MILWAUKEE
MODEL NO. 2D
ROTARY HEAD MILLING MACHINE

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K E A R N E Y & T R E C K E R
P R O D U C T S
Corporation

Subsidiary of
Kearney & Trecker Corp.

Milwaukee Wisconsin

Revised to conform with machines in lot No. 4063 and up.

INSTALLATION, LUBRICATION, OPERATION & ADJUSTMENT

The finest materials and workmanship have gone into the construction of the Model D Rotary Head Milling Machine. Proper care by the user in the installation, operation and maintenance of the machine will preserve its initial accuracy and performance for many years.

INSTALLATION OF MACHINE

UNCRATING — Carefully remove protective crating and skids so the machine and its parts are not marred, scratched or impaired in any way. In the event of damage in transit, communicate at once with our representative and the transportation company making delivery.

SHORTAGES — Check shipment carefully against the itemized packing list which is included in the parts box. When two or more boxes are necessary, the parts list will be found in the one marked "PACKING LIST IN THIS BOX". In case of shortages, report them immediately to the representative from whom the machine was purchased, indicating parts not received which have been checked on the packing list.

HOISTING

DO NOT USE CHAIN OR CABLE! BE CERTAIN ROPE IS OF SUFFICIENT STRENGTH (1-1/2" manila standard or equal). Exercise extreme care when hoisting machine. For lifting purposes, a hooked extension is cast integral with the column at throat of machine around which the rope is placed double from the crane hook. Be certain the rope clears the spindle drive housing and be sure to place a soft wood block underneath the hand grip on the right side of machine. Thoroughly protect all rope contact to the machine with burlap or equivalent. When hoisting, balance the weight equally by positioning the saddle toward the forward end of knee. Machine weight approximately 5015 lbs.

NOTE: (SEE HOISTING TAG ATTACHED TO MACHINE).

PLACING ON SOLID FOUNDATION

Milwaukee Milling Machines are extremely rigid and accurate. The base and column is cast in one piece and machined on the bottom to insure level installation when resting on a flat surface. Where a concrete foundation is used, it is advisable to apply grouting to eliminate any uneveness, thus providing a solid base at all points. When setting machine on an upper floor, select where possible, a position over a girder, near a wall, or some other suitable place where vibration will be at a minimum. Long and satisfactory service will repay the time taken in properly setting machine.

LEVELING MACHINE

The milling machine work table is the index to proper leveling. Prepare the machine for accurate installation by crosswise and lengthwise level readings of the table after the machine has been supported from the following three points: The right front corner, the left front corner and the rear center of base. Upon obtaining a level position insert additional supports around the entire base.

CLEANING

Thoroughly clean slush from machine with kerosene. Do not move any part of machine until all exposed surfaces have been cleaned and oiled. Then by hand, move all sliding members to the limit of travel in one direction. Clean and lubricate the exposed ways, etc., repeating the process after sliding each unit to the opposite limit of travel.

NOTE: Make certain all clamps are released before moving any of the various units.

WIRING The machine is completely wired at the factory. To connect the machine electrically, it is only necessary to run an appropriate conduit to the machine and connect the lead wires to the proper source of current. Be sure to connect the machine to electric current of voltage, phase and cycles specified.

A wiring diagram is cemented to inside of the electrical control panel door.

ELECTRICAL CONTROL PANEL The electrical control panel built into the left side of the machine column contains magnetic line starters with overload and low voltage release for each motor, overload reset switches and a transformer for 110 volt lighting and controls.

MASTER CONTROL SWITCH The Master Switch (No. 5) located at left side of column is used to shut off the current to the entire machine.

SWITCH PANEL The switch panel (No. 13) located at front of head, controls the rotation of the spindle motor and engages the power to the Rotary Head, Coolant and Air Pump motors.

TABLE FEED MOTOR SWITCH The table feed drive motor switch is located on the switch panel (No. 13)

DIRECTIONAL ROTATION OF MOTORS When the spindle motor switch is snapped to side marked "RIGHT" on control panel (No. 13) the spindle should revolve correctly for drills and right hand end mill cutters. When this occurs all other motors are wired to operate properly.

CAUTION: Serious damage to gear boxes Nos. 51 and 72 may result from running them in the wrong direction.

OVERLOAD RESET The overload reset switches are located inside the electrical control panel. To open the panel door, throw the master switch lever (No. 5) to the open position on the plate marked "OFF" "OPEN" "ON", and remove the three hollow head cap screws which hold the door shut.

The switch lever must remain at the open position when closing the door until the cap screws are again tightened.

LUBRICATION

Do not operate machine until it has been properly lubricated.

Use Gargoyle D.T.E. Oil Heavy Medium or equivalent. (Saybolt Universal Viscosity 300-325 seconds at 100° F.) at all oilers and oil reservoirs.

Use Gargoyle Grease No. 1 or equivalent at all grease fittings and packed gear cases.

These lubricants are products of Socony Vacuum Oil Company, Inc. We do not wish to infer that other brands of lubricants cannot be used.

When operating machine more than one eight hour shift per day, lubricate at correspondingly more frequent intervals.

Refer to descriptive illustrations at rear of book.

Air Pump - No. 2 - Fill sight oilers as required.

Hand Wheels - Nos. 6, 23, 25, and 38 - Oil three times weekly.

Knee to Column Ways - No. 8 - Fill two oilers daily.

Table to Saddle Ways - No. 10 - Fill oil reservoir daily. Reservoir also supplies lubricant to table screw.

Saddle to Knee Ways -No. 11 - Reservoir located on rear of saddle on right of machine. Fill daily.

Rotary Head Worm Wheel and Bearings - No. 14 - Grease every three months.

NOTE: The rotary head should be in motion while greasing to insure proper distribution of lubricant.

Quill Stud-- No. 19 -Oil walls of slot daily.

Table Feed Change Gear Box - No. 20 - Fill to high level line on oil sight gage located on front of gear box. Drain and refill every six months. Drain plug No. 52.

Elevating Screw and Gears - No. 22 - Remove flat head screw and fill reservoir three times weekly.

Saddle Screw - No. 29 - Fill oiler daily.

Quill Feed Gear Box - No. 35 - The spindle quill feed mechanism is packed in grease and requires no further attention until at such time it is necessary to remove the covers to make adjustments.

Spindle Slide Screw Bracket - No. 37 - The bracket for hand adjustment to spindle slide is provided with sealed-for-life bearings and the gear mechanism is packed in grease, therefore, requires no further attention.

Rotary Head Feed Change Gear Box - No. 43 - Fill to high level line on oil sight gage. Drain and refill every six months. Drain plug No. 44.

Rotary Table Power Drive Bracket - No. 45 - Fill oilers three times weekly.

Spindle Slide, Spindle Quill and Slide Adjusting Screw - No. 58 - These three parts are lubricated through the wicks in two oil wells located in the top of the rotary head. Turn rotary head until wells are accessible. Add oil to the wells every two days. Fill wells only to within one-half inch of the top of the copper tubes. IMPORTANT - Do not apply oil directly into the copper tubes.

Belt Adjusters - Nos. 61 and 62 - Fill oilers three times weekly.

Variable Sheave Pulley - No. 65 - Apply a very small amount of grease monthly.

Motor Slide Bars - No. 66 - Two round bars on which the spindle drive motor slides are located down inside the column. Oil bars weekly.

Rotary Head Reversing Gears - No. 67 - Grease every six months.

Electric Motors - All Motors are equipped with sealed-for-life ball bearings and require no futher lubrication.

