by an adjustable scale on the side of the cross-slide, and by the cross-slide dial at the ball crank. The scale is graduated in tenths of an inch while the dial is graduated in 100 one-thousandth of an inch increments. One revolution of the ball crank advances or retracts the cross-slide one-tenth of an inch. The cross-slide can be locked in any position by rotating the cross-slide clamp lever in the clockwise direction.

OPERATION CHECK NO. 3 — To make a 1.237″ setting of the spindle cross-slide:

1. Turn cross-slide clamp lever counterclockwise to loosen cross-slide.
2. Turn cross-slide ball crank clockwise until 1.2 inch line on cross-slide scale is aligned with zero line on rotary head.
3. Continue turning ball crank until cross-slide dial registers .037″.
4. The center of the spindle is now 1.237″ from the center of the rotary head.
5. Turn cross-slide clamp lever clockwise to lock slide in position.

Caution: *Never attempt to move cross-slide unless clamp lever is released. Always lock cross-slide in position before performing cutting operation.*

SWIVEL BLOCK AND SPINDLE

The swivel block is supported in trunnions located in either side of the cross-slide and enable the operator to mill at any angle up to 15 degrees from the vertical, with a straight end mill. The angle of inclination can be determined by the graduations, in increments of one degree, on the swivel block. Swivel adjustment is made by loosening the two hexagon nuts on one face of the swivel block, setting to the desired angle, and tightening the nuts.

Note: *For more precise settings involving minutes and seconds, the use of a Sine-bar and dial indicator as shown in Fig. 24 is suggested.*

The spindle is mounted vertically in the swivel block in two opposed Timken preloaded tapered roller bearings. The spindle taper end is hardened and ground to receive spring collets which are held in place with the collet nut. The collet nut is operated with a spanner wrench.

The spring loaded, plunger type spindle lock is provided to prevent spindle rotation while installing or removing cutting tools. The lock knob is depressed and held in while loosening or tightening the collet nut.

OPERATION CHECK NO. 4 — To install or remove cutting tool:

1. Depress spindle lock knob. If knob cannot be fully depressed to prevent spindle rotation, grasp flexible shaft ferrule at input base and rotate input base in either direction until lock pin engages and drops in hole in spindle.
2. Using spanner wrench, turn collet nut counterclock-

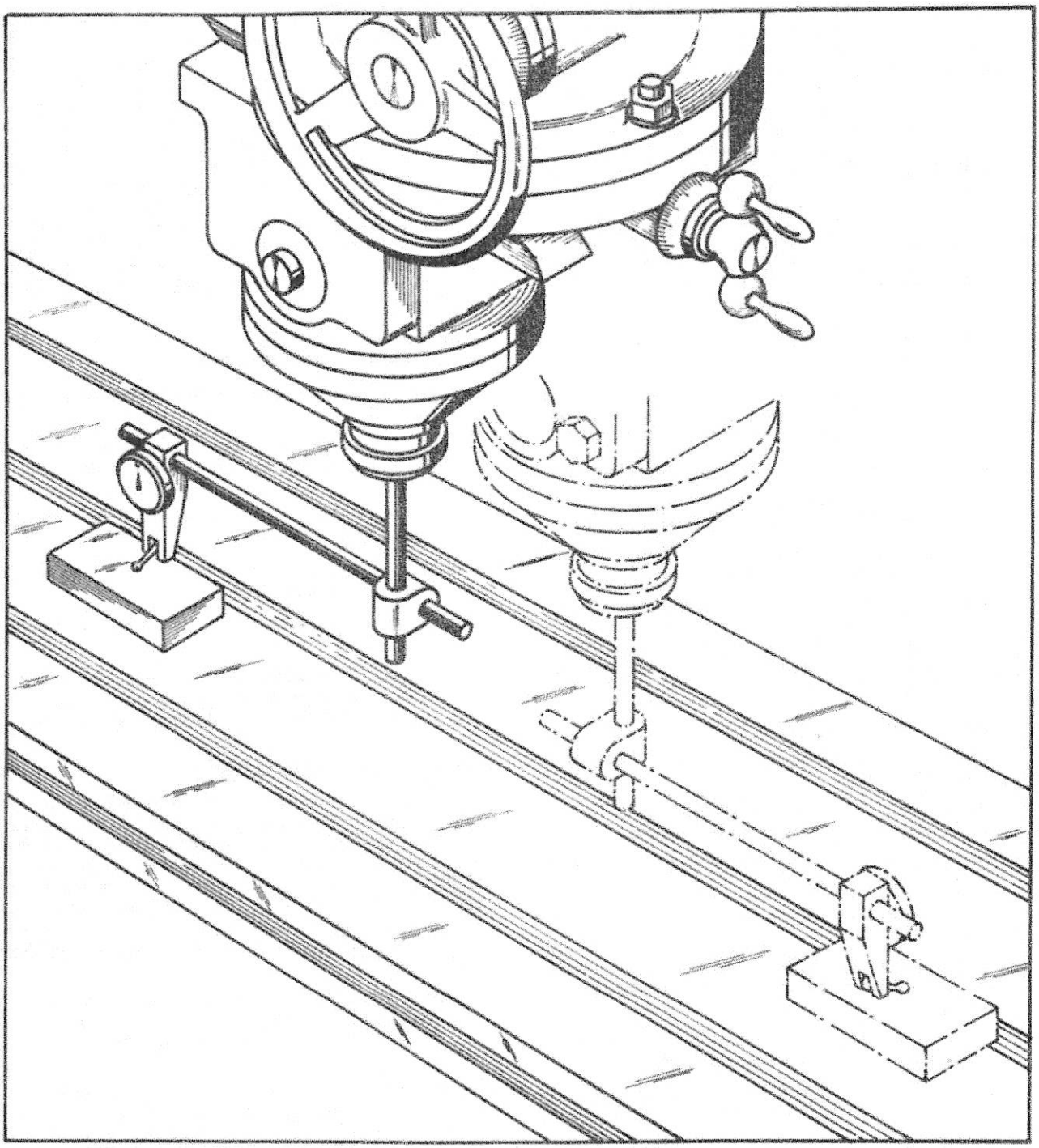


Fig. 4 Tramming Attachment into Position.

wise to loosen nut.

3. Insert cutter in collet and turn collet nut clockwise to tighten.

Caution: Be sure spindle lock pin is fully disengaged before attempting spindle rotation under power.

SPINDLE POWER SOURCE

Power is obtained from the machine or an outside source and is transmitted to the spindle by a flexible shaft which can be run in either direction. The shaft drives a set of helical gears in the input base, providing a 3 to 1 spindle ratio.

PRE-OPERATIONAL ADJUSTMENTS

Before the attachment is to be used for actual milling operations, the following four adjustments should be made.

