KEARNEY & TRECKER
MILWAUKEE®

Operator's Manual

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7½ hp No. 3 and 10 hp No. 4

MODEL H

Plain — Universal — Vertical Milling Machines

KEARNEY & TRECKER CORPORATION

MILWAUKEE, WISCONSIN, U.S.A. 53214

MODELS NO. 3H AND NO. 4H
PLAIN, UNIVERSAL & VERTICAL
MILWAUKEE MILLING MACHINE

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K E A R N E Y & T R E C K E R
Corporation
Milwaukee Wisconsin

OPERATION
LUBRICATION & ADJUSTMENT

UNCRATING — Carefully remove protective crating and skids so that the machine and parts are not marred, scratched or impaired. In the event of damage in transit, cummunicate 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 box marked "PACKING LIST INSIDE 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, balancing on rope before raising. Machine weight - 9000 lbs.

- Horizontal Machines -

Place spliced rope in U fashion under rear of overarms, passing rope through crane hook; continue rope double under front end of overarms and attach loop to crane hook which should be centered both ways above machine. (SEE HOISTING TAG ATTACHED TO MACHINE.)

- Vertical Machines -

Place rope double under neck of column, making certain rope clears the sliding head. Thoroughly protect all rope contact with machine by using soft wood blocks and burlap.
(SEE HOISTING TAG ATTACHED TO MACHINE.)

PLACING ON SOLID FOUNDATION — Milwaukee Milling Machines are extremely rigid and accurate. The 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 unevenness, thus providing a solid base at all points. When erecting machine on an upper

floor, select where possible, a position over a girder, near a wall or some other suitable place where building vibration is at a minimum. A carefully prepared foundation will improve a machine's efficiency.

LEVELING MACHINES — The milling machine's work table is the index to proper leveling. Center the saddle on the knee and the table on the saddle. Prepare the machine for accurate installation by crosswise and lengthwise level readings of the table after the machine has been supported on taper wedges at each of the four corners. After obtaining a level position insert additional wedges around entire base. Use lag screws to secure machine solidly to foundation.

CLEANING — Thoroughly clean slush and grit from machine with gasoline or kerosene. Do not move any of its parts until all exposed surfaces have been cleaned and oiled. Then unclamp and by hand move the table, saddle, knee and (sliding head on vertical machines) to the extreme limit stop in one direction. Clean and lubricate the exposed sliding ways, screws and t ripping mechanism, repeating the process after sliding each unit to the extreme opposite limit stop.

OVERARMS — Remove the outer support brace (No. 45) and over arm supports (No. 38). Unclamp overarms (No. 2) and clean exposed ends; then slide the arms forward and back full length to clean and oil the center to permit free movement and prevent corrosion inside the column bores.

SPEED OF PULLEY SHEAVE AND DIRECTION OF ROTATION — The correct R.P.M. with arrow indicating the direction of rotation is clearly shown on face of large V-belt pulley, located inside the motor safety door (No.54). It is essential that the R.P.M. and direction of rotation be noted and maintained as the drive clutches and lubricating pumps will not operate sucessfully when the motor rotates in the wrong direction.

SETTING MOTOR — Place V-belt sheave on end of armature shaft with fan toward motor, seat motor on base plate through safety door opening (No. 17). Check motor contact to base plate and allign carefully with a straight edge from outer face of both motor sheave and drive pulley. (The distance from the center of the outer groove to the outside faces of both V-belt sheave and pulley are identical.) Having ascertained the position of the motor, mark out its location by transferring the bolt hole centers to the base plate for drilling and tapping of holes to mount motor.

PLACING AND ADJUSTING DRIVE BELTS — The motor plate is of the hinged type, rocking on pins at forward end. For adjustment of V-Belt driving tension the motor plate can be regulated by means of two jack screws, located at rear right and left sides of plate. Open motor safety doors (No. 17 and 54) to regulate plate for belt adjustment and proceed as follows:

1) Release and raise the jack screw at right of motor sheave at inner side of motor safety door (No. 54) to permit plate movement to its extreme upper limit.
2) Release and raise the motor plate by turning downward on jack screw at left rear of plate located at inner side of motor safety door (No. 17).
3) Mount V-belts one at a time, alternating them to grooves of both sheaves until all have been placed.
4) Raise the jack screw at left rear of plate to its upper limit to permit lowering plate.
5) Regulate the jack screw at right of motor sheave for adjustment of V-belts to proper driving tension.
6) To secure motor plate, regulate the jack screw at left rear of plate until screw end contacts base of machine.
7) Secure the motor plate by locking both jack screws with jam nuts provided.

NOTE: To avoid unnecessary pressure on the motor bearing, the V-belt adjustment should be less than required for a flat leather belt.

LUBRICATION — DO NOT OPERATE MACHINE UNTIL IT HAS BEEN PROPERLY OILED.

REFER TO DESCRIPTIVE ILLUSTRATIONS AT REAR OF BOOK.

COLUMN LUBRICATION

The mechanism in the column and drive units attached to it are lubricated under pressure by a geared pump and centralized reservoir located above the motor compartment. This reservoir should be filled with a high grade, perfectly clean machine oil, (S.U.V. 300-325 seconds at 100° F). Fill reservoir through spring cap opening located at rear center of column, until oil corresponds with high line on sight level gauge (No. 11). This oil level should be inspected frequently and maintained to high line on sight gauge. To prevent overflow do not add oil while machine motor is in operation.

COLUMN OIL FLOW GAUGE

An oil flow gauge (No. 6) on horizontal machines and (No. 67) on verticals is provided at upper left side of column, and tells at a glance whether the oil is circulating under pressure when the motor of machine is in operation.

COLUMN OIL FILTER

The circulation of the column lubricating oil is constantly drawn through the disc filter(No. 10) mounted to a cored pocket at left side of column. To purify the oil and to clean the filter cartridge, revolve the handle one or two complete turns in either direction twice each day while motor of machine is operating. There is no danger in turning the filter lever too often, as there is nothing to wear out or replace. When the lever cannot be turned, by hand, then the disc cartridge has become clogged and the filter should be removed and washed in some solvent until it turns freely. A wrench or other tool should never be used in an endeavor to turn the handle of filter which through neglect has become plugged.

KNEE LUBRICATION

Fill lubricant reservoir in knee through hexagon head pipe opening directly above sight gauge #22 until oil level meets arrows on combination sight level and drip gauge (No. 22). Use a good grade machine oil (S.U.V. 300-325 seconds at 100° F).

The lubricant gauge (No. 22) is a combination oil level and flow gauge. It indicates the height of oil level in knee and shows its constant circulation when machine motor is running. A gear driven pump supplies oil in large volume to all the rotating members in the knee, including the ways sliding on column, the vertical elevating screw and the feed and rapid traverse drive mechanism attached to the knee.

NOTE: This lubricant level should be inspected frequently and kept to correspond with arrow line on gauge (No. 22)

SLIDING HEAD LUBRICATION

- Vertical Machines Only -

Use the same high grade machine oil (S.U.V. 300-325 seconds at 100° F). Fill head reservoir through spring cap opening (No. 66) to arrow line on combination sight level and drip gauge (No. 67). The sliding head is self-contained and equipped with a geared pump which forces the oil above the top bearing in head, distributing it over all gears, drive shafts and bearings. The sliding head ways are automatically lubricated through this medium. Inspect frequently to maintain oil level and to prevent overflow, do not add oil while the spindle is rotating. Filling the reservoir above the gauge line will cause an overflow by submerging the oil slinger at bottom of spindle.

CLEANING AND FLUSHING OIL RESERVOIRS

With daily machine operation the column, knee and vertical head should be drained approximately every four months and filled to gauge lines with kerosene in order to flush pumps, piping and rotating mechanism throughout the machine. This is accomplished by operating machine for a period of five minutes.

To drain the column reservoir, remove the pipe cap located at top side of motor housing inside of motor safety door (No. 54).

To drain the sliding vertical head, remove the slotted screw below the spring lid filler cap (No. 66).

To drain the knee reservoir remove the drain plug located at bottom right center of knee.

After flushing units with kerosene, drain the column, knee and head reservoirs thoroughly before applying fresh oil. The necessity of periodically flushing out the old lubricant cannot be overemphasized.