OPERATION

Your Model 2D Miller with its attachments offers a rapid and accurate means of machining any geometrical form. Its operation is very simple. If you know (first) how to read a blue print, (second) how to remove metal by the milling process and (third) the principles of geometric construction, you will soon be able to mill some of the most complex jobs accurately and economically.

SETTING UP THE JOB — Place the work piece on the machine with any previously finished edges properly aligned with the table movements. After the job is securely clamped, line up the center of the rotary head with the working center of the job. Next, set the micrometer dials on the longitudinal and transverse screws to zero position and set the scale pointers to line up with the nearest inch graduation on the scales.

MACHINING THE JOB — Most work can be machined completely at a single setting. Use the same technique as the draftsman does when making the drawing.

The longitudinal lines on the plan view of the blue print are cut into the metal by using the longitudinal table travel. The vertical lines of the print are cut by using the transverse movement of the table. The rotary head and spindle slide are used to cut the arcs and angles. Holes can be bored by means of the spindle quill travel.

Thus any geometric shape in a horizontal plane can be machined. For machining third dimensional forms involving arcs and angles see "CHERRYING ATTACHMENT".

MACHINE SPINDLE — The spindle is mounted on preloaded ball bearings. The spindle end is hardened and ground. Spring collets are held in the spindle taper by means of the draw-in rod (No. 60).

SPINDLE LOCK — The spindle is provided with a lock to prevent its rotation when applying or discharging cutting tools. The spindle lock is located inside of the large cover at top of machine, directly underneath the spindle drive

pulley. The lock is of the plunger pin type and is in operating position when the rotary head zero graduation is within fifteen degrees on either side of the stationary zero line stamped on machine housing. Release plunger pin and turn spindle pulley until pin snaps into spindle locking plate.

SPINDLE DRIVE — The spindle is driven by a 3/4 H.P. constant speed motor. An adjustable sheave pulley mounted on end of motor shaft drives a double idler pulley, the upper half being a three step V belt pulley which in turn provides a belt drive to the three step spindle pulley.

SPINDLE SPEEDS — The spindle drive provides an infinitely variable number of speeds, the range being from 250 to 4000 r.p.m. when operating on 60 cycle current.

Desired speed ranges are selected by means of an indicator (No. 64) located under the cover at top of machine. The speed indicator panel has five figures (from one to five) which corresponds with the top row of figures on the speed chart (No. 69) located on the right side of column. The following example will be of value in determining a desired speed setting.

To select a spindle speed of 1115 R.P.M. follow instructions in sequence.

1. Unclamp pulley adjustment lock (No. 63).
2. Revolve V Belt tension adjusting crank (No. 61) and shift belt to center step of both idler and spindle pulleys.
3. Readjust belt to proper driving tension.
4. Release spindle if locked and start spindle drive motor.
5. Turn variable sheave pulley adjuster crank (No. 62) until pointer coincides with the figure three on the indicator panel, then tighten adjustment clamp, (No. 63).
6. For speed settings between 1115 and 1360, adjust sheave pulley accordingly.

CAUTION: When using high spindle speeds - be certain the V Belt is not adjusted too tight. During sustained high speed operation the machine cover should be left open for maximum ventilation.

ROTARY HEAD FEED — The Rotary Head is operative by either hand or power. The handwheel, No. 38, and graduated dial permit accurate adjustment in increments of minutes.

Sixteen power feed changes are provided. The changing of feeds is speedily accomplished by gear shifting levers (No. 72). A feed chart (No. 71) is located on the front end of the feed box.

Feed changes should be made with the rotary head drive motor running but with feed control lever in neutral position.

Engagement of the rotary head power feed lever (No. 42) is directional with rotation of head.

The handwheel disengages automatically when the power feed to head is applied.

Trip dogs (No. 12) are provided to limit the power feed to rotary head as desired.

CAUTION: When operating the rotary head by either hand or power feed, make certain that locking screws (No. 68) are released.

SPINDLE SLIDE

The Spindle Slide is adjustable by hand only.

The micrometer dial (No. 36) on the adjusting screw is set to read zero when the center of the spindle is in line with the center of the rotary head. This dial setting should not be disturbed except for necessary periodical adjustment.

The minute dial (No. 16) is set at zero when the spindle slide is parallel with the center tee slot of the machine table and should not be disturbed except for necessary periodical adjustment.

The spindle slide can be locked in position by tightening hexagon locking nuts. One nut located on each side underneath the dove tail section.

QUILL FEEDS

The spindle quill has three inches of travel by hand or power. Eight power feeds are obtainable by positioning the feed selector lever (No. 56) to correspond with the feed chart, and engaging the two position range gear shifter knob (No. 74). Lever (No. 54) is used for engaging feeds up or down. The quill travel can be limited as desired by adjustable trip dogs, which in turn provide safety to the quill range when dogs are positioned at extreme limits.

A safety slip clutch prevents damage to the quill feed mechanism. The clutch is set to absorb normal loads on quill feeds - excessive loads or obstructions will cause slippage. This clutch is permanently adjusted at the factory and requires no further attention.

NOTE: When the quill feeds are not in use, the feed selector lever should be set in the neutral position - preventing accidental engagement.

CAUTION: When using quill feeds, be sure that quill locking ring nut (No. 53) is released.

TABLE FEEDS

Power feeds to the table are obtained by regulating the gear shifter levers (No. 51) to the various positions shown on the table feed chart (No. 50). The sixteen table feed changes should be made with motor in operation.

Direction of table feed is controlled by lever (No. 31).

The table travel can be tripped as desired by setting adjustable trip dogs (No. 49). These same adjustable trip dogs serve as limit stops when set to extreme position on rod.

HAND WHEELS

All hand wheels are of the clutched type permitting disengagement to avoid disturbing dial settings accidentally.

ROTARY HEAD, SPINDLE SLIDE AND QUILL CLAMPS

Locking screws (No. 68) are provided for clamping the rotary head in a fixed position when necessary.

The spindle slide is clamped by means of lock nuts located on each side underneath the dove tail section. These nuts should be tightened during all milling operations, - except when the spindle slide is used in feeding the cutter or when the cherrying attachment is in operation.

The quill is secured by means of lock ring (No. 53), which should be locked at all times except when the quill feed or cherrying attachment is being used.

TABLE, SADDLE AND KNEE CLAMPS

Table clamp lever (No. 21), saddle clamp lever (No. 28) and knee clamp lever (No. 4) are provided to insure added rigidity to the machine on rough milling operations. It is usually unnecessary to apply any of these clamps on finish milling or boring operations.

CAUTION: Before moving any sliding member by hand or power, make sure that respective clamps are released, thus preventing damage to sliding ways.

DIAL & SCALE GRADUATIONS

The periphery of the rotary head is graduated on the entire circle in degrees. The dial on the rotary head drive shaft is graduated in minutes. The ratio between the wormwheel and worm is 120 to 1, which moves the rotary head three degrees with each revolution of the handwheel (No. 38).

Accurate adjustment to the spindle slide, quill, table, saddle and knee are possible by means of micrometer dials having one hundred graduations, reading in thousandths of an inch.

The scale for the spindle cross slide is graduated in tenths of an inch, the zero line of the graduated dial is set to correspond with the tenth readings on the scale.

The table and saddle scales are graduated in tenths of one inch. The adjustable pointers permit synchronizing the scale readings with zero reading of the dials.

FEED SCREWS

All feed screws are manufactured of wear resisting steel and ground to precision limits of .001 per foot.