TRAMMING TRI-D INTO POSITION (See Fig. 4)

Tramming the attachment into position is leveling it perpendicular to the machine table, and is done as follows:

1. Remove clamp screw from power input coupling and withdraw flexible shaft from attachment.
2. Release cross-slide clamp and turn cross-slide ball crank clockwise to offset spindle 2½" on cross-slide scale.
3. Mount a dial indicator in the spindle, using an extension rod to obtain the best reading.
4. Install a ground parallel block on the machine table, under the indicator button.
5. Using the rotary handwheel, rotate head counterclockwise to 270 degree reading at same time locating dial indicator and extension rod to left of spindle, parallel to table travel.
6. Raise machine knee until parallel block contacts indicator button, and set dial to zero reading.
7. Rotate head counterclockwise and indicator to 90 degree reading and check dial reading.
8. If indicator reading at 90 degrees is minus, loosen the four ⅝" mounting stud nuts holding the attachment to the mounting bracket and rotate attachment slightly clockwise. Tighten mounting nuts.
9. Repeat steps 5 through 8 until indicator zero reading is obtained at both 270 degree and 90 degree readings.
10. If indicator reading at 90 degrees is plus, attachment must be rotated counterclockwise to correct error.
11. Steps 5 through 10 should be repeated as often as necessary to obtain zero reading with head at 270 degree and 90 degree positions.

TRAMMING IN SWIVEL BLOCK (See Fig. 5)

1. Remove clamp screw from power input coupling and withdraw flexible shaft from attachment.
2. Release cross-slide clamp and set cross-slide at zero reading on cross-slide scale.
3. Mount dial indicator in spindle using an extension rod to locate indicator about 4" off center of spindle.
4. Rotate head to 270 degree reading, with indicator and extension rod to left of spindle and parallel to table travel.
5. Install a ground parallel block on machine table, under indicator button.
6. Raise machine knee until parallel block contacts indicator button and set indicator to zero reading.
7. Rotate spindle and indicator 180 degrees clockwise and check indicator reading at this position.
8. If indicator reading is minus, loosen both swivel block clamp nuts and rotate swivel block slightly clockwise and tighten clamp nuts.
9. Repeat steps 6 through 8 until indicator zero reading is obtained at both positions.
10. If indicator reading is plus, swivel block must be rotated counterclockwise to correct error.
11. Steps 6 through 10 should be repeated as often as possible to obtain zero reading at both positions.

SETTING SPINDLE CROSS-SLIDE PARALLEL TO TABLE TRAVEL (See Fig. 6)

1. Remove clamp screw from power input coupling and withdraw flexible shaft from attachment.
2. Set rotary head at 270 degree reading.
3. Set cross-slide to zero reading on cross-slide scale.
4. Mount dial indicator in spindle with indicator button contacting either vertical surface of one of the machine table T-slots. Set indicator at zero reading.
5. Using the cross-slide ball crank, feed cross-slide through its 2½" of travel. Check indicator reading.
6. If indicator reading is minus, rotate head slightly clockwise and repeat steps 4 and 5 until an indicator zero reading is obtained through the full 2½" of cross-slide travel.
7. If indicator reading is plus, head must be rotated counterclockwise to correct error.
8. When indicator zero reading through full cross-slide travel has been obtained, loosen minute dial set screw and reset minute dial to zero reading. Tighten set screw.
9. Check setting by rotating head counterclockwise a few degrees, then turning handwheel clockwise until minute dial reads zero and feeding cross-slide through its full travel and checking indicator reading.

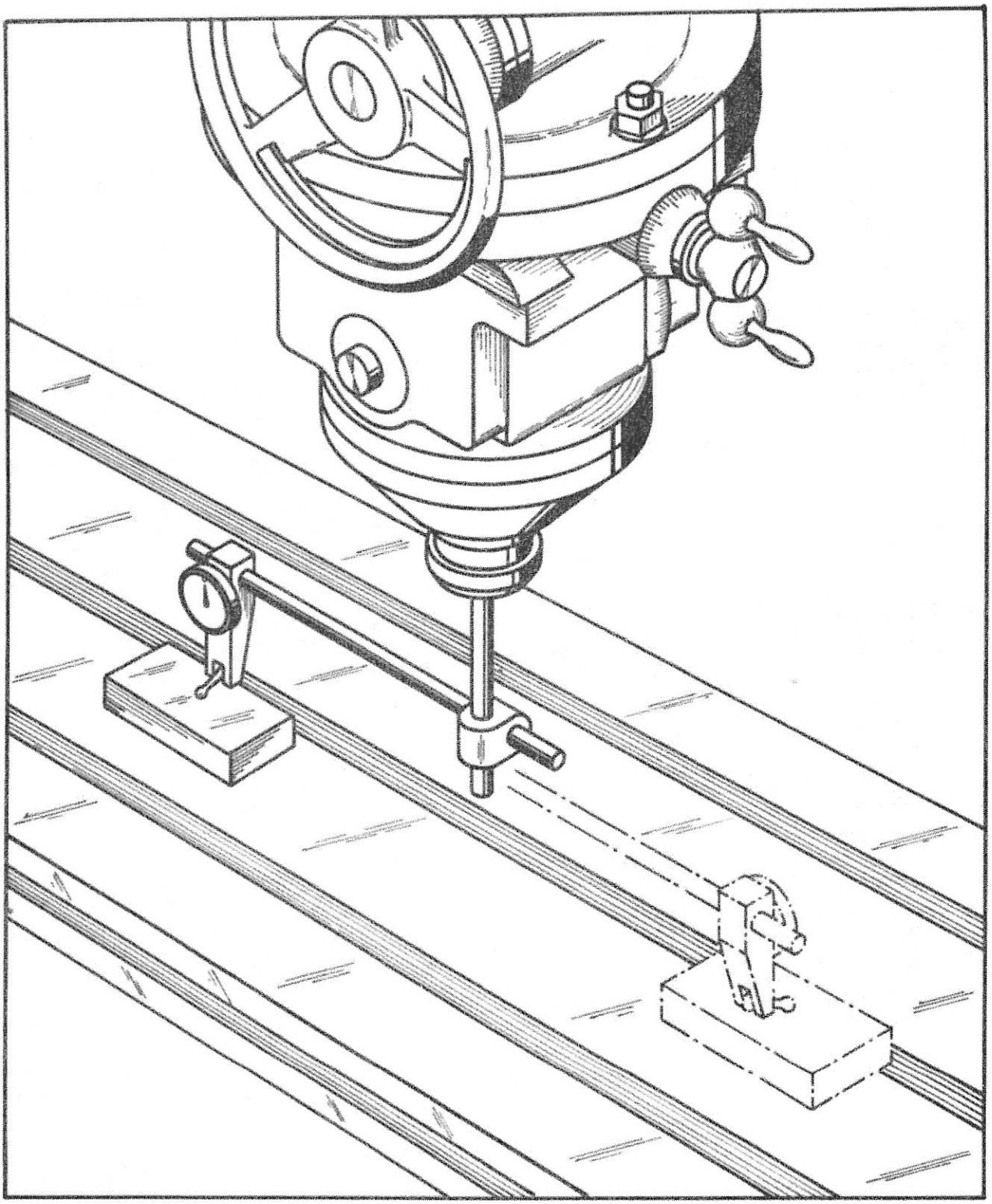


Fig. 5 Tramming in Swivel Block.