SADDLE LUBRICATION

The oil reservoir located at front center of saddle should be inspected and filled daily. Use the same good grade of machine oil (S.U.V. 300-325 seconds at 100° F.) Positive lubrication by

enclosed wicks provide a continual flow of filtered oil to the table and cross feed screws, nuts and driving members. This same reservoir also provides automatic lubrication to both the bearing surfaces of the saddle contacting the sliding ways of the table and knee.

TABLE THRUST BEARING LUBRICATION — The table drive brackets supporting the screw are provided with oilers; fill daily to lubricate bearings at both ends of the table screw.

LUBRICATION OF OVERARMS — The overarms should be kept clean and provided with a thin film of oil for ease of movement and to prevent corrosion inside the column bores.

ARBOR SUPPORT LUBRICATION — Arbor supports (No. 39) are equipped with oil reservoirs and sight gauges which provide automatic lubrication to the adjustable bronze bushing and arbor bearing.

MOTOR LUBRICATION — Motor bearing cups should always be filled with oil. To lubricate bearings open motor safety door (No. 17).

BALL BEARING MOTOR LUBRICATION — Apply grease every six months.

MOTOR VENTILATION — Fresh air is constantly circulated through the motor compartment by a safety fan mounted on the armature shaft inside of the v-Belt drive sheave. Fresh air is constantly drawn and expelled through louvers cast into the motor safety doors (No. 54 and 17).

COOLANT RESERVOIR — The cutter coolant reservoir is located in base of machine. To fill reservoir, remove the screen cover plates (No. 23) at top of base and pour the coolant onto base until level meets screens., Capacity 7 gallons.

CLEANING CUTTER COOLANT PASSAGES AND RESERVOIRS — Coolant pockets in machine table are provided with fine mesh screens to prevent chips entering and clogging return channels. Cover plates are fitted to top of screens and for protection should be intact when milling cast iron and other materials not requiring coolant. Plate covers and screens can readily be removed to clean the fine grit deposited into the base as the coolant returns to the reservoir. Fine steel chips will pack into a caked mass and clog the return channel to cause an overflow at top of table when periodic cleaning of channel is neglected. To clean coolant reservoir, remove the screens under circular plates(No. 23). Pump the reservoir dry and remove the sediment from reservoir through the circular openings. The passage to coolant pump can be cleaned by removing the cover

plate at rear of base.

NOTE: When again attaching cover plate--use a liquid seal to prevent coolant leak.

CUTTER COOLANT PUMP — The cutter coolant pump (No. 50) is located inside the motor safety door (No. 54). This low pressure pump of the gear type provides coolant to cutters in large volume, the pump is engaged by means of a detent controlled clutch (No. 51) mounted on the lower end of the vertical feed drive shaft. When milling materials not requiring coolant the drive clutch should be disengaged.

CUTTER COOLANT FLOW — The cutter coolant flow can be regulated by means of valves connected to the outlet nozzels (No. 37) which can be swivelled for distributing a low pressure volume of coolant to all diameter and types of cutters. MAXIMUM VOLUME 2 GALLONS PER MINUTE.

The coolant unit can be attached to either over-arm by means of a split circular clamp (No.59).

The disengagement of the starting lever (No. 1) stops the spindle and coolant flow - which again are in operation by engagement of the starting lever.

- Vertical Machines -

The coolant pump, drive and operating features are indentical as outlined above, except for a singular coolant outlet equipped with a compound adjustable split clamp (No. 82) for mounting the coolant pipe to stud end at right side of sliding head. When coolant is not required the unit can be parked on Stud (No. 80) at rear right side of column.

STARTING LEVER — To operate the speeds and feeds, the main driving clutch is engaged by means of starting lever (No.1 on horizontal machines) or (No. 60 on vertical machines). For convenient operation both type starting levers are adjustable.

To reset the starting lever (No. 1 on horizontal machines) raise the lever at hub about 1" and position to suit. To reset the starting lever (No. 60 on vertical Machines) release set screw and withdraw lever from shaft.

- Horizontal Machines -

PUSH BUTTON CONTROL — The push button station for starting or stopping the motor is built into the starting lever (No. 1) within easy reach of the operator.

- Vertical Machines -

On vertical's the push button unit (No. 63) is mounted into the column, conveniently located for controlling the motor.

SPINDLE SPEED SETTING

To obtain a desired spindle speed, jog the starting lever slowly permitting the speed train to coast, then withdraw the spindle speed selection knob, (No. 8) and revolve lever in either direction until the spindle speed selected is in line with the R.P.M. plate. One turn of the speed lever will increase or reduce the spindle speed one increment on both the low and high range.

NOTE: WHEN CHANGING SPEEDS THE MOTOR SHOULD BE RUNNING.

- Horizontal Machines -

The spindle speed selection lever (No. 8) and the speed range change lever (No. 7) are both mounted on the speed drive unit at side of column. The speed range change lever can be placed and secured in either of two positions, when lever is set forward or to the right the low speed range is engaged and the R.P.M. plate cast into hub corresponds with the speed dial numbers in black, placing lever to the left engages the high speed range and the desired speed in red figures determines the spindle R.P.M.

- Vertical Machines -

The spindle speed selection lever is located on the speed drive unit at side of column. The speed plates "fast" and "slow" correspond with the black and red figures of rotating dial. In selecting a desired speed jog the starting lever and withdraw the speed change lever knob to rotate lever in either direction until the speed wanted is in line with the R.P.M. plate.

The range change lever (No. 69) is located at front of sliding head. In changing the speed range release the plunger knob and rotate lever to obtain either the fast or slow range.

SPINDLE REVERSE

The spindle reverse is of the built in mechanical type and easily operated by plunger knob (No. 9) located on the speed drive unit. In reversing the direction of spindle rotation disengage the starting lever and set the speed range lever in the slow position, apply pressure to push or pull the reverse plunger and jog the starting lever.

Reversing the spindle has no effect on the direction of the feed or power control levers to the table, saddle, knee or sliding head.

REMOVING ARBORS

With speed range lever (No. 7 or 69) set in the "SLOW" position, release the locking nut on draw-in

rod several threads and tap outer nut face lightly with wrench to release arbor from spindle taper. Rotate the rod to disengage the threaded end to remove arbor from spindle taper.

NOTE: The standardized non-sticking spindle taper makes it necessary to hold the arbor into the spindle taper until the threaded end of draw-in bolt is engaged.

FEED CHANGES

Sixteen changes of feed are instantly available by rotating the feed change lever (No. 24) in either direction. When selecting feeds the spindle should be operating. The feed change transmission is built into the knee of machine. Gears are heat-treated and hardened, mounted on multiple splined shafts rotating on anti-friction bearings. The entire feed mechanism runs in oil supplied by a geared pressure pump located at end of rapid traverse drive shaft. Like the column lubricating pump, the knee pump is operating when machine motor is running.

FEED MOVEMENT

When engaging the longitudinal, cross or vertical feed levers for movement of either the table, saddle or knee, it is desirable to have the spindle running.

The table is controlled by engagement of feed lever No. 29.

The saddle is controlled by engagement of feed lever (No. 27).

The knee is controlled by engagement of feed lever (No. 25).

All power feed levers are independent of one another. To engage the cross or vertical feeds withdraw handwheel (No. 28) or handcrank (No. 26) and engage either lever to correspond with movement desired as indicated on front of knee.

The vertical head is controlled by engagement of feed lever (No. 79). Move lever "UP" or "DOWN" for corresponding head travel.

POWER RAPID TRAVERSE

Live rapid traverse in all directions is immediately available when motor is operating. The rapid traverse to all sliding members is engaged through a multiple disc clutch by raising lever (No. 46) at right front of knee. To operate the rapid movement of the table, saddle, knee or head, engage either of the feed levers before raising the rapid traverse lever.

REAR CONTROLS

On machines equipped with duplicate or rear controls the same interlocking safety features apply as provided for the front controls of the cross and vertical movements of saddle and knee.

With either feed lever engaged, hand feeds are impossible and likewise when the handcrank is applied the feed levers are

automatically locked.

The hand feed crank (No. 18) is removable and has a parking position on rear control unit when not in use. The rapid traverse lever (No. 16) on rear control unit provides the fast rate of travel to the table, saddle or knee by merely raising it after selecting the unit to be moved.

HAND MOVEMENTS

On all milling machines, regardless of age or make, the following hand movements have always been standard.