DIAL INDICATORS AND MEASURING RODS

Dial indicators (No. 27) and measuring rods are used for obtaining extremely precise transverse and longitudinal movements to the machine table. The set of micrometer rods is provided with two micrometers which read from zero to one inch by ten thousandths of an inch.

NOTE: The measuring rod stops are adjustable to provide the setting of micrometer and indicator to zero readings.

CUTTER COOLANT RESERVOIR

On wet machines provided with coolant pump (No. 1), the coolant reservoir in the base is filled through the screened openings under cover plates (No. 30). Coolant capacity 6 gallons.

NOTE: A light bodied transparent cutting oil is recommended for tool and die work.

CUTTER COOLANT PUMP

The coolant pump (No. 1) is of the geared type and is located at left side of machine base. A pressure relief valve functions when coolant is shut off at the outlet nozzle.

AIR PUMP

The air pump (No. 2) is of the vane type. Its location is at the left side of the column base A relief valve is provided to release the pressure when the air is shut off at either the outlet nozzle or the petcock in the distributor block. (No. This relief valve is set for 15 P S I. It is recommended that the air pump motor be stopped if air is not required.

AIR AND COOLANT DISTRIBUTION SYSTEM

The coolant and air lines from the pumps enter separately into a distribution block (No. 9). The distributor block has a single outlet to the discharge nozzle which is mounted on the support ring (No. 34). This support ring is mounted on the spindle quill housing and causes the stream of air or coolant to follow the cutter at all times.

Both lines coming from the pumps are equipped with a petcock where they enter the distributor block. The use of both pumps and the proper adjustment of the petcocks will give a mist effect at the discharge nozzle. If coolant or air is not required, the respective pump should be stopped, not simply shut off at the distributor block petcock. Also; if one pump is in use and the other is not, the petcock for the pump which is not in use should be shut off. This is especially necessary to avoid pumping coolant into the air pump and its supply lines when the air pump is not in use.

ADJUSTMENTS

The Model D Rotary Head Milling Machine is finely adjusted at all points before leaving the factory. If given proper care it should not require further adjustment for many months.

SETTING MACHINE SPINDLE CONCENTRIC WITH ROTARY HEAD

To align the spindle center accurately with rotation of head:

1. Set the spindle slide in the zero position.
2. Release the spindle plunger lock (No. 58).
3. Place indicator from machine table to contact spindle nose.
4. Rotate head by power at the high feed (3 RPM).
5. Adjust both spindle slide gibs until the spindle indicates true crosswise between both gibs, and until a slight drag is felt in movement of slide by hand.
6. Turn the spindle slide feed screw until the spindle indicates true lengthwise with the slide.
7. Reset and lock the graduated dial to zero.
8. Back up the feed screw at least one revolution, then revolve it clockwise to the zero position.
9. Recheck adjustment with spindle slide locked in position.

SETTING SPINDLE SLIDE PARALLEL TO TABLE TRAVEL

To align the spindle slide parallel with longitudinal travel of table:

1. Set rotary head at 90° reading.
2. Indicate parallelism of spindle slide with center tee slot of table. Hold indicator in spindle collet.

3. Reset minute dial to zero position.
4. To check setting, back up the head several degrees - turn handwheel clockwise until dial reads zero, and reindicate table tee slot.

NOTE: The spindle should be locked while indicating the slot.

ROTARY HEAD BEARINGS

The rotary head is mounted on preloaded precision ball bearings having large diameter races and should give years of accurate service without any further adjustment.

BACKLASH ADJUSTMENT OF ROTARY HEAD WORM AND WORM WHEEL

When excessive backlash develops between the worm and worm wheel in the rotary head drive it can be taken up as follows:

1. Remove set screw and hexagon lock nut from center of cover No. 40.
2. Pull hand wheel No. 38 off its shaft along with the shifter fork and rod.
3. Cut paint seal around cover No. 40 with Knife and remove six hollow head cap screws. Lever No. 42 will come off with cover.
4. Clean excessive grease away from exposed worm and worm setting nuts.
5. Remove the snap ring from the serrated lock nut at each end of the worm.
6. Slide the serrated lock ring at each end of the worm over far enough to just clear the mating serrated washers which are between the serrated lock nut and the worm.
7. Loosen the serrated lock nut at the right end of worm a small amount by turning the lock ring with a pin or spanner wrench. Follow up with the lock nut at the left end of the worm and repeat until the backlash is reduced to from 30 seconds to 1 minute of arc as read on the minute dial No. 16.
8. Tighten lock nuts securely and at the same time lining up the serrations with the serrations on the lock washers.
9. Check setting to make sure worm operates smoothly and evenly all around the worm gear.
10. Slide lock rings back into position and replace snap rings.
11. Reassemble cover No. 40 and replenish the grease supply through fitting No. 14.
12. See "SETTING SPINDLE SLIDE PARALLEL TO TABLE TRAVEL".

ADJUSTMENT OF TABLE GIB

The table is provided with a full length taper gib located at front dovetail of saddle. The gib has an adjusting screw at both ends. To take up gib, loosen screw at small end (right end of

table) 1/8 turn, and bring up screw at large end the same amount, backing up the screw at large end slightly to make certain gib is not bowed. Repeat until a slight "drag" is felt when moving the table full distance by hand.

ADJUSTMENT OF SADDLE GIB

The left side dovetail of saddle is provided with a full length taper gib having adjusting screws at both ends. To make adjustment, loosen screw at small end (rear) 1/8 turn and bring up screw at large end the same amount. Repeat until a slight drag is felt when moving saddle full distance by hand.

ADJUSTMENT OF KNEE GIB

The left side of knee dovetail is provided with a full length taper gib having adjusting screws at both ends. To make adjustment, loosen screw at small end (bottom) 1/8 turn and bring up screw at large end the same amount, backing up screw slightly to make certain gib is not bowed. Repeat adjustment when necessary. Smoothness of knee movement can be checked by placing the hand on top of gib and column dovetail while knee is being moved both up and down.

NOTE: Gib adjustments are of vital importance in maintaining machine accuracy - loose gibs cause chatter, vibration and poor finishes to work as well as undue wear to machine ways. All gibs should be checked frequently and properly adjusted whenever necessary.

ADJUSTMENT OF TABLE SCREW THRUST BEARINGS

The table screw is mounted on taper roller bearings and adjustment is seldom, if ever, necessary. The bearings can be taken up by following the instructions below.

1. Remove micrometer dial locking screw.
2. Remove snap spring from end of table screw.
3. Loosen set screw at periphery of knurled clutch knob.
4. Remove clutch knob. Watch for 3/16" dia. detent ball.
5. Remove snap spring and retainer pin from hub of hand wheel.
6. Remove hand wheel and micrometer dial.
7. Loosen set screws on exposed take up nut and adjust until table screw begins to turn stiffly on its bearings, then back off the adjusting nut gradually until screw turns smoothly with the hand wheel.

ADJUSTMENT OF SADDLE SCREW THRUST BEARINGS

To take up end play of thrust bearings on the saddle screw, release both set screws at periphery of adjusting nut located at inner end wall of knee, take up on the nut gradually until the saddle screw begins to turn stiffly, then back off the adjusting nut gradually until the screw turns smoothly with the hand wheel.

VERTICAL SCREW

No provision is made for the knee elevating screw adjustment. This unit is properly adjusted at the factory and requires no further attention. The weight of the knee prevents lash between the screw, nut and driving members.