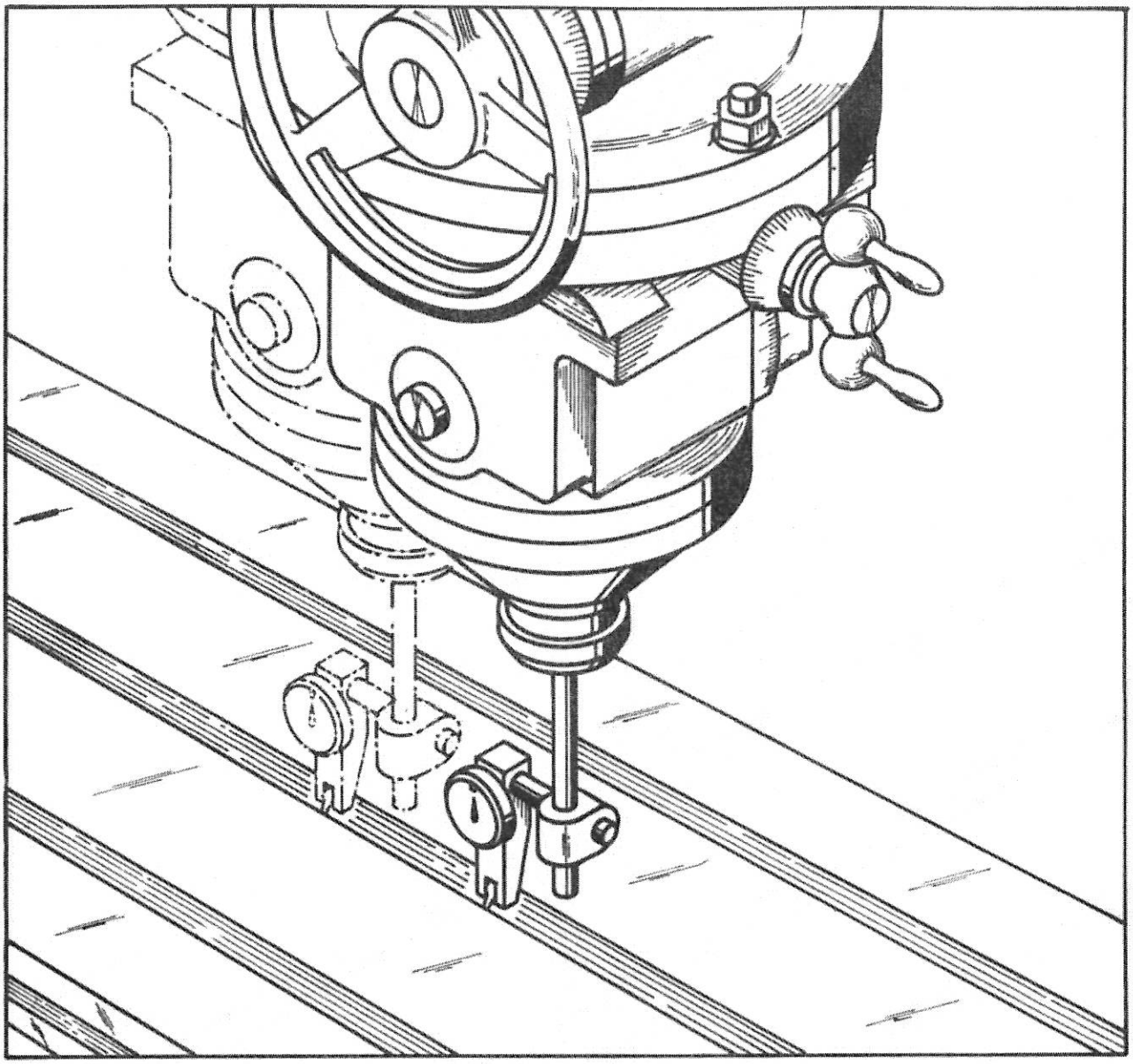


Fig. 6 Setting Spindle Cross-Slide Parallel to Table Travel.

10. If any error in parallelism prevails, repeat steps 6 through 9 until error is corrected.

SETTING SPINDLE CONCENTRIC WITH ROTARY HEAD (See Fig. 7)

1. Remove clamp screw from power input coupling and withdraw flexible shaft from attachment.
2. Remove collet nut and collet from spindle.
3. Set spindle cross-slide at zero reading on scale.
4. Place dial indicator on machine table to contact inside of spindle taper.
5. Rotate head, checking indicator readings crosswise between both gibs.
6. If necessary, adjust both cross-slide gibs until spindle indicates true crosswise between both gibs and until a slight drag is felt in movement of the cross-slide.
7. Rotate head, checking indicator readings lengthwise parallel with cross-slide feed screw movements.
8. Turn cross-slide feed screw until spindle indicates true, lengthwise with slide.
9. Reset and lock feed screw dial at zero reading.