Turn the table handwheel (No. 13) to the right and the table moves from left to right;

Turn the cross handwheel (No. 28) to the right and the saddle moves "IN";

Turn the elevating hand crank (no. 26) to the right and the knee moves "UP";

The power feed engagement levers (No. 25) and (No. 27) have indentical directional movements;

Engage lever (No. 29) to left for corresponding table travel;

Engage lever (No. 27) to left and saddle travels "OUT";

Engage lever (No. 25) to left and knee travels "DOWN".

SAFETY TYPE HANDWHEELS AND CRANKS

All handwheels and cranks are provided with means for safety and efficiency. They are interlocked, positive and foolproof. Handwheels and cranks cannot be left engaged to accidantally revolve when power is applied. The operator is fully protected regardless of position in controlling machine.

TABLE FEED LEVER IS RE-ENGAGING TYPE

The table feed lever (No. 29) is directional and so constructed that by raising the handle it is possible to pass a preset trip and continue the table movement as the operator desires. Thus the work piece can be rapid traversed up close to the cutter and the table movement stoped by contact of the adjustable trip dog in disengaging the table feed lever. Then the operator raises the table lever and instantly re-engages the feed into the cut. This exclusive feature facili tates a wider and move efficient use of the power rapid traverse with absolute safety to the operator and machine.

After a cut is finished and it is desired to return the table to the starting position, then, it is only necessary to reverse the feed lever which will automatically pass the preset trip dog and return the table to the original position for unloading and loading a duplicate work piece. Tripping to a starting position is accomplished

by an opposite hand trip dog which is adjustable and can be placed at will to stop the table travel at any point to the desired distance from the revolving cutter to permit changing of workpieces in perfect safety without stopping the spindle.

The tilting of the table feed lever (No. 29) offers a skip-stop arrangement that is entirely under the control of the operator at all times. This re-engaging type table feed lever is the most convenient lever ever placed on a milling machine, and it is well to study the possibilities of this feature in obtaining the maximum productive results from the machine.

ADJUSTABLE AND POSITIVE SAFETY LIMIT STOPS

Both type stops provide a tripping movement to disengage the feed levers for the longitudinal, cross and vertical power feeds. Automatic tripping is fully controlled by adjustable trip dogs furnished as standard equipment. Two right and two left are provided on the table, one right and left for the saddle, and a dog at both the top and bottom of the column T-slot for tripping the knee. These adjustable trip dogs can be rapidly set to trip the table, saddle or knee at any desired point.

Fixed limit trip dogs are mounted to the table, saddle and column to assure positive safety in tripping the longitudinal, cross and vertical movements within the maximum range of travel.

- Vertical Machines -

When equipped with power drive the vertical sliding head range is fully protected with adjustable trip dogs (NO. 81). These dogs can be set at any point within the limit stop pins to automatically trip the head movement in either direction as desired.

CAUTION: Never remove the adjustable trip dogs from the tee slot of head, the maximum movement of sliding head is obtained when the adjustable trip dogs contact the upper and lower safety limit stop pins.

On vertical machines equipped with the four position micrometer stop rod unit, the power feed to head is disengaged when either of the stop rods (No. 72) contact the tripping plunger. The trip plunger is connected with dial indicator (No. 78) and depresses about 1/4" before the feed lever (No. 79) is disengaged.

When stop rods for step milling are in use, the adjustable trip dogs should be set to contact the limit safety pins in obtaining the full range of head travel.

On vertical machines (having hand movement to head only) full protection is privided by a limit stop at top of slide. All heads with power drive omitted are equipped with a single adjustable stop rod and locking nut graduated in thousandths.

CLAMPING TABLE, SADDLE, KNEE AND VERTICAL HEAD

On milling operations using table movement, the saddle and knee members should always be clamped to insure maximum rigidity.

The sliding head (on Vertical Machines) can be clamped by lever (No. 62) for locking the head sufficiently rigid on light and medium type milling operations. When step milling this clamp lever should be used in securing the head and released before engaging the feed lever (No. 79). In addition to the clamp lever (No. 62) three clamping bolts (No. 61) are provided for locking the head securely at four equal points. Two of these clamp bolts are located at upper left and right sides of head, the third bolt is placed at lower right directly opposite the clamp lever. On heavy milling operations the head should be clamped solidly at all four points to obtain best results.

CAUTION: Be certain to release respective clamps before attempting to operate the table, saddle, knee or sliding head. Neglect may result in damage to the sliding ways.

The table, saddle, knee and head clamp levers are serrated to permit adjustment when necessary.

SAFETY CONTROLS

The cross slide handwheel (No. 28) and vertical knee handcrank (NO. 26) are interlocking and to insure added safety to machine and operator both crank and wheel can be set to a neutral position, eliminating the hazard of accidentally engaging the feed levers or disturbing the dial settings. Interference rings are cast integral in the cross and vertical power feed control levers, both "front" and "rear" and cannot be engaged when the handcrank is applied to either of the rear control levers or when the handwheel and crank is placed to inner or center positions at front.

These interference rings obstruct the engagement of the power feed when hand feed is in use, and in like manner, hand feeds are impossible when power feeds are engaged.

Both the handwheel and handcrank have three positions and detent controlled: Pull handwheel or crank (Nos. 26 and 28) all the way out and power feed engagement can be made; pull either half way out to obtain the neutral position in disengaging both hand and power feeds, permitting the saddle and knee to be clamped solidly in fixed positions. By moving either the handwheel or crank inwardly, hand adjustments for the saddle and knee are possible.

The table handwheel (No. 13) automatically disengages when the table is operated by power. In like manner the handwheel (No. 70) for hand movement of the sliding head disengages when power movement is applied. These interlocking features are absolutely safe, positive and foolproof.

FEED SAFETY SLIP CLUTCHES

Built into the feed drive mechanism located in the knee, the safety feed clutches protect the feed gear train and are adjusted to carry 100% overload. When excessive loads are imposed the clutches automatically disengage and a series of successive clicks will be heard, warning the operator that movement of either the table, saddle or knee has met with an obstruction, or that the power feed is beyond the capacity of the machine. After corrections are affected or the feed reduced, the safety clutches re-engage automatically to

absorb the power transmitted through the feed train for normal operation.

RAPID TRAVERSE SAFETY CLUTCH

This safety clutch is mounted into the rapid traverse gear train, located in the drive unit bolted to the column. This slip clutch is intended to prevent damage to the rapid traverse drive gear train. Fast movement of the table saddle, knee and sliding head is possible by engaging the rapid traverse lever (No. 46) located at front right of knee. A duplicate control lever (No. 16) is mounted at the left rear of knee. The rapid rate of power reduces manual effort to a minimum and offers increased speed with safety when used with alertness and good judgment.

Safety clutches are provided to protect the drive mechanism of the machine. They are designed to function automatically when cutting pressures are excessive, or when a machine runs into obstructions. They must perform immediately to be effective and at the same time be correctly adjusted to carry the load in operating the machine under normal working conditions.

It must be realized that where the shock to a safety clutch is hammerlike and abrupt, that damage to the driving screw and nut of the movable member is possible since these driving parts receive the shock directly.

On the other hand, when the shock is gradual and of a somewhat resilient nature as a soft object or loosely piled chips, then the safety clutch will generally function without the slightest damage to any part of the machine.

The adjustable trip dogs are another insurance against damage in preventing the workpiece from striking the cutter or arbor at a speed far above the normal cutting rate. Accidents can and will happen when operating the rapid rate of movement by repeatedly milling work without setting the trip dogs.

NOTE: To avoid accidents and damage, be certain that hammers, wrenches or other solid objects are never placed on top of knee.

ADJUSTMENT OF THE MAIN DRIVE CLUTCH

The main drive clutch for driving the spindle and power feeds is built into the center of the large drive pulley (No. 53) and controlled by the "IN" and OUT movement of the starting lever (No. 1 or 60). This clutch is of the single plate disc type and has for years been proven superior by the automotive industry. By opening the motor safety door (No. 54) the clutch becomes accessible and adjustment is made without the use of any tools. To adjust the clutch to proper driving tension:

1. Set the spindle to revolve at the highest speed;
2. Pull out the spring plunger look pin (No. 53) located between two of the clutch fingers, and turn the clutch finger ring to the right, one notch at a time;
3. Engage the starting lever and determine the normal pickup of spindle to high speed.