ADJUSTMENT OF TABLE SCREW NUT

To eliminate excessive backlash between the table screw and nut, move the table until the two nut adjusting screws at the left end of the table are over the one inch diameter holes in the saddle channel. Use a hexagon headless set screw wrench to adjust the take up nut until a slight drag can be felt when turning the screw. Ease up on the take up nut slightly and see that adjusting screws are sufficiently tight to prevent them from jarring loose. Try screw for entire length of table travel to make sure that nut does not tighten up in spots. One to two thousandths back lash is ideal adjustment.

ADJUSTMENT OF SADDLE SCREW NUT

The backlash between the saddle screw and nut can be taken up in identically the same manner as outlined for the table screw nut adjustment. The adjusting screws are at the rear of the saddle screw nut.

REPLACING SPINDLE BEARINGS

The machine spindle is supported by five ball bearings. Three of the bearings are fitted directly on the spindle inside the quill. Two bearings mounted on a splined sleeve absorb the side thrust load from the belt. If in time one or more of the bearings fail, remove the spindle and quill assembly and run the spindle pulley on the remaining two bearings. If they operate quietly it is quite likely that the damaged bearing is in the quill.

The spindle and quill assembly is removed by lowering the knee, running the table back close to the machine column and pushing the assembly down through the quill housing. Observe the following instructions in the sequence given.

1. Unscrew left hand nut No. 59 and remove draw-in rod No. 60.
2. Unscrew quill lock nut No. 53.
3. Unscrew quill feed change gear shifter knob No. 74.
4. Remove quill feed gear box cover No. 35. Ball crank No. 73 will come off with cover. Take care not to lose two 3/16" diameter detent balls located at the right end of the cover.
5. Remove bearing retainer at end of exposed worm shaft. Retainer can be jacked out by removing short set screw in the center and using a longer screw.
6. Release clutch nut No. 57 and pull out worm far enough to clear bronze worm wheel.

7. Drill, tap (10 x 24) and jack out expansion plug covering quill pinion at end opposite clutch nut No. 57.
8. Drive out quill pinion shaft assembly including the clutch, bronze worm gear and bronze bushing. Be sure that bevel gear on worm shaft is clear of worm wheel during this operation.
9. Take out two diametrically opposed spring retainer screws on the ground diameter of the quill housing.
10. Remove quill stud No. 19 and push spindle and quill assembly down through the housing.
11. To reassemble reverse the procedure.
12. When reassembling the quill pinion remove all other parts from the shaft and assemble them in the machine one at a time.
13. Before replacing cover No. 35 clean out most of old grease and repack to full capacity.

NOTE: When it is necessary to replace a spindle bearing in the quill we suggest that the spindle and quill assembly be returned to the factory where the work will be done at a nominal charge.

REMOVING SPINDLE DRIVE MOTOR

The spindle drive motor should give many years of trouble free service. The motor requires no lubrication as it is provided with sealed for life bearings. If for any reason it should become necessary to dismount the motor, disconnect the wires; remove the adjustable sheave pulley; remove the four screws which fasten the motor to slide and with eye bolt placed into tapped end of motor shaft, lower motor and remove it through the column door.

REPLACING SPINDLE DRIVE BELTS

Two belts are used in the spindle drive. When ordering replacements be sure to state serial number of machine and give length and width of belts required.

CLEANING COOLANT SYSTEM

The rear longitudinal pocket in the milling machine table is provided with a fine mesh screen to prevent chips entering and clogging the coolant return channels. This screen can readily be removed for the purpose of periodically removing the fine grit deposited by the coolant on its return to the machine base.

To clean the coolant reservoir in the base of machine, remove the screens under cover plates (No. 30). The coolant and any accumulations of sludge and grit can be removed through these two openings. A plate at the rear of column base can also be removed to clean the channel leading to the coolant pump.

THE FOLLOWING ATTACHMENTS ARE AVAILABLE WITH MACHINE
DESCRIPTIVE VIEWS ARE SHOWN AT THE REAR OF THE BOOK

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SLOTTING AND CORNERING ATTACHMENT

This attachment is used for light slotting and cornering operations on a tool or die, after the milling has been finished. The circular bracket is bored to fit accurately over the spindle quill housing. The hand operated ram has a stroke of 1-1/2" and is provided with a kick out motion which breaks off the chips when working to a blind bottom. To set the stroke, hold the ram in the down position and raise the knee until the work touches the slotting tool; release ram, and set the vertical feed dial at zero and raise the knee to whatever depth is required for the work. The attachment is adjustable for angular slotting in either direction.

RIGHT ANGLE MILLING ATTACHMENT

The right angle milling attachment is useful for performing light horizontal milling operations inside of die cavities, etc. The housing is bored accurately to fit over the spindle quill. Two inches of quill adjustment is possible with attachment in use. A slotted driving pin is furnished with this attachment, and should be mounted with the bottom of driving slot flush with end of 7/16" collet. The entire attachment is packed with grease and requires no further lubrication. The attachment can also be used in conjunction with the rotary head movement.

CHERRYING ATTACHMENT

The cherrying attachment is an auxilliary rotary head which can be mounted on the machine at 90° to the main rotary head. This attachment combines and coordinates the horizontal movement of the spindle slide with the vertical movement of the spindle quill to make it possible to cut arcs and angles in a vertical plane. The addition of this feature expands the field of machine applications to work involving the laws of solid geometry.

MOUNTING CHERRYING ATTACHMENT

A finished pad is provided on the bottom side of the rotary head for supporting the cherrying attachment. In applying this attachment follow instructions in the order given.

1. Remove quill feed trip dog bracket (No. 18).
2. Remove the rotary head lock screw (No. 68).
3. Set spindle cross slide to zero position on scale (No. 33) and dial.
4. Adjust cross slide of attachment by revolving screw (No. 84) clockwise until graduated dial and center line on slide face read zero.
5. Oil attachment slide and quill stud (No. 19) and the slot in which it slides.
6. Mount attachment by engaging the bronze slide with the quill stud (No. 19) and elevate the spindle quill until key of attachment engages keyway of rotary head.
7. Place both 1/2" screws supporting attachment in rotary head.
   NOTE: Turn screws in by hand, do not use wrench at this stage for final clamping of attachment.
8. Loosen clutch nut (No. 57) to disengage quill feed.
9. Tighten attachment securely into position.
10. Release spindle slide nut by removing both hollow head screws with short Allen wrench furnished.
11. Revolve spindle slide screw to back nut against screw shoulder.
    NOTE: Flat edges of released nut must be positioned in line with the locating opening of the slide.

OBTAINING CIRCULAR MOTION OF CHERRYING ATTACHMENT

The bronze slide of the attachment is adjustable off center by means of a micrometer screw and dial (No. 84). Maximum radial travel of slide is one inch. With the attachment dial and bronze slide set at zero, the movement of handcrank (No. 82) would only revolve the bronze slide around the stud (No. 19) without transmitting any motion to the cutting tool.

Setting the bronze slide off center one turn by adjustment of micrometer screw (No. 84) and revolving the handcrank (No. 82) the center of the cross slide bore will travel in an arc, having a radius of .050". The center of the stud (No. 19) is carried in the same arc or circular path and since the stud is guided by a slot in the quill housing and is securely fastened to the quill, the rotation of the ball crank (No. 82) so combines and controls the vertical movement of the quill and horizontal movement of the spindle slide, as to cause the center of a ball cutter held in the machine spindle to travel in an arc or circular path having a radius equal to the amount the attachment cross slide has been set off center.

Combining the circular motion of the cherrying attachment with the circular motion of the rotary head, it is possible to cut both internal and external spherical forms.