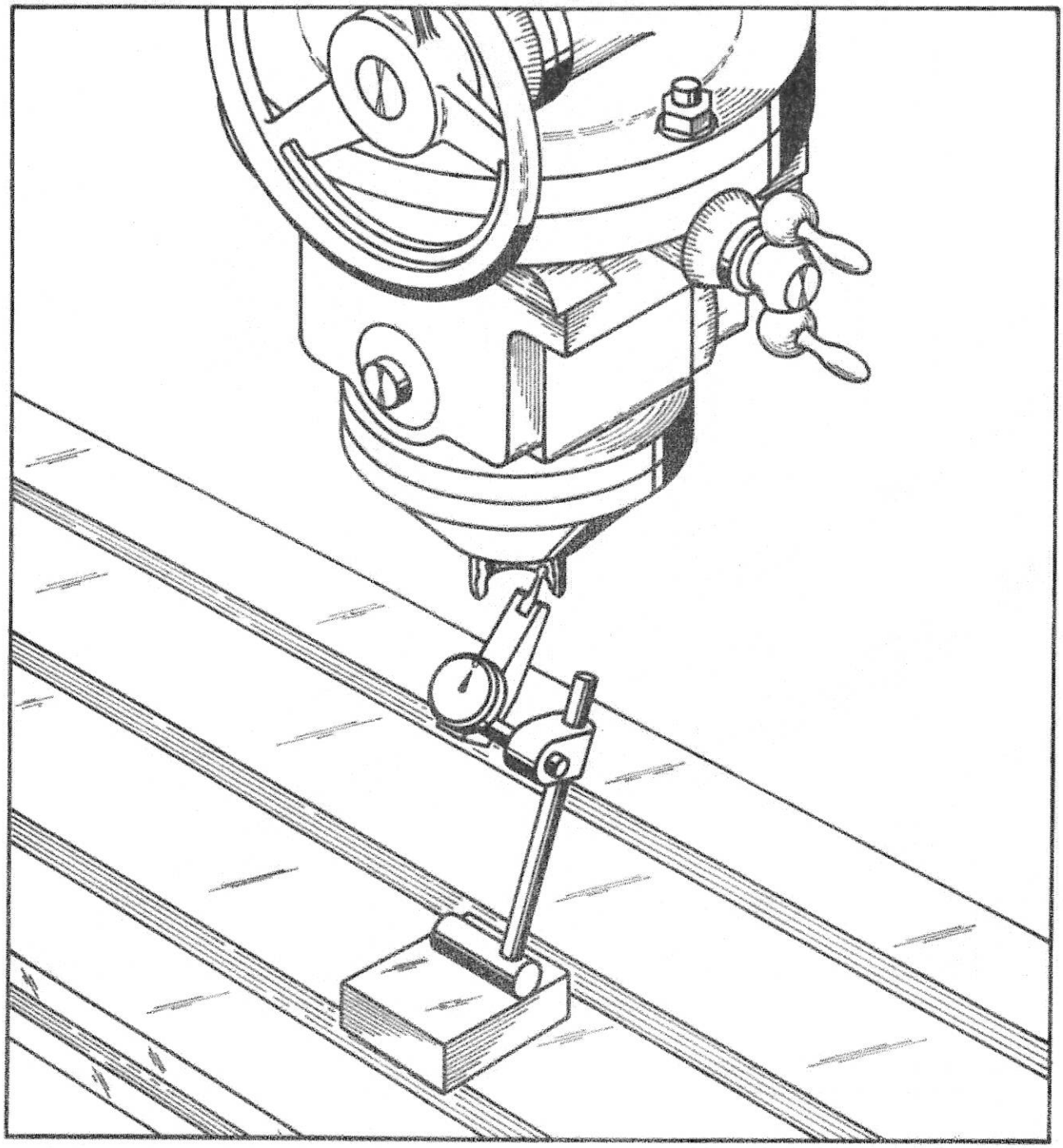


Fig. 7 Setting Spindle Concentric with Rotary Head.

10. Turn feed screw counterclockwise at least one full revolution, then rotate it clockwise to zero reading on dial.
11. Recheck concentricity by rotating head 360 degrees. If any error remains, repeat steps 5 through 10.
12. If necessary, loosen cross-slide scale screws and set scale to zero reading.

Note: *If attachment has been removed and reinstalled on machine, it is necessary to only tram the attachment into position. All other checks will prevail.*

SECTION IV

ADJUSTMENTS

ROTARY WORM AND WORM WHEEL BACKLASH ADJUSTMENT (See Fig. 8)

1. Loosen lower setscrew located immediately to the rear of the minute dial slightly, and tighten upper setscrew same amount. Correct adjustment is when backlash as indicated on minute dial does not exceed two minutes.
2. When making backlash adjustment, it will be necessary to readjust minute dial according to instructions contained in paragraph "Setting Spindle Cross-Slide Parallel to Table Travel".

ROTARY BEARING ADJUSTMENT (See Fig. 9)

1. Remove clamp screw from power input coupling and withdraw flexible shaft from attachment.
2. Remove limit block cap screw and travel limit block from top of attachment.
3. Remove four screws and remove rotary base cover.
4. Loosen both setscrews in bearing adjusting nut.
5. Loosen both rotary head clamp nuts.
6. Insert a $\frac{3}{8}$" pin in hole in periphery of bearing nut and turn nut clockwise to tighten adjustment. Correct bearing adjustment is when rotary head can be turned with but a slight drag on the rotary handwheel.
7. Tighten both setscrews in bearing adjusting nut.
8. Install rotary base cover on top of rotary base and secure with four screws.
9. Install travel limit block and cap screw at top of attachment.
10. Install flexible shaft in power input base and secure with clamp screw.

SPINDLE BEARING ADJUSTMENT (See Fig. 10)

1. Remove clamp screw from power input coupling and withdraw flexible shaft from attachment.
2. Remove both swivel block clamp stud nuts and studs.
3. Remove both socket head cap screws from each swivel block trunnion and remove trunnions.
4. Remove swivel block and spindle assembly from cross-slide.
5. Remove power input clamp screw from input base and withdraw coupling and drive gear.
6. Pry swivel block dust cap from top of swivel block.
7. Loosen both setscrews in bearing adjusting nut.
8. Insert a $\frac{1}{4}$" pin or rod in hole in periphery of adjusting nut and turn nut clockwise to tighten adjustment. Correct adjustment is when no spindle end play exists but no noticeable drag is felt when spindle is rotated by hand.
9. Tighten both setscrews in bearing adjusting nut.
10. Install dust cap in top of swivel block and tap in place.
11. Insert and engage drive gear and coupling in power input base and secure with clamp screw.
12. Locate swivel block in position on rotary head and install both trunnions.
13. Install and secure two socket head cap screws in each trunnion.
14. Install and secure both swivel block clamp studs and nuts.
15. Insert flexible shaft in coupling and secure with clamp screw.

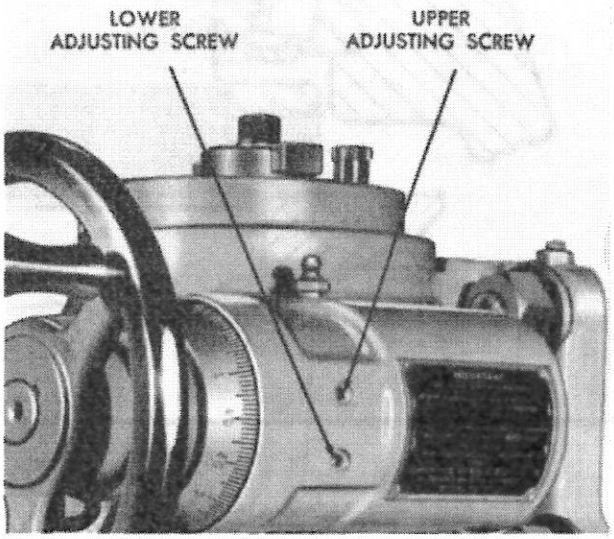


Fig. 8 Rotary Worm and Worm Wheel Backlash Adjustment.