4. Should spindle speed pickup appear sluggish, repeat adjustment;
5. After proper adjustment has been effected and spindle increases normally to high speed, the feed drive will function correctly;
6. Do not adjust clutch too tight - abnormal pressure to starting lever places a tremendous strain on the clutch drive fingers which may break when forced over cone.

ADJUSTMENT TO POWER RAPID TRAVERSE DRIVE CLUTCH — The rapid traverse clutch is of the multiple disc type, located at right side of knee. This clutch is controlled by levers, (No. 16) and (No. 46) located at right front and left rear sides of knee. The rapid traverse clutch is accessible for adjustment after removal of cover plate (No. 47). To adjust, disengage lock plunger pin located between two of the clutch fingers and turn the clutch finger ring to right for proper driving tension.

NOTE: To check adjustment, engage the vertical feed lever (No. 25) to raise knee by power, then engage the rapid traverse lever (No. 46) and when the knee moves up instantly at this fast rate of travel, the clutch is properly adjusted. Upon release of rapid traverse lever the knee should not float or bind when reduced to the normal rate of feed movement. If it does, proper adjustment to the knee gib is necessary.

CAUTION: Always engage the rapid traverse clutch gently as a safety precaution against intereference when using this fast rate of travel. Undue wear to clutch mechanism is the result of jerking or applying a great amount of pressure by engagement of the rapid traverse lever.

BREATHER PLATES — The column and knee are provided with Breather plates to prevent condensation inside these members. Both are constructed to prevent oil seepage and entry of dirt and chips.

ADJUSTMENT OF SPINDLE BEARINGS — Spindles are properly adjusted at the factory and should run for a long period of time without any further attention. However, when it becomes necessary to adjust the spindle the following instructions will be of value.

- Horizontal Machines -

1. Set the range change lever (No. 7) on speed box in the neutral or vertical position;
2. Remove breather plate (No. 56) from right side of column to expose the spindle adjusting nut;
3. The spindle adjusting nut is located at rear of center bearing, free nut by releasing both set screws. (Allen type)
4. Tap nut lightly at sides of set screws to free bronze shees contacting spindle thread;
5. Use spanner wrench for nut takeup and prevent spindle from turning with flat bar across tongues at front face;
6. Turn adjusting nut to right to seat bearings into cups;
7. Tap spindle lightly with lead hammer at both ends to remove all looseness between collar and bearings;
8. When adjustment is completed lock collar nut securely.

Great care should be exercised not to adjust the spindle too tight. Proper adjustment is determined by grasping the spindle at both ends which should revolve by hand. Perfect adjustment is possible

with the use of an indicator, allowing .0003" end play.

A spindle properly adjusted will produce fine finishes with large diameter cutters on heavy milling operations and still be free enough to run continuously at the higher speeds without excessive heating and undue wear.

- Vertical Machines -

1. For adjusting the spindle, set the spindle speed selection lever to correspond with the high speed on dial.
2. Set the range change lever (No. 69) on front of vertical head to "FAST";
3. Remove range change lever from shaft;
4. Remove cover (No. 68) from head and break seal by placing two screws into tapped holes of cover face;
5. Loosen both set screws (ALLEN TYPE) at outer diameter of adjusting nut which is located directly above the center bearing;
6. Follow instructions as outlined on horizontal machines.

ADJUSTMENT OF FOUR POSITION MICROMETER STOP

VERTICAL MACHINES - For step milling and blind boring on machines with power feeds to head having the four position micrometer stop, adjustment is possible by regulating the stop screws (No. 72) with upper and lower lock nuts (No. 75 and 77). Stop screws pass through a revolving cylinder (No. 73) so that one pull of the ratchet handle (No. 76) revolves the cylinder one quarter turn bringing the next stop screw into operating position. Stop screws (No. 72) can be adjusted either by measurement, trial or gauge, to required heights.

Fast travel of head is possible by raising the rapid traverse lever (No. 46) when the feed lever (No. 79) is engaged. Trip screws must contact to depress the indicator plunger about 1/4" to disengage the feed lever in tripping the head.

MICROMETER SETTING

Stop screws can be set to trip the down travel of head to within 1/32" on rapid traverse, then a slight movement of the hand wheel (No. 70) will effect desired head settings to zero reading of dial indicator (No. 78). After the first step has been milled the feed and rapid traverse levers are again engaged to raise the head for stop rod clearance and turning of cylinder in placing the following stop screw in position to trip the head for the second cut, etc.

Upward movement of head is tripped by the lower adjustable dog (No. 81).

Downward movement of head can be tripped as desired by either the stop screw or upper trip dog.

The trip dogs (No. 81) mounted into tongue slot at right side of head can be set to any position within the limit pin range, when dogs contact upper and lower bumper pins the maximum movement of head is obtained.

CAUTION: TO AVOID DAMAGE, NEVER REMOVE THE ADJUSTABLE TRIP DOGS FROM TONGUE SLOT OF HEAD.

ADJUSTMENT OF TABLE SCREW THRUST BEARINGS

The table feed screw is mounted into brackets mounted at both ends of table. The bearing in the left bracket is of the radial load type, while two opposed taper bearings in right end bracket are provided with adjustment for removing end thrust of screw. Both taper cups are mounted solidly in right bracket, the inner roller bearing is pressed on the screw, while the outer cone is clutched for affecting adjustment.

Take up is accomplished as follows:

1. Remove screwed cover from right end table bracket
2. Free lock spring lug from slot of adjusting nut
3. Engage table feed lever (No. 29)
4. Turn adjusting nut to right to seat bearings
5. Bend spring lug to corresponding nut groove to secure adjustment
6. Determine proper adjustment by hand wheel movement of table screw permitting .005 lash on graduated dial. Thrust bearings and the table gib should be inspected frequently and adjusted whenever necessary.

ADJUSTMENT OF CROSS FEED SCREW BEARINGS

To take up bearings on the cross feed screw, remove the handwheel (No. 28) feed engagement lever (No. 27) and graduated dial to expose the adjusting nut.

1. Withdraw the serrated collar at outer diameter of nut about halfway to free the fixed portion of the nut;
2. Turn adjusting collar to right in making adjustment;
3. Allign serrations on both the loose and fixed portions of nut and slip locking collar into original position;
4. Assemble dial, lever and hand wheel and test adjustment by hand movement of screw within .005" lash on dial.

VERTICAL KNEE SCREW

No provision is made or necessary for the elevating screw adjustment. This assembly is properly fitted at the factory and requires no further attention.

SLIDING HEAD SCREW

VERTICAL MACHINES - The elevating screw for vertical head travel is permanently adjusted and requires no further attention.

ADJUSTMENT OF TABLE GIB

The table is provided with a full length taper gib located at front dovetail of saddle. To take up on gib, loosen screw at small end 1/8 turn and bring up screw at large end the same amount, backing up the screw at large end the least bit to make certain a bow has not been placed in gib. Repeat until a very slight "drag" is felt along entire range of table travel by hand movement.

NOTE: To maintain an even wear along the full travel of table ways, the

drive screw and nut, place fixtures, vises and workpieces alternately as jobs permit, to the right, left and top center of table. When machine is idle for an hour, a day or over week ends, get into the habit of centering the saddle to top of knee and table to saddle thus preventing deflection due to weight and overhang.

ADJUSTMENT OF SADDLE GIBS — Two tapered gibs are used for adjusting the saddle to knee. The center gib at right side of knee channel forms the guide for the transverse alignment of saddle. To adjust this gib, release the screw at rear or small end and tighten screw at front end until proper adjustment is made, backing up on the front screw a trifle to make certain a bow has not been placed in the gib. The second gib is placed at left underside of saddle; the adjustment to this gib is done in a similar manner, in drawing the saddle to top of knee. Both gibs should be adjusted a bit at a time until a very slight "drag" is felt when moving the saddle full distance by hand.

ADJUSTMENT OF KNEE GIB — This tapered gib is located at left rear of knee and is adjusted by means of a screw at both ends. To determine proper adjustment, engage the elevating crank for hand movement. Raise and lower knee, making adjustment to gib screws until knee moves freely up and down without jumping. Smoothness of knee movement can be felt by placing the hand to column dovetail and top of gib.

ADJUSTMENT OF SLIDING HEAD GIB — VERTICAL MACHINE - Gib is located at left side and provides the means for adjustment to vertical head. This gib is tapered and has two screws, one at each end. In making adjustment, release the screw at bottom or small end and tighten the screw at top or large end, backing up screw the least bit to prevent bowing gib. To determine proper adjustment, raise and lower the head by hand movement to feel smoothness of travel with hand placed on top of gib and head way.