Adjustable stops are located on the periphery of the attachment for limiting its rotary travel to any part of a circle - removing stops permits continuous circular motion.

OBTAINING ANGULAR MOTION OF CHERRYING ATTACHMENT

The periphery of the attachment is graduated in degrees and can be locked in any position by the clamp bolt (No. 83).

For angular milling it is necessary to remove both fillister head screws from face of attachment cross slide bracket to remove the cross slide screw (No. 84) from bronze slide.

When milling any angle less than 50° from the horizontal plane, clamp the attachment head (Clamp bolt No. 83) on desired angle and feed the spindle cross slide, thus causing the quill to be raised or lowered the required rate necessary to produce the desired angle.

To mill any angle greater than 50° from the horizontal plane, clamp the attachment head (Clamp bolt No. 83) on desired angle and feed the spindle quill by again engaging the ball crank (No. 73) through clutch nut (No. 57).

The angular action produced by the cherrying attachment is similar to a lathe taper attachment.

The angular movement of the cherrying attachment can be combined with the circular motion of the rotary head to produce internal or external conical forms.

CAUTION: With cherrying attachment in use, be sure to release the spindle slide clamp nuts and quill locking ring (No. 53).

UNIVERSAL MILLING ATTACHMENT

The universal milling attachment is constructed with or without quill adjustment.

The spindle of machine can be set to a maximum of 4" off center with the rotary head; the universal milling attachment extends this range to 8".

To mount the universal milling attachment to spindle quill housing:

1. Raise spindle quill to upper limit.
2. Remove quill feed trip dog bracket (No. 18).
3. Mount attachment driving gear in spindle taper.
4. Apply grease to drive gear teeth.
5. Position attachment over quill housing to upper limit and place key to locate attachment spindle parallel with the rotary head slide.
6. Clamp the attachment securely with the two nuts (No. 85).
7. Lower spindle quill to contact adjusting screw (No. 86), for proper meshing of drive gears.
   NOTE: Adjusting screw No. 86 is properly set at factory and requires no further adjustment.

The spindle of attachment can be swiveled through full 360°.

The attachment and machine spindles have identical taper. Speed ratio between spindles is 1 to 2.

Attachments equipped with quill have 1-1/2" of spindle adjustment.

The spindles are mounted on sealed for life bearings - further adjustment or lubrication not necessary.

ROTARY TABLES

For Model No. 2-D Machines, the rotary table should be either 12" or 16" in diameter. These standard size tables can be furnished with either the hand wheel and graduated dial or the index crank and three index plates as both units are interchangeable. Rotary tables are available with or without provision for power drive.

Rotary tables have a central reservoir for complete lubrication. Running parts are submerged in oil. The oil filler cap is located at the right hand end of the table. Keep oil reservoir filled.

MODEL H DIVIDING HEAD

The Model H Dividing Head is of the worm and worm wheel type having an indexing ratio of 40 to 1. The spindle is mounted on preloaded ball bearings and has a number 40 National Standard taper.

A simple adjustment is provided for taking up the backlash between the worm and worm wheel.

Keep oil reservoirs filled to proper level. Fill oilers regularly.

MODEL K DIVIDING HEAD

The Model K Dividing Head employs hypoid bevel gears to obtain a 5 to 1 indexing ratio. The spindle is mounted on preloaded ball bearings and has a number 50 National Standard taper.

The index plates are reversible. Every tenth hole in each circle of holes is ringed to facilitate rapid and accurate counting. One standard double index plate is furnished. For dividing in finer increments by simple indexing, two additional high number double index plates are available.

Large diameter clamp rings of the floating type, firmly grip all the way around the spindle, spindle block and index plates.

The index crank is provided with two screws for side adjustment to permit dropping the plunger pin into nearest hole without moving the dividing head spindle.

NOTE: Release three lock screws in hub face when making adjustment.

The power drive shaft is equipped with an adjustable collar, graduated in increments of five minutes, for use when angular milling or spacing work which is laid out in degrees.

The entire dividing head is lubricated from two reservoirs, each provided with filler plugs marked "OIL LEVEL" - one plug located at lower left of index plate, the other at rear of spindle block. Oil levels should be checked once each month and only "Stanorust No. 0," as made by the Standard Oil Company, or its equivalent should be used. The use of anti-rust oil is important.

ASTRONOMICAL DIVIDING ATTACHMENT

A simplified direct reading wide range divider that is interchangeable with and replaces the index crank on any hypoid bevel gear head. This unit will divide a circle into 1,296,000 parts or one second of arc. Degrees, minutes and seconds are instantly available.

ROTARY TABLE AND DIVIDING HEAD POWER DRIVE BRACKET

When power drive to the rotary table or dividing head is required, a drive bracket (No. 45) can be mounted over the table feed gear box at the right end of the saddle. This drive unit is provided with a splined drive shaft that slides in an eccentric sleeve. By turning the sleeve half a turn the splined drive shaft will line up with the corresponding spline shaft in either the 12" or 16" diameter rotary tables or the 8" and 10" model H, or 10" and 12" model K dividing heads.

The splined shaft is adjustable vertically to take care of slight variations in height of machine tables. Two screws (No. 47) are used for adjusting the mesh between the idler gear and the driven gear. These adjustments are made at the factory and should require no further attention. Power is transmitted to the bracket when knob (No. 46) is in all the way.

The rate of feed at the periphery of the rotary table will be the same as that shown on the table feed chart.

ROTARY HEAD INDEXING

The 12" rotary table index crank and plates are interchangeable with the hand wheel (No. 38) and graduated dial (No. 16) on the rotary head. A reamed hole (No. 15) anchors the lock ring for the index plates. An interlocking pin fits in place of the hand wheel while the index plates are being used.

CENTER SCOPE AND EDGE BLOCK

The Center Scope is a locating microscope used for accurately positioning the machine spindle in relation to an edge, line or punch mark on the workpiece and measuring dimensions that are inaccessable to mechanical measuring devices.

The Variable Center Scope which is recommended for use on the model 2-D Rotary Head Milling Machine has a straight shank and is held in the spindle by means of a spring collet.

When using the Variable Center Scope, turn the machine spindle so that the eyepiece is parallel to the side of the table. Adjust elevation of the Center Scope to bring the work into proper focus. The focal distance is approximately 5/8" from the objective lens.

Move the machine table until the reference point is directly under the guide line of the microscope. Set micrometer dial on table screw to zero. Turn the spindle 180°. If the reference point remains centered under the guide line it is splitting the spindle axis and no compensation for spindle run-out is necessary.

If run-out is present, the distance in the image between the new position of the guide line and the reference point is the diameter of the total run-out. Turn table screw until reference point again lines up with the guide line. Take micrometer dial reading and return table half the distance traversed from zero position on the micrometer dial. Again set dial to zero position. Turn the knurled trimming screw on the body of the Center Scope until the guide line is over the reference point. Turn the spindle 180°. If guide line is still over the reference point it is in line with the spindle axis in one direction.

Turn the spindle 90° so that the eyepiece is toward the operator then turn the saddle screw until reference point is directly under guide line.

The spindle axis is now in line with the initial starting point of the job.

When it is desired to measure a dimension on the work piece which is inaccessable to standard mechanical measuring tools, mount the Center Scope in the machine spindle or other suitable holder over the work piece. Adjust the work table to bring one edge of the dimension to be measured under the Center Scope guide line. Note the micrometer dial reading on the machine and traverse the table until opposite edge of dimension is in line with the guide line. The measurement can then be taken from the micrometer dial.