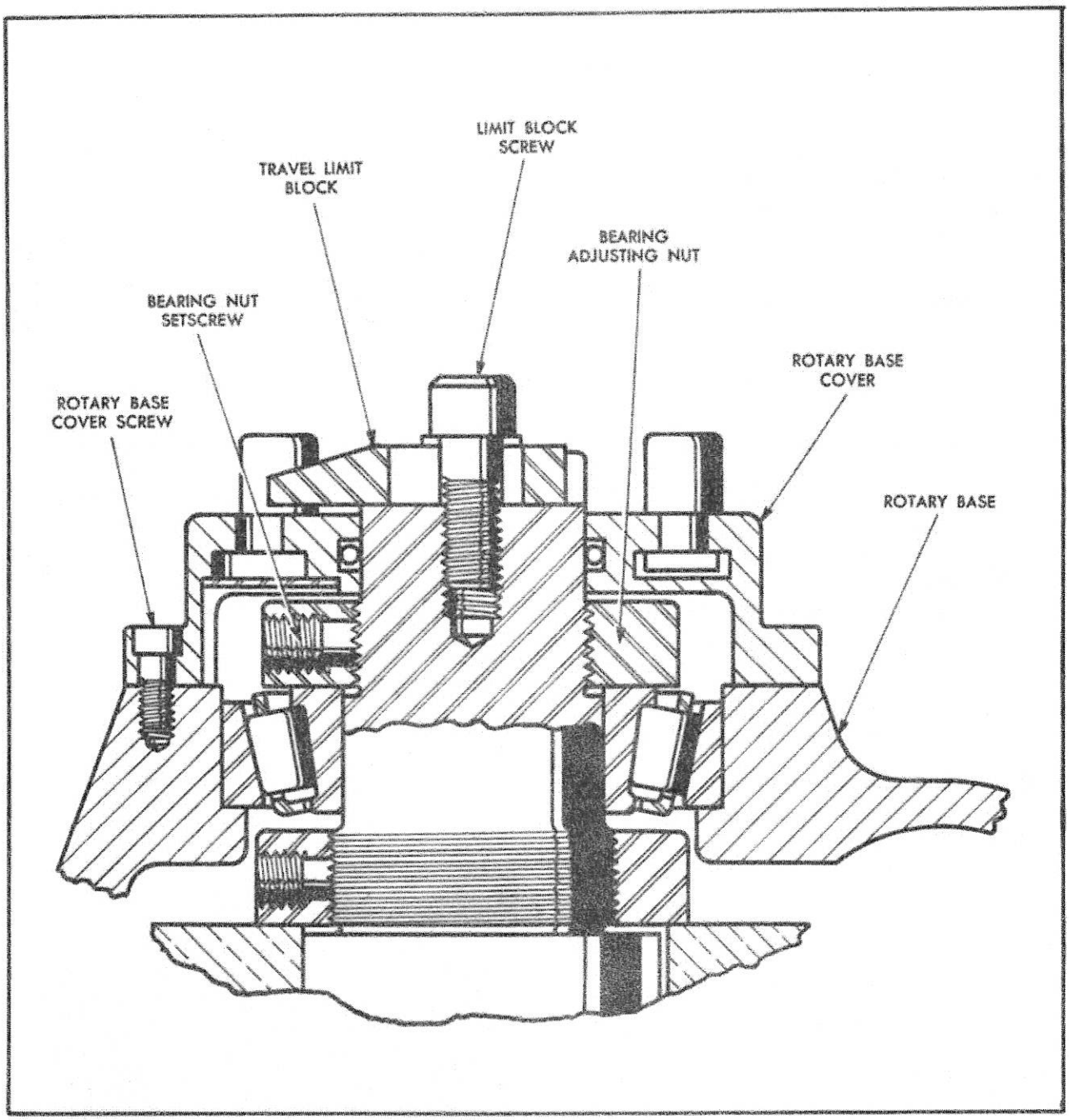


Fig. 9 Rotary Bearing Adjustment.

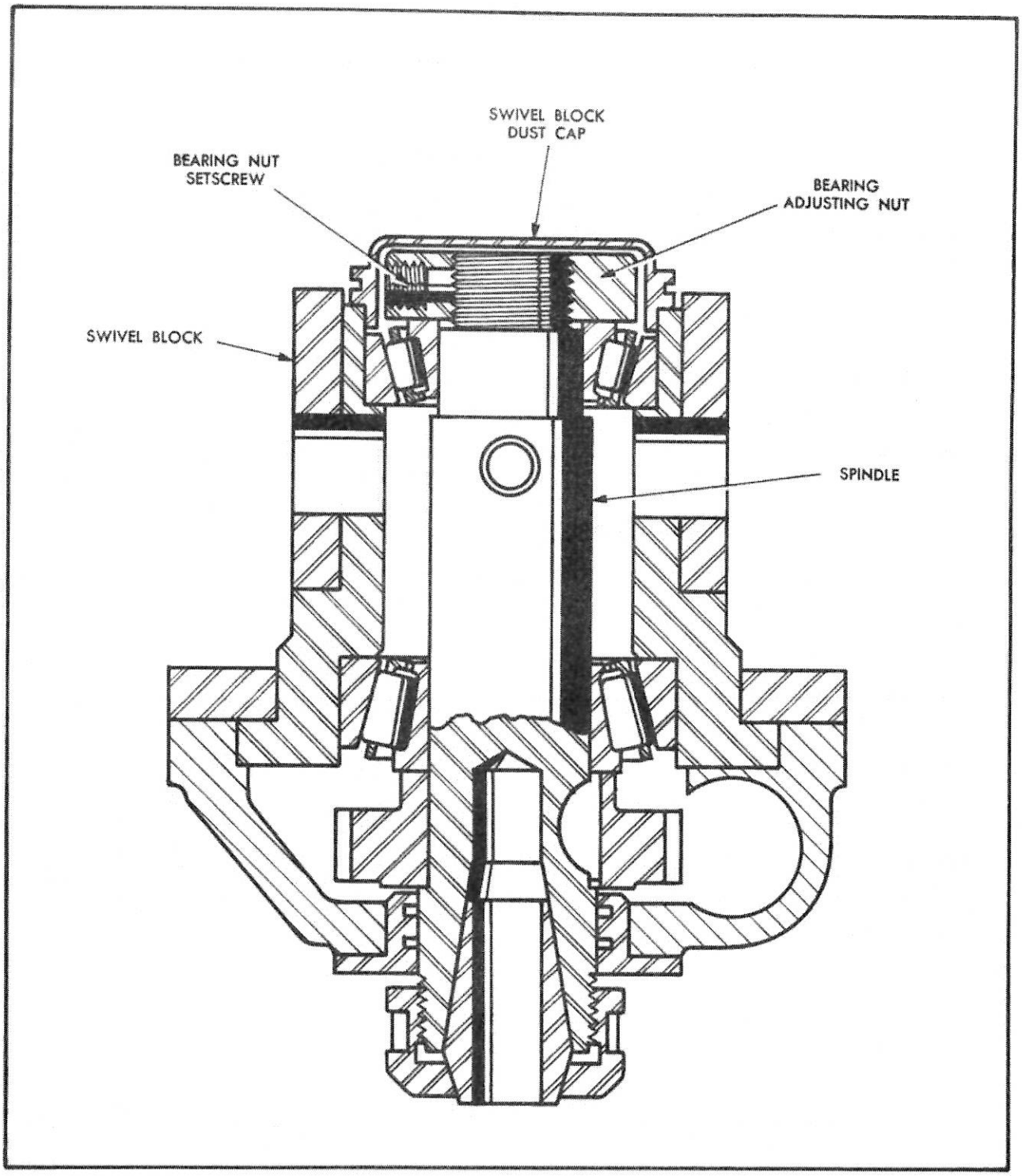


Fig. 10 Spindle Bearing Adjustment.

SECTION V

OPERATOR'S PRACTICE PROJECT

The practice project explained on the following pages has been developed to acquaint the operator with the basic movements of the TRI-D Milling Head. The various fundamental operations which can be performed on the TRI-D, their problems and ultimate solutions, are purposefully presented in this practice project.

WORKPIECE MATERIAL AND CUTTER

Use a ½" x 3" x 5¼" block of mild steel mounted in a vise clamped to the machine table. Insert a .3125" diameter two lip straight end mill in the attachment collet and tighten collet nut. Perform Exercises 1 through 9 following all settings closely.

EXERCISE 1

ESTABLISHING WORKING CENTER (See Fig. 11)

1. Set cross-slide at zero offset.
2. Set rotary head at zero degree reading.
3. Set swivel block at zero degree reading.
4. Touch cutter up against right side of block, lower knee and move table to right 1.906" (1.750"+.156"). Set table dial to zero reading.
5. Touch cutter up against rear side of block, lower knee and move saddle in 1.281" (1.125"+.156"). Set saddle dial to zero reading.
6. Set spindle speed to approximately 1200 rpm. (See spindle speed charts, page 29.)