GIB ADJUSTMENTS — Gib adjustments to table, saddle, knee and sliding head are of vital importance in maintaining machine accuracy. Loose gibs cause chatter, vibration and poor finishes as well as undue wear to machine ways.

NOTE: All gibs should be examined frequently and properly adjusted when necessary.

DOUBLE OVERARMS — HORIZONTAL MACHINES - The overarms consist of two parallel round steel bars which are laced together by rigid triangular arbor supports (No. 38) which insure positive alignment to outer end of arbors. The overarms are secured by means of two circular self-equalizing clamp blocks (No. 2).

OVERARM PILOT WHEEL ADJUSTMENT — The overarms can be quickly regulated to suit all lengths of arbors, by means of the pilot wheel

(No.4). The pilot wheel can be withdrawn in moving the left arm, or engaged by means of a clutch to move both arms at one time.

ARBOR SUPPORTS — When applying or removing arbor supports (No. 38) always extend one overarm from three to six inches ahead of the other. This procedure provides the convenience of one single arm for handling of supports with a minimum of effort. The double overarm construction eliminates the necessity of removing the arbor support in making a cutter or arbor change. Merely extend one arm forward to act as a swivel point, withdraw support to free one arm and swing it upward to rest on the second bar.

If the work to be milled permits only one support in guiding the arbor at the outer end and then should support be a considerable distance from the column, additional rigidity can be obtained by mounting the other arbor support top side down and half way between the column and outer support. When two supports are used at one time, place them in the desired position before clamping them to the overarms.

NOTE: Always tighten or loosen the arbor nut with the arbor support in place. This practice will prevent springing the arbor. Both arbor supports are equipped with adjustable bushings to provide a running fit for arbor bearings. This adjustment should be made whenever necessary to eliminate chatter and vibration. Neglect will result in reduced feeds and poor finishes.

OVERARM BRACE — On heavy milling it is good practice to apply the overarm brace (No. 45) to tie the front of knee and overarms together. The outer brace is adjustable along the knee top and can be set toward the column as closely as the work permits. To attach the outer brace, the overarms should be flush with outer face of support. Apply brace to contact top of knee and lock brace firmly into position to both members.

NOTE: The vertical movement of knee is possible with outer brace in position. Unclamp brace from support by loosening the two locking nuts (No. 41).

CUTTERS, ARBORS, COLLET, ETC. — This machine is equipped with a No. 50 National Standard taper spindle (3-1/2" per foot). All standard No. 50 taper shank arbors, collet holders, centering plugs, etc., are held into the spindle taper with the draw-in rod.

DRAW-IN ROD — To attach an arbor tc the machine, see that both arbor and spindle tapers are perfectly clean and free from nicks and burrs. Due to the steep angle non-sticking taper, it is necessary to hold the arbor into the spindle until the threads of the draw-in rod have started in the arbor. When placing collars and cutters on arbors be certain they are clean and fit the arbor properly to prevent springing when tightening the arbor nut.

NOTE: The spindle nose and contact face of large diameter cutters should be thoroughly inspected and cleaned before application to prevent runout.

This same procedure and carefulness should be followed when applying collets and plug adapters to a machine spindle. A true rotating tool insures maximum production and fine milled finishes.

ACCESSORIES — The builders of this machine also manufacture many useful attachments which are available for this equipment.

Light, Standard or Heavy duty - Vertical and Universal milling attachments.

Rotary Table - hand or power drive, handwheel or indexing type.

Slotting attachment.

Thread Milling attachment

Rack Milling attachment. Rack Vise.

Vise - Plain or Circular Base

Arbors, Collets, Plugs, and

Full Back Face Mill Cutters

WHEN REQUESTING PARTS OR INFORMATION ON THIS EQUIPMENT, KINDLY INCLUDE THE SERIAL NUMBER STAMPED ON BOTH SIDES OF COLUMN.

K E A R N E Y & T R E C K E R
Corporation

Milwaukee Wisconsin

HYPOID BEVEL GEAR

SPIRAL UNIVERSAL DIVIDING HEAD

(5:1 Ratio)

UNIFORM ACCURACY UNDER ALL LOADS — The Hypoid Bevel Gear Dividing Head is a practical rugged precision instrument for use in the most exacting toolroom, inspection department, experimental laboratory, and is capable of superior heavy duty performance on production requirements.

THE MEANING OF OIL FILM FLOAT — In every plain bearing dividing head spindle, there must be an oil film or the spindle could not be revolved. Even though the oil film is thin, it is one of the greatest destroyers of dividing accuracy. Without any load, the plain bearing spindle will show an "apparent accuracy" that measures up to general requirements. Place that same plain bearing spindle under the load of average cutting pressures, and the oil film is squeezed to one side with the result that "performance accuracy" (that is, accuracy of the work produced) does not measure up to the "apparent accuracy" of the plain bearing head when idle.

OIL FILM FLOAT HAS BEEN OVERCOME — Realizing the inaccuracy caused by a film of oil, this practical dividing head was developed PERMITTING LUBRICATION TO THE SPINDLE BEARINGS WITHOUT ANY FLOAT. Instead of ordinary plain bearings, this rugged head spindle is mounted on oversize super precision anti-friction bearings that are preloaded at the factory to several hundred pounds pressure which provides a metal to metal bearing contact with no interposing oil film and consequently the spindle cannot float under load. For the first time "performance accuracy" equals no load "apparent accuracy."

A PRACTICAL SPINDLE MOUNTING — It is as essential to have anti-friction bearings on dividing head spindles, as it is to provide anti-friction bearings to spindles of modern milling machines. A preloaded spindle runs the same true course under pressure of cutter thrust as it does when running free.

ADJUSTMENT — The preloaded spindle bearings are properly assembled when built and require no further adjustment at any time during the life of the attachment.

STANDARDIZED SPINDLE END — The hardened and ground head spindle has a No. 50 Standardized taper, (non-sticking 3-1/2" per foot). All arbors, having the No. 50 taper shank are interchangeable between the head and machine spindles.

EXPANDING DRIVE KEY — An adjustable drive key mounted onto nose of dividing head spindle will eliminate any free motion

between the driving flange of arbors, chucks and center drive plates. This expanding key is regulated by means of a slotted square head screw controlling a hardened button.

DIVIDING HEAD CHUCKS — The three jaw universal chuck centers on the outer diameter of head spindle and is secured to face with three screws which pass through the chuck body. The jaws are designed for internal or external gripping. The chuck has a 2-1/2" diameter hole through the center and is guaranteed by the manufacturer to register true to .003 of one inch.

INDEX PLATES — To assure extreme indexing accuracy, the index plates are constructed in two sections. The double plate is reversible, having seven circles of holes on each side - each hole is drilled and diamond bored clear through - to permit full contact of plunger pin.

SECTOR FINGERS — The sector fingers contact the index plate under spring pressure. The fingers are readily adjustable and clamped securely by means of the open end wrench furnished. For easy counting and to avoid errors in spacing fingers, the index plates have every tenth hole in each row of holes circled.

STANDARD AND HIGH NUMBER INDEX PLATES — The three double index plates available with this dividing head will divide all numbers from 2 to 100 and many beyond by direct or simple indexing, thus eliminating any chance for error or inaccuracies caused by the former method of differential indexing. For complete information refer to lead and indexing book furnished with this equipment.

INDEX CRANK — A tapered extension with drive key is provided on the index pinion for positive and secure mounting of the index crank. The crank and sector fingers are readily removable for the changing of index plates.

SIDE ADJUSTMENT OF INDEX CRANK — The index crank is provided with "side" adjustment for engagement of plunger pin into nearest plate hole - without disturbing the work setup. To effect adjustment, loosen the three nuts circling the hub face of crank, then regulate the crank as desired by means of both thumb screws at side of hub.

QUICK INDEXING 5 to 1 RATIO — Instead of the old indexing ratio of 40 to 1 between the index crank and spindle, a SIMPLER, EASIER and FASTER RATIO OF 5 to 1 is used. This is accomplished by replacing the conventional old style worm and worm wheel with a large diameter hardened and ground hypoid curved tooth bevel gear and pinion. This 5 to 1 ratio means less turning; as all divisions greater than five require less than one turn of the crank, which means eight times

less chance for error and the workpiece can now be revolved and indicated rapidly and direct by turning the indexing crank.