The extremely fine line of the Edge Block facilitates centering the edge of a workpiece to the spindle axis within .0001".

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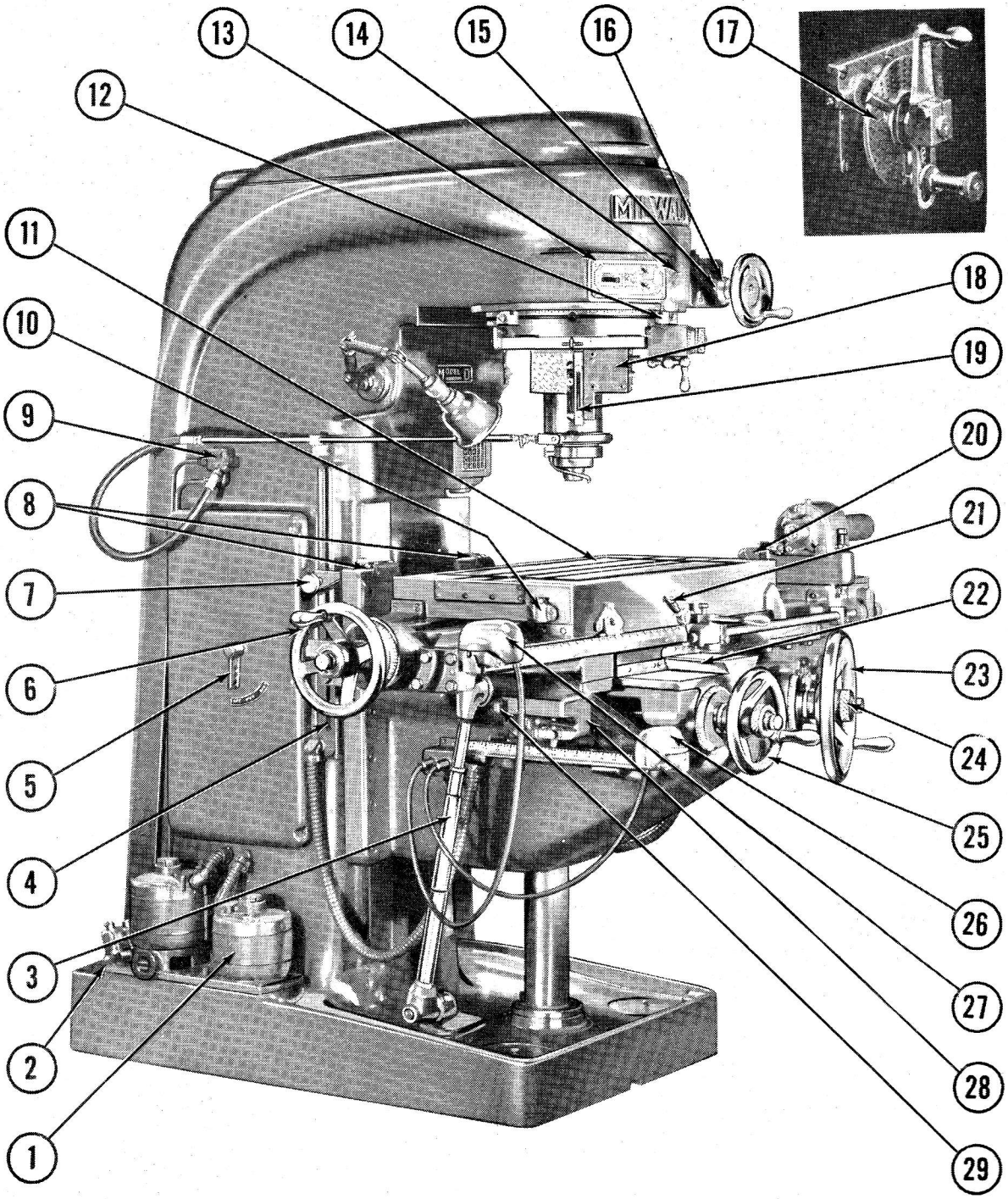
When desiring information regarding machine or attachments, be sure to forward the serial number stamped on respective units.

K E A R N E Y & T R E C K E R
P R O D U C T S
Corporation

Subsidiary of
Kearney & Trecker Corp.