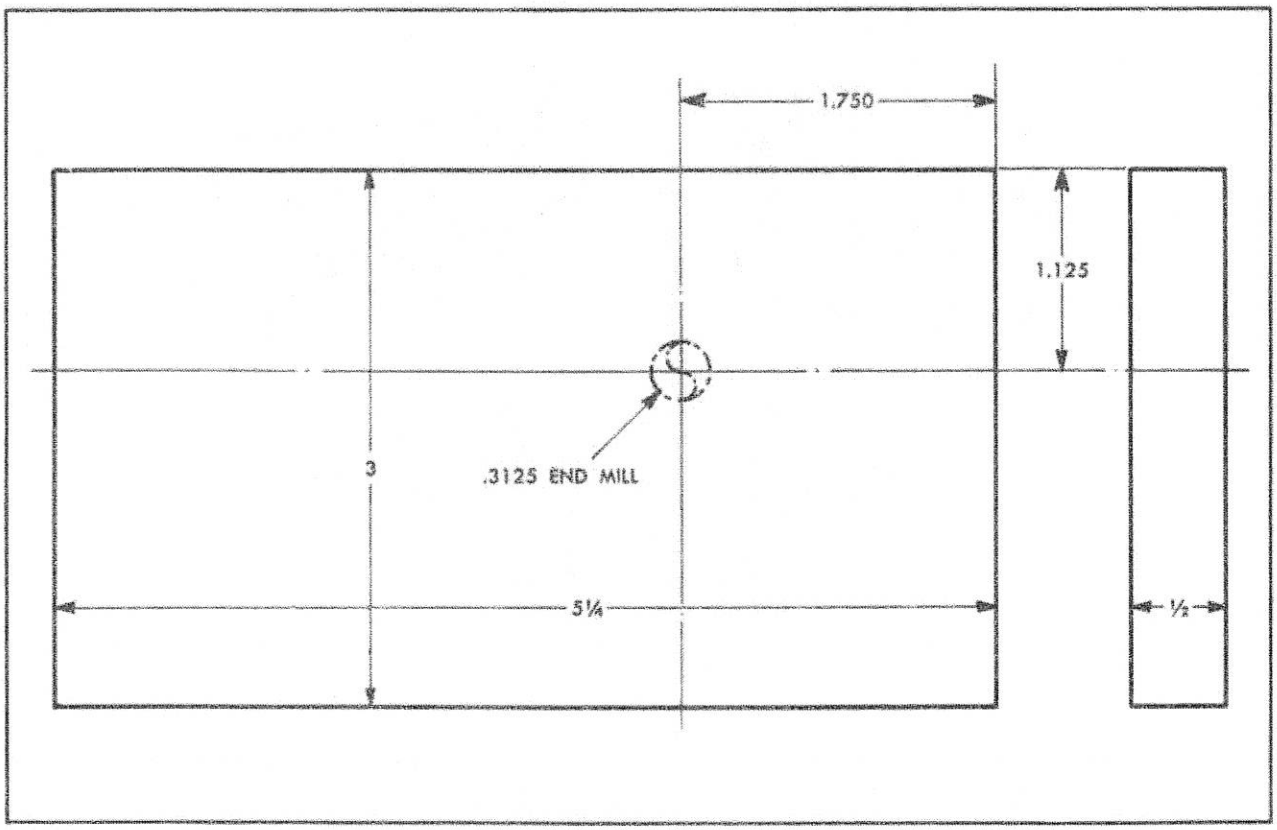


Fig. 11 Practice Project—Exercise 1.

EXERCISE 2

MILLING OUTER CONTOUR (See Fig. 12)

1. Turning cross-slide ball crank clockwise, offset head .4587".
2. Raise machine knee until cutter contacts workpiece and zero machine elevating dial.
3. With cutter under power, raise machine knee .290".
4. Feed machine table to left .625".
5. Rotate head clockwise to 180° reading on head scale.
6. Feed machine table to right 1.250".
7. Rotate head clockwise to 0° reading on head scale.
8. Feed table to left .625".
9. Lower machine knee to clear workpiece.

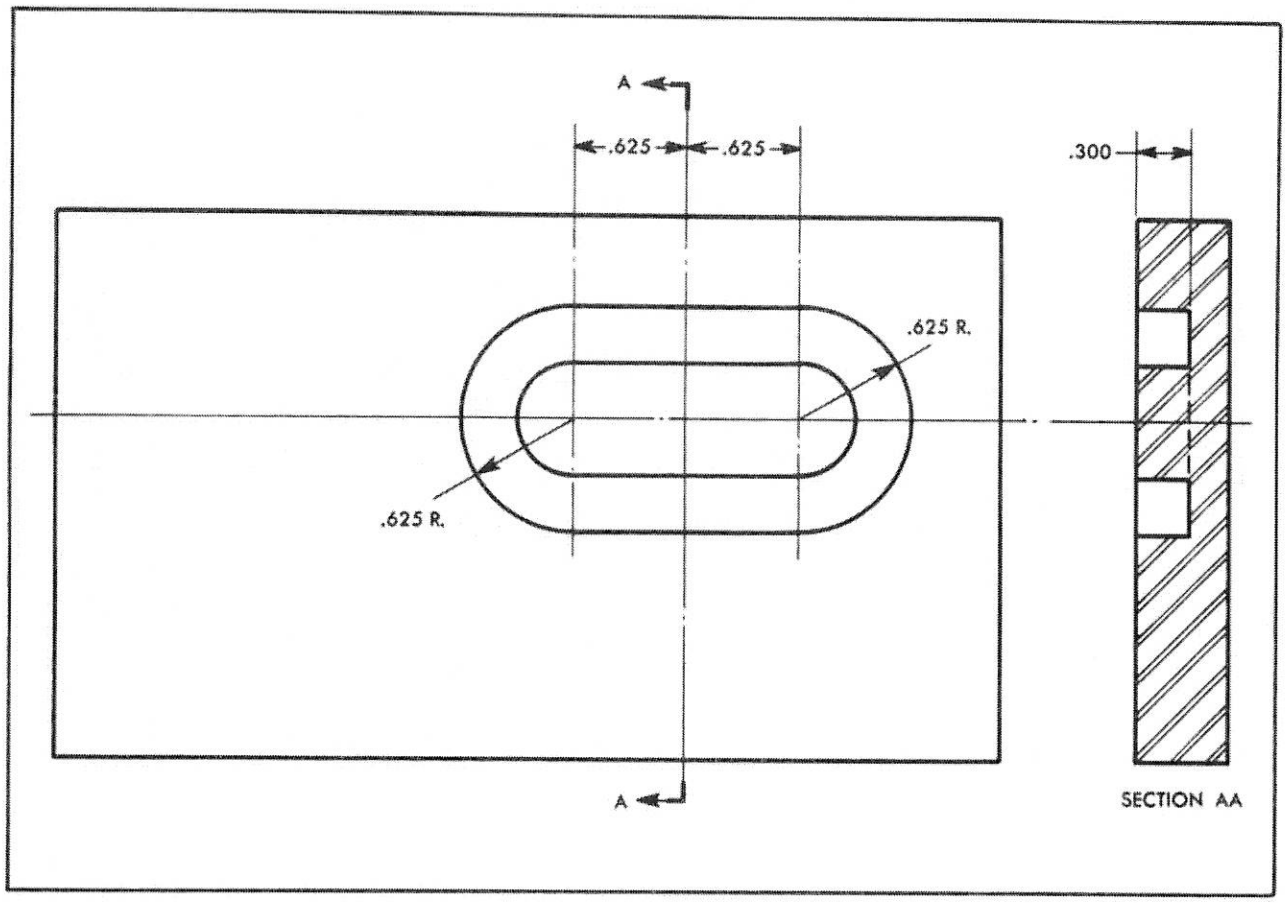


Fig. 12 Practice Project—Exercise 2.