LEAD RATIO IS STANDARD 40 to 1

The ratio between the index crank and the spindle is 5 to 1. There is an 8 to 1 ratio between the driving shaft and index crank, thus retaining the familiar 40 to 1 ratio between the driving shaft and dividing head spindle for spiral milling. The driving shaft on the head is equipped with an adjustable collar, graduated in minutes, for use when spacing work or milling cams laid out in degrees, etc. A splined crank that fits on the end of the power drive shaft is furnished for spacing the dividing head spindle by hand movement.

LUBRICATION

The entire dividing head is lubricated from two reservoirs, each provided with oil level plugs, one located at lower left of index plate the other at rear of spindle block. Both oil levels should be checked once each month and only "STANORUST NO. O", as made by the Standard Oil company, or its equivalent should be applied through the filler plug opening at top center of head and the worm wheel housing. Both reservoir levels provide lubrication to all rotating members including the tooth diameter of the hypoid bevel gear and spiral drive worm which extend beneath the oil level.

OIL SEALS

The entire head is tightly sealed against lubricant seepage or entry of cutter coolant.

NOTE: Be certain that the filler and oil level plugs are secured at all times.

POSITIVE CLAMPING

Large diameter clamp rings of the floating type, grip firmly all the way around the spindle, spindle block and double index plates, without creating any possible distortion. To adjust the spindle clamp lever (No. 35) it is merely necessary to loosen the hub clamp screw in reseting the lever as desired.

CUTTING LEADS BELOW 8" USING THE LOW LEAD ATTACHMENT

With this type attachment all leads under 8" are driven by the auxiliary drive shaft mounted parallel to the screw. For leads under 8" the table feed lever (No. 29(should be locked by means of the knurled screw mounted in lever block.

On all leads under 8" the power movement to table is engaged through the directional feed lever (No. 31) mounted on the low lead unit. Lever (No. 31) is engaged to either right or left for corresponding table movement.

The upper lever (No. 32) controls the reverse clutch for changing the hand of the spiral. When plunger of lever is placed into the center or neutral hole the drive to the dividing head is disengaged.

All low lead setups should be checked by hand before applying power, this is accomplished by attaching the hand crank on squared end inside of the low lead box.

When spiral milling - the plunger of the index crank should be set to engage the outermost row of holes on the index plate. Where indexing of the work is not necessary, the index plunger pin should engage any hole in the outer row of index plate. Be certain to release the index plate and spindle clamps, before engaging lever (No. 31) on leads under eight inches and lever (No. 29) over eight inches.

For automatic tripping of power table feed on leads under 8" attach the trip dog rod (No. 30) to the front of machine table and connect it to slot at shaft end of table lever (No. 31). Set the adjustable trip blocks along the rod to any desired position - thus permitting the trip blocks to contact both right and left sides of locked directional table feed lever (No. 29). In this way the tripping of the table is accomplished on low leads to desired limit movements when milling spirals.

NOTE: On machining operations where it is necessary to rotate the Dividing Head spindle by power (using the low lead attachment) and not transmit any movement to the machine table, as required when cutting dwells, circles, etc., lock the table feed lever (No. 29) into neutral and remove the worm or wormwheel from the table screw end, then engage the levers (No. 31 and 32).

POWER DRIVE CONNECTION

The dividing head when set parallel to the machine table, is connected between the splined end of worm shaft and splined sleeve attached to the low lead unit.

RIGHT ANGLE DRIVE ATTACHMENT

The right angle drive attachment is required to transmit the power drive from the low lead attachment to the dividing head, when head is set at right angle to machine table. With head spindle facing machine spindle, the head is secured to table at three points - place two tee-bolts at forward slot of table; place the bottom nut into center slot of table; attach the right angle drive unit circling the end of worm drive housing, and connect opposite end of attachment to the low lead drive unit. Place clamp block over hole at extended arm of right angle attachment and contact clamp into groove at right side of head. Place gear over splined end of worm shaft, insert graduated collar into bored opening of right angle attachment and clamp assembly with sleeve nut.

A separate clamp block is furnished to secure the right side of dividing head to table, when the right angle power drive unit is not required.

CUTTING LEADS ABOVE 8" USING THE LOW LEAD ATTACHMENT

For all leads above 8" the drive is direct from the table screw, and the table feed lever (No. 29) located at center of machine saddle is engaged to transmit the power to the dividing head. The auxiliary drive shaft is disconnected by locking the table feed lever (No. 31) by means of the knurled screw in lever.

The reverse lever (No. 32) located on the low lead attachment controls the direction of the head rotation.

Before applying power, all lead setups above 8" should be checked by hand movement. This is accomplished by engaging the handwheel (No. 13) at left end of table.

CAUTION: When operating the low lead attachment, follow instructions regarding power lead lever engagement as outlined at bottom of each page in lead book.

CONVENTIONAL LEAD ATTACHMENT

The conventional lead attachment (No. 55) is furnished as standard equipment. With the use of this type attachment all leads are driven direct from the table screw. Leads from 3" to 149" are power driven, the rapid traverse lever (No. 46) can only be engaged on leads from 10" or over.

POWER RAPID TRAVERSE TO DIVIDING HEAD

When the machine is set up for and has cut a lead, and it is desired to return to the starting point, without disturbing the setup, power rapid traverse can be used as follows: -

1) On machines equipped with the low lead attachment (No. 33) the power rapid traverse can be applied on all leads - when the lead is set up as outlined in the lead book furnished for this type attachment.

2) On machines furnished with the conventional lead attachment (No. 55) the power rapid traverse can only be used on leads from 10.000" and up, as outlined in the lead book furnished.

NOTE: Engage the power rapid traverse lever (No. 46) GENTLY when driving through a lead attachment. This procedure will prevent any damage should a desired lead be set up in error.

ROTATE ALL LEAD SETUPS BY HAND BEFORE APPLYING POWER.

LEAD BOOKS

The lead books furnished with universal machines outline the application of either the conventional or low lead attachments and correspond with the unit supplied with the machine.

LOW LEAD ATTACHMENT

With the use of this attachment, 42.363 leads are possible within the range as listed in the lead book furnished. Any desired lead, within the range not listed in the lead book is available and can be furnished in a very few minutes, by exchanging telegrams with the home office at Milwaukee.

Master lead books incorporating all 42,363 leads can be purchased at slight extra cost.

CONVENTIONAL LEAD ATTACHMENT

With the use of this standard attachment more than 1,300 leads are possible. Every lead setup is outlined in the lead book supplied with this type of equipment.

Both lead books include tables for indexing with the use of both the standard and high number plates.

Each possible division is listed, showing the proper plate and hole circle including the turns of crank and holes necessary in obtaining the desired division.

TAIL CENTER

The tail center has top and side clearance which permits operations on small diameter work. Cutters can be set as close as 1/4" to the point of the center and pass along the entire top and side of the unit with ample clearance.

The tail center can be elevated (FOR TAPER WORK) and is provided with a built in rack and pinion for convenience in setting desired elevation. Two large binder bolts firmly clamp the center block. Dropping the center block back to its lowest and solid position brings it back to accurate horizontal alignment.

A locking bolt (No. 36) is provided for securely clamping the tail center. Properly clamped - this tail center will not shift out of line under cutting pressures.

CENTER REST

An adjustable V-Block with fine screw adjustment is provided to support long slender work.

ASTRONOMICAL DIVIDER

Here is a simple, wide range divider with which highly accurate indexing operations may be performed. This unit is convenient to operate, and is easily attached to either the 10" - 12" or 14" Hypoid Bevel Gear Spiral Universal Dividing Head.

- APPLICATION -

This divider is interchangeable with and replaces the standard index plates and crank. The separate 72 hole index plate is mounted to the wormwheel hub identically in the same manner as the standard double plates. The circular index plate clamping band is also interchangeable. The attachment is keyed and centered on the tapered end of the indexing pinion shaft, drawn into position and secured by a singular nut at center of face.

- LUBRICATION -

The dividing attachment is packed with a light grease at the factory which does not require replacement. With daily use - approximately every year a quantity of light, fine grade grease can be added through the screw opening located at outer diameter of attachment.