Milwaukee Wisconsin

1. Coolant Pump - A light bodied transparent cutting oil is recommended.
2. Air Pump - Supplies a steady stream of air to cutter.
3. Coolant Return Tube.
4. Knee Clamp Lever.
5. Master Electrical Control Switch.
6. Handwheel for longitudinal table travel.
7. Knee Gage - Indicates approximate height of knee in relation to cutter.
8. Knee to Column Way Oilers.
9. Coolant and Air Check Valve.
10. Oil Reservoir - Lubricates table to saddle ways.
11. Oil Reservoir - Lubricates saddle to knee ways.
12. Rotary Head Power Feed Trip Dogs.
13. Switch Panel - Controls spindle drive, rotary head feed, coolant and air pump motors.
14. Grease Fitting - Lubricates rotary head worm gear and bearings.
15. Reamed Hole - Used for anchoring index plate clamp ring on No. 17.
16. Rotary Head Adjusting Dial - Graduated in minutes.
17. Rotary Head Indexing Unit.
18. Quill Feed Trip Bracket.
19. Quill Stud - Serves as quill key and connection to cherrying attachment.
20. Table Feed Change Gear Box Oil Filler Plug.
21. Table Clamp Lever.
22. Oil Hole - Carries oil to elevating screw, thrust bearing and bevel gears.
23. Knee Elevating Hand Wheel.
24. Micrometer Dial Locking Screw.
25. Hand Wheel for transverse table travel.
26. Micrometer Dial - All micrometer dials have one hundred graduations and read in thousandths.
27. Dial Indicators - To be used with measuring rods.
28. Saddle Clamp Lever.
29. Transverse Screw Oiler.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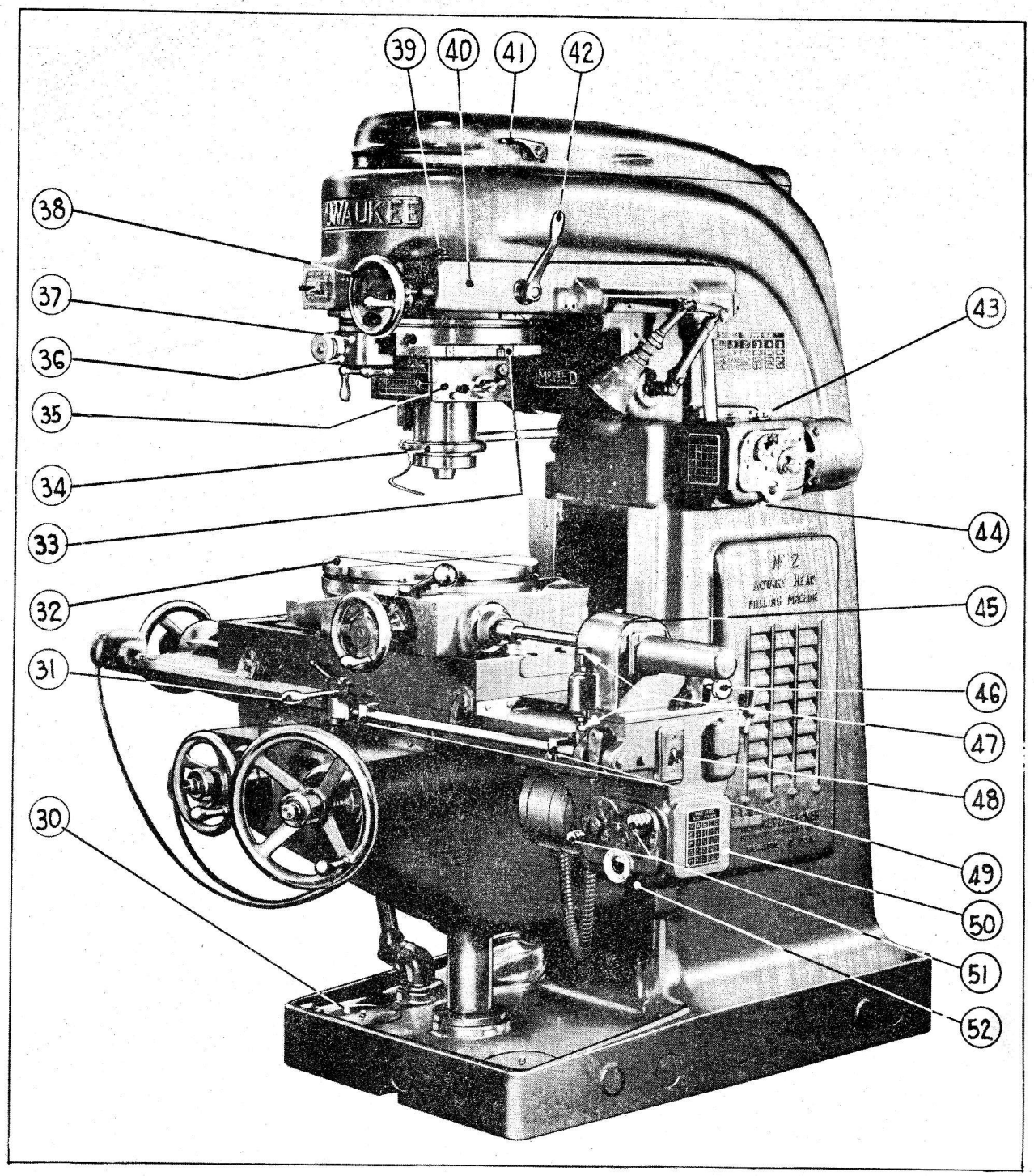
30. Coolant Reservoir Cover Plates.
31. Table Feed Lever - Directional control.
32. Rotary Table - Machine takes 12" or 16" K&T rotary tables.
33. Spindle Slide Scale - All scales graduated in tenths of one inch.
34. Coolant and Air Nozzle Support Ring.
35. Gear Box Cover - Quill feed mechanism.
36. Micrometer Dial - This dial is set at factory. Do not release.
37. Spindle Slide Adjusting Screw Bracket.
38. Rotary Head Hand Wheel - Automatically declutched when power-feed is applied.
39. Oil Reservoir - Supplies lubricant to worm shaft.
40. Rotary Head Worm Drive - Remove cover to adjust back lash.
41. Cover Locking Lever.
42. Rotary Head Power Feed Lever - Directional control.
43. Rotary Head Feed Change Gear Box Oil Filler Plug.
44. Gear Box Drain Plug.
45. Rotary Table Power Drive Bracket.
46. Clutch Knob - Engages and disengages power drive bracket.
47. Gear Center Adjusting Screws.
48. Table Feed Motor Switch.
49. Table Feed Trip Dogs.
50. Table Feed Chart.
51. Table Feed Selector Levers.
52. Gear Box Drain Plug.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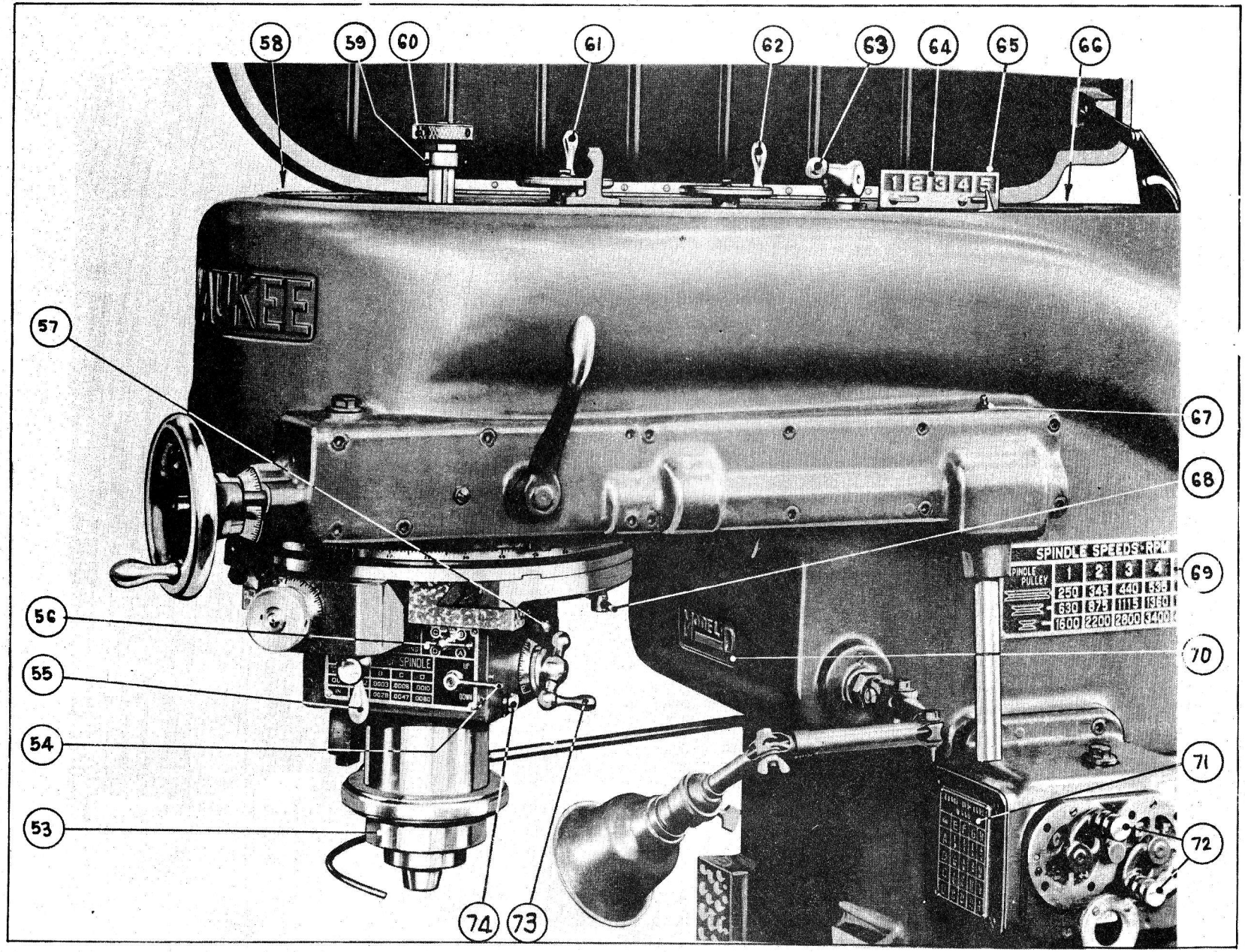
MILWAUKEE
MODEL D
No 2
PLAIN HEAD
MILLING MACHINE