EXERCISE 3

MILLING INNER CONTOUR (See Fig. 13)

1. Offset cross-slide to .385".
2. With cutter under power, raise machine knee to .290"
3. Feed machine table to left .500".
4. Rotate head clockwise to 180° reading on head scale.
5. Feed machine table to right 1.125".
6. Rotate head clockwise to 0° reading on head scale.
7. Feed machine table to left .625".
8. Lower machine knee to clear workpiece.

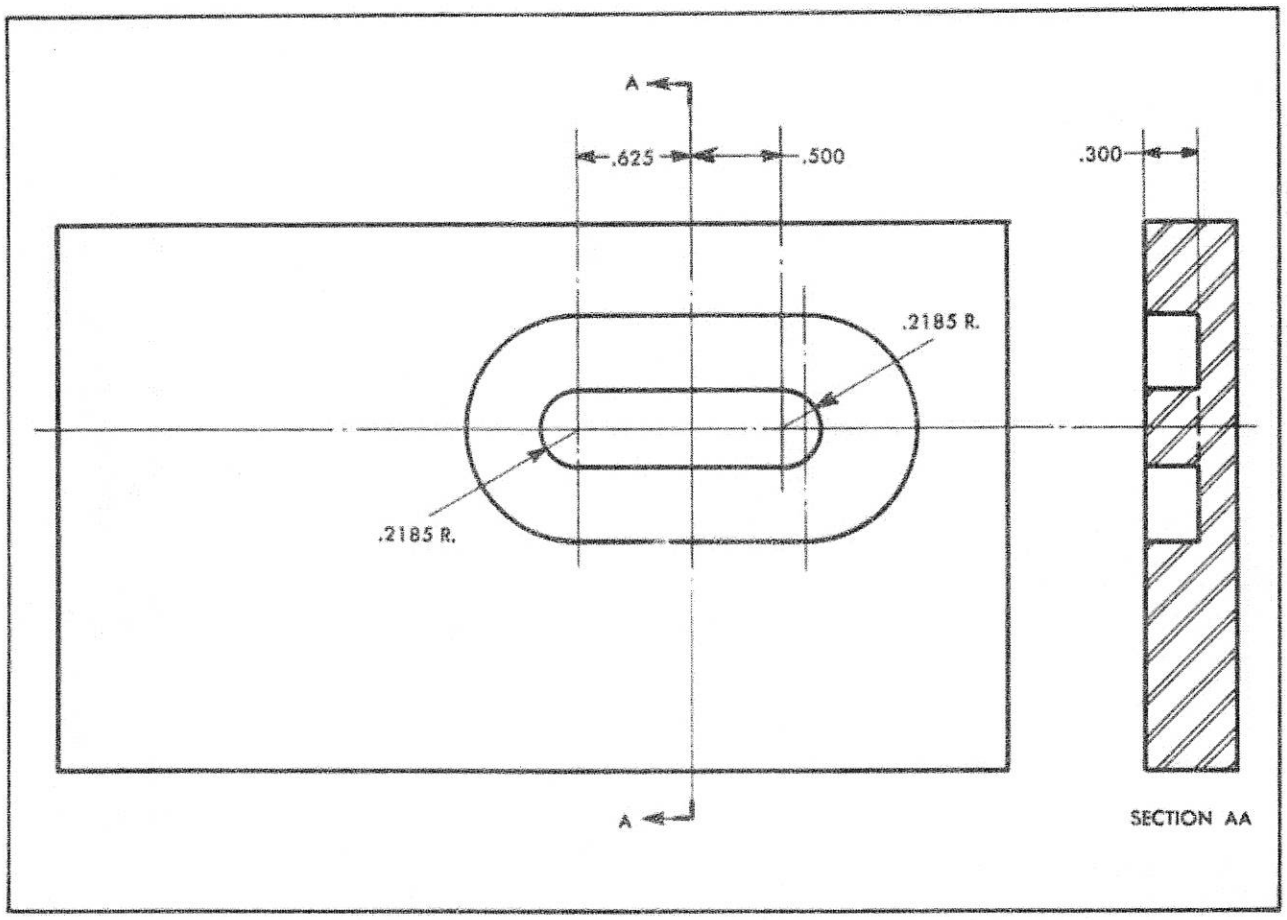


Fig. 13 Practice Project—Exercise 3.

EXERCISE 4

FINISH MILLING OUTER CONTOUR (See Fig. 14)

1. Offset cross-slide to .4687".
2. Rotate head counterclockwise to 359° reading on head scale.
3. With cutter under power, raise machine knee to .300".
4. Rotate head clockwise to 0° reading on head scale.
5. Feed machine table to left .625".

   Note: *Step 4 is a blending operation. Step 5 should be started immediately upon completing Step 4. These two steps should be one smooth continuous operation.*

6. Rotate head clockwise to 180° reading on head scale.
7. Feed machine table to right 1.250".
8. Rotate head to 0° reading on head scale.
9. Feed table to left .640".
10. Rotate head to 1° reading on head scale.

    Note: *Step 10 is a "running-out" operation and should be a continuation of Step 9. These two steps should be one smooth continuous operation.*