- ADJUSTMENT OF SECTOR FINGERS -

The small double end wrench regularly furnished with the dividing head in adjusting the standard sector fingers is also used for all three sector finger circles of the dividing attachment.

- OPERATION -

This astronomical attachment embodies a mechanism that is capable of dividing directly in degrees, minutes and seconds, when applied to either size hypoid dividing head.

Three independently controlled indexing plunger levers are used: The smallest plunger indicates "seconds"; the center or slightly larger plunger registers "minutes"; the outer or largest plunger divides the spindle in "degrees".

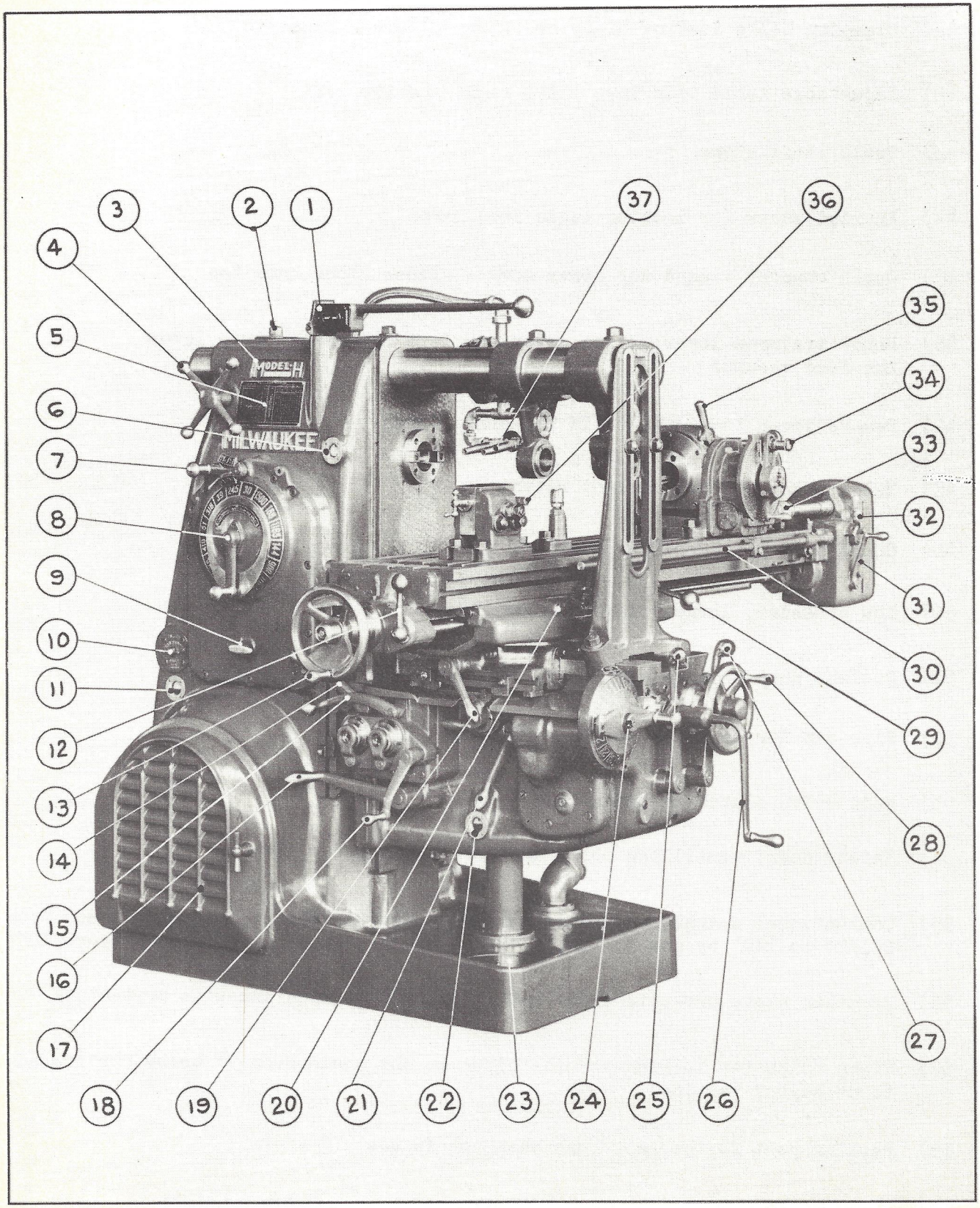
When indexing requirements make it necessary to operate more than one plunger in completing a desired division, always begin with the plunger operating the finest increment of movement as seconds, then minutes and finally degrees.

Prior to indexing, be certain the spindle clamp lever (No. 35) is released and the index plate clamp ring is locked.

When operating either plunger, be certain the remaining ones are secured in their respective index plate circles.

When spiral or angular milling place the degree plunger pin into any plate hole and release both spindle and index plate clamps before applying power.

1) Adjustable starting lever with built in push button station
2) Equalized clamps firmly grip both overarms without springing column
3) Model and serial number used to identify machine
4) Pilot wheel for sliding one or both overarms in and out
5) Speed chart to determine quickly correct speeds for all cutters and materials
6) Column oil flow sight gauge; determines at a glance that oil is circulating
7) Speed range change lever
8) Speed selection lever; dial revolves in either direction
9) Built in mechanical spindle reverse does not reverse feeds
10) Disc filter for oil purification
11) Oil level gauge for column reservoir
12) Table feed lever; operative from rear control position
13) Table handwheel and safety interlock knob prevents rotation when power is engaged
14) Rear cross feed lever - directional control
15) Rear vertical feed lever - directional control
16) Rear rapid traverse lever; lift to engage, release and feed resumes
17) Cross mounted motor; easily ventilated and accessible
18) Parking position for rear cross and vertical hand crank
19) Adjustable saddle clamp lever
20) Adjustable table clamp lever
21) Adjustable knee clamp lever
22) Combination oil level and flow gauge for knee
23) Coolant screen covers; protect screens when coolant is not used
24) Feed selection lever; dial revolves in either direction
25) Vertical feed engagement lever for power feeds to knee
26) Vertical hand feed crank for hand movements to knee
27) Cross feed engagement lever for power feed to saddle
28) Cross feed hand wheel for hand movements to saddle
29) Table feed lever - directional control
30) Feed trip rod used with leads under 8" and low lead attachment
31) Directional table feed lever used on leads under 8" with low lead box
32) Reverse lever for changing hand of spiral on low lead attachment
33) Telescopic drive shaft, and adjustable collar, graduated in minutes, for use when spacing holes or cams that are laid out in degrees
34) Index plunger crank
35) Spindle clamp lever
36) Tailstock center clamp lock
37) Adjustable coolant valves; double joint adjustable outlets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38) Support clamp - no-springing grips support on full circumference of bars

39) Arbor supports have oil level gauge and adjustable bronze bushings

40) V Type adjustable center rest for supporting long slender work

41) Clamping bolts locking brace to outer "B" arbor supports

42) Adjustable table trip dogs - two right and two left

43) Table limit stops

44) Knurled screw for locking table feed lever

45) Outer support - used for heavy work - slides along knee top

46) Rapid traverse lever; raise lever for fast movements; drop lever and feed resumes

47) Remove cover to adjust rapid traverse clutch

48) Telescopic tube for coolant return

49) Guarded single screw for vertical knee movements

50) Low pressure, large volume coolant pump

51) Coolant pump drive clutch; snaps on and off by hand movement

52) Pipe cap for draining column reservoir

53) Main drive clutch adjusting pin

54) Safety door; ventilates motor and covers drive

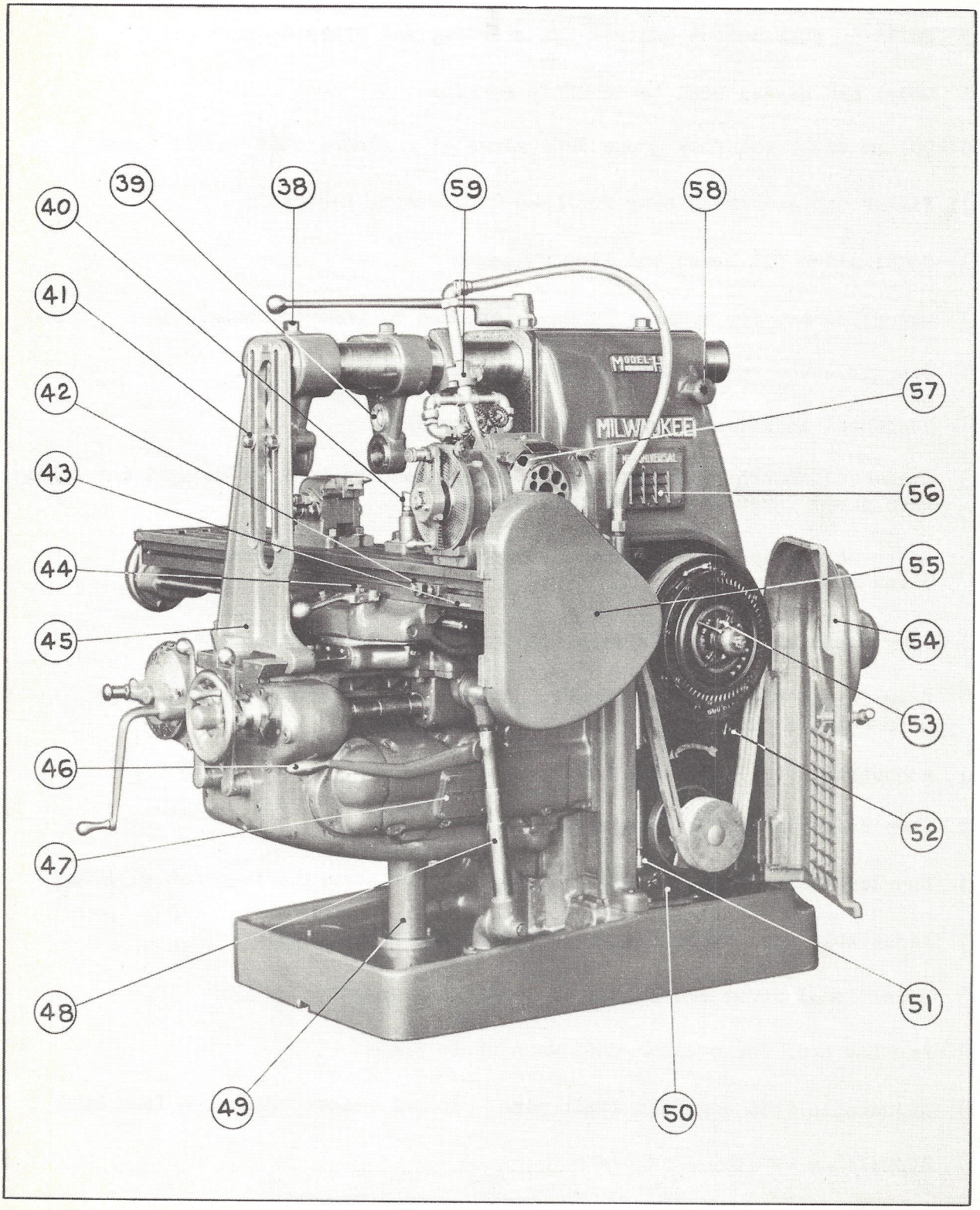
55) Conventional spiral lead attachment (standard equipment) provides leads from 2-1/2" to 149" by power. Rapid traverse can be used on all leads above 10"

56) Breather plate prevents condensation in column; knee likewise protected

57) Clamp bolts for locking spindle block at any angle from 5° below horizontal to 5° beyond vertical

58) Parking post for coolant hose when not in use

59) Adjustable coolant clamp ring can be applied to either overarm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60) Adjustable starting lever can be set to suit operator's convenience

61) Clamp nut - two additional at right side for clamping head at four equal points, on heavy milling

62) Vertical head clamp lever; convenient to control on step milling operations

63) Built in push button control for starting and stopping machine motor

64) Model and serial used to identify machine

65) Column sight oil flow gauge determines at a glance that oil is circulating

66) Filler cap and drain plug for head lubricating reservoir

67) Combination oil level and flow gauge

68) Adjusting nut for spindle takeup - exposed by removing cover

69) Spindle speed range change lever

70) Handwheel adjustment for sliding head movement

71) Handwheel clutch releases when power movement to head is engaged and engages when power lever is tripped into neutral

72) Adjustable trip rods for speed and accuracy when step milling or blind boring

73) Four position micrometer stop rod unit; convenient to control

74) Draw-in rod for securing arbors, collet adapters and centering plugs into spindle taper

75) Adjustable stop rod clamp nuts

76) Stop rod cylinder indexing crank

77) Knurled dials, graduated in thousandths, for accurate stop rod adjustment

78) Adjustable dial indicator and safety type tripping post

79) Directional power control lever for head movement

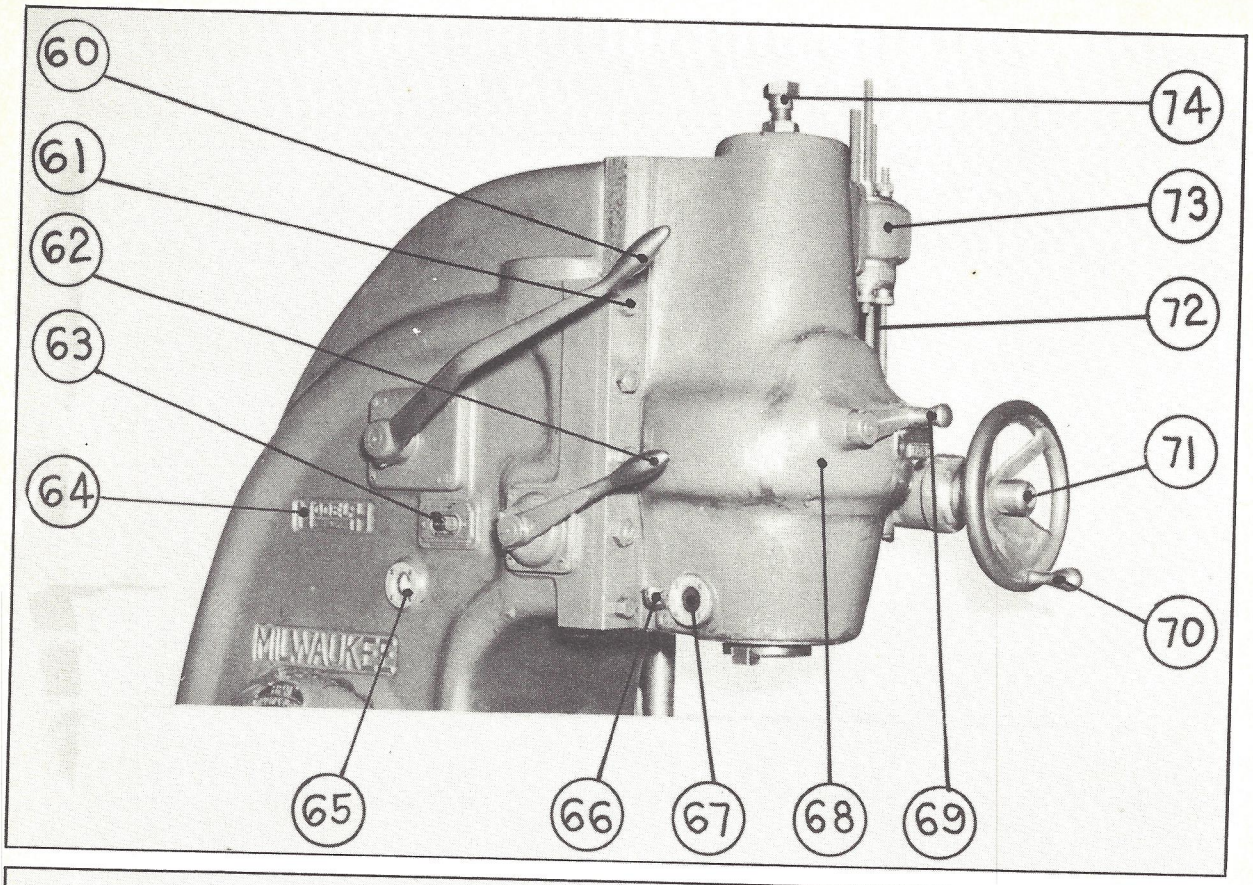
80) Parking stud for coolant unit when not in use

81) Adjustable trip dogs and limit pins - do not remove trip dogs from head

82) Adjustable coolant pipe clamp

83) Ball controlled coolant outlet

84) No. 50 non-sticking spindle taper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