53. Spindle Quill Lock Ring
54. Quill Feed Lever - Directional control.
55. Spindle Slide Ball Crank.
56. Quill Feed Selector.
57. Clutch Nut - Releases clutch between quill pinion and feed mechanism.
58. Spindle Lock and Oil Stand Pipes - Located inside spindle drive housing.
59. Left Hand Nut - Supports draw-in rod while ejecting collets.
60. Collet Draw-in Rod.
61. Vee Belt Tension Adjuster.
62. Variable Sheave Pulley Adjuster.
63. Pulley Adjustment Lock.
64. Spindle Speed Indicator.
65. Adjustable Sheave Pulley Grease Fitting.
66. Motor Slide Bars - Located inside spindle drive housing.
67. Rotary Head Reversing Gear Grease Fitting.
68. Rotary Head Lock Screw - One screw on each side of rotary head.
69. Spindle Speed Chart.
70. Machine Model and Serial Number - Identify machine when requesting information.
71. Rotary Head Feed Chart.
72. Rotary Head Feed Selector Levers.
73. Quill Hand Feed Ball Crank.
74. Quill Feed Range Gear Shifter.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SPINDLE SPEEDS R.P.M.
SPINDLE
1 2 3 4
250 345 440 535
630 871 1115 1360
1600 2200 2800 3400
1 2 3 4 5
SPINDLE

SLOTTING & CORNERING ATTACHMENT

75. Slotting Tool Lock Screw.
76. Ram Stroke Lever.
77. Clamp Screws - 7° Angular Adjustment.
78. Attachment Clamp Bolts.
79. Swivel Clamp.

RIGHT ANGLE MILLING ATTACHMENT

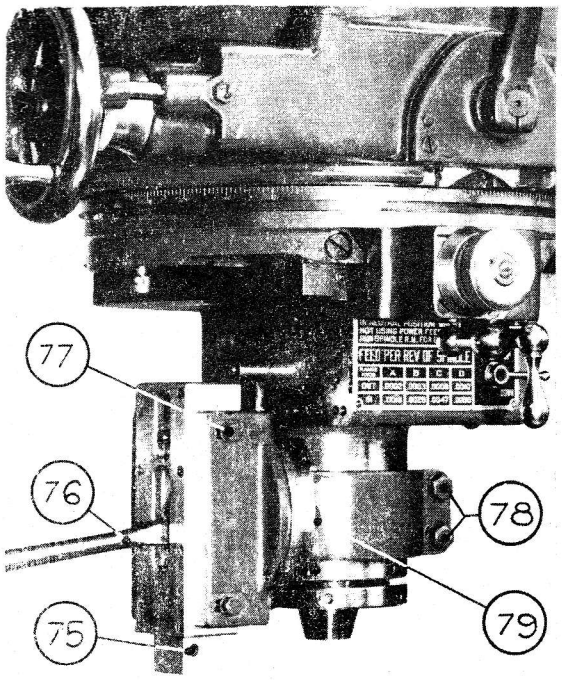
80. Attachment Clamp Bolt.
81. Attachment Spindle - Operates in either direction. One to one ratio.

CHERRYING ATTACHMENT

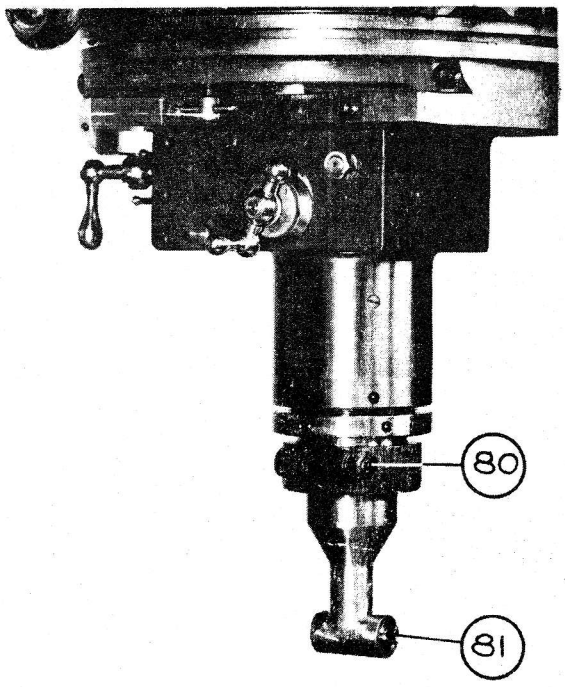
82. Attachment Hand Crank.
83. Head Locking Clamp.
84. Attachment Slide Adjusting Screw - Dial graduated in thousandths.

UNIVERSAL MILLING & EXTENSION ATTACHMENT

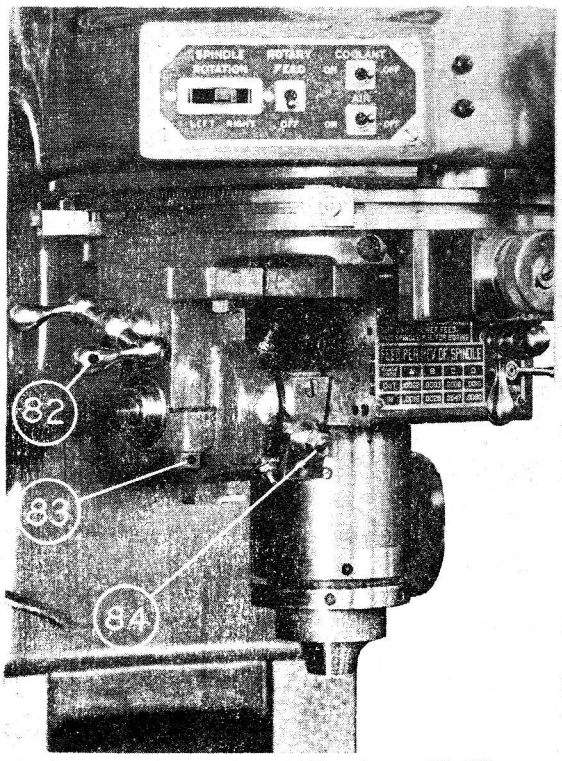
85. Attachment Clamp Bolts.
86. Gear Tooth Mesh Adjusting Screw - Properly adjusted at factory.
87. Adjustable Quill Stop.



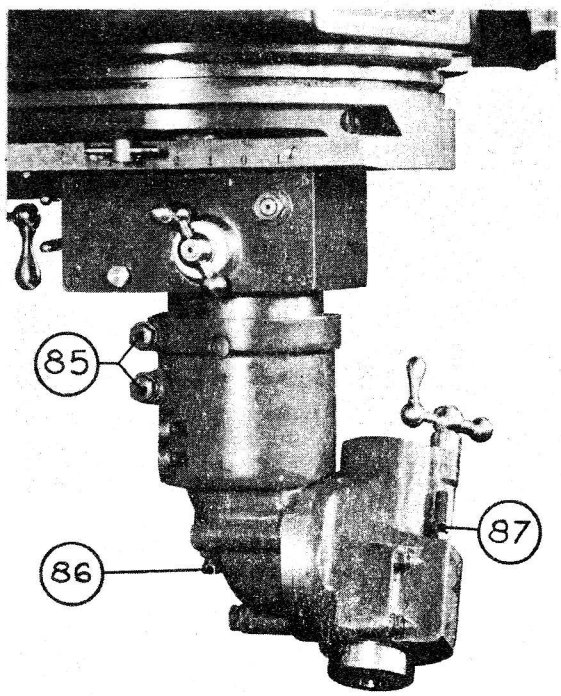
SLOTTING & CORNERING ATTACHMENT



RIGHT ANGLE MILLING ATTACHMENT



CHERRYING ATTACHMENT



UNIVERSAL MILLING ATTACHMENT