11. Lower machine knee to clear workpiece.

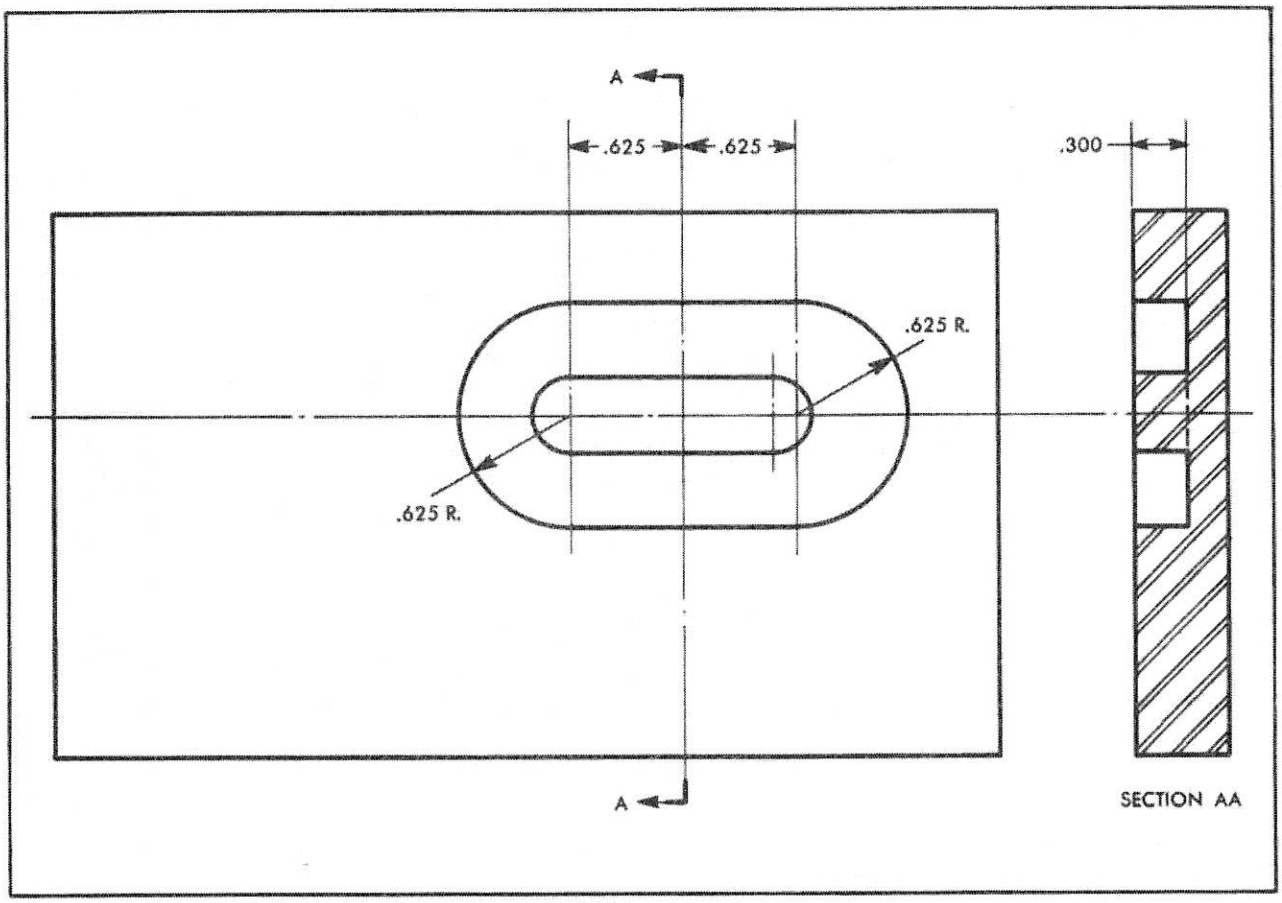


Fig. 14 Practice Project—Exercise 4.

EXERCISE 5

FINISH MILLING INNER CONTOUR (See Fig. 15)

1. Offset cross-slide to .375".
2. Set head at 180° reading on head scale.
3. Move machine table to left .525".
4. With cutter under power, raise machine knee to .300".
5. Move machine table to right .025" to .500" reading.
6. Rotate head counterclockwise to 0° reading on head scale.
7. Feed table to right 1.125".
8. Rotate head counterclockwise to 180° reading on head scale.
9. Feed table to left 1.150". This will allow cutter to run-out.
10. Lower machine knee to clear workpiece.

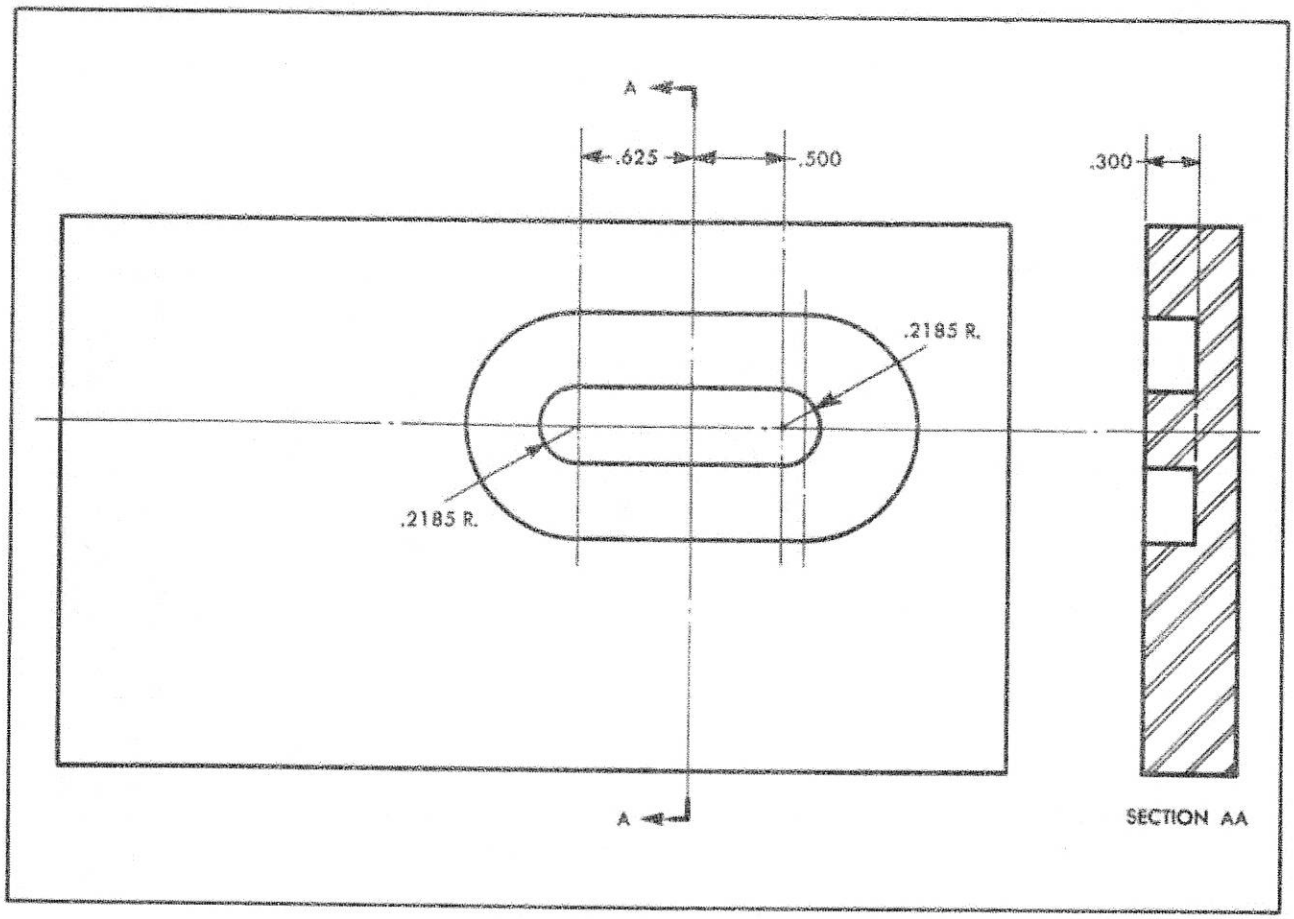


Fig. 15 Practice Project—Exercise 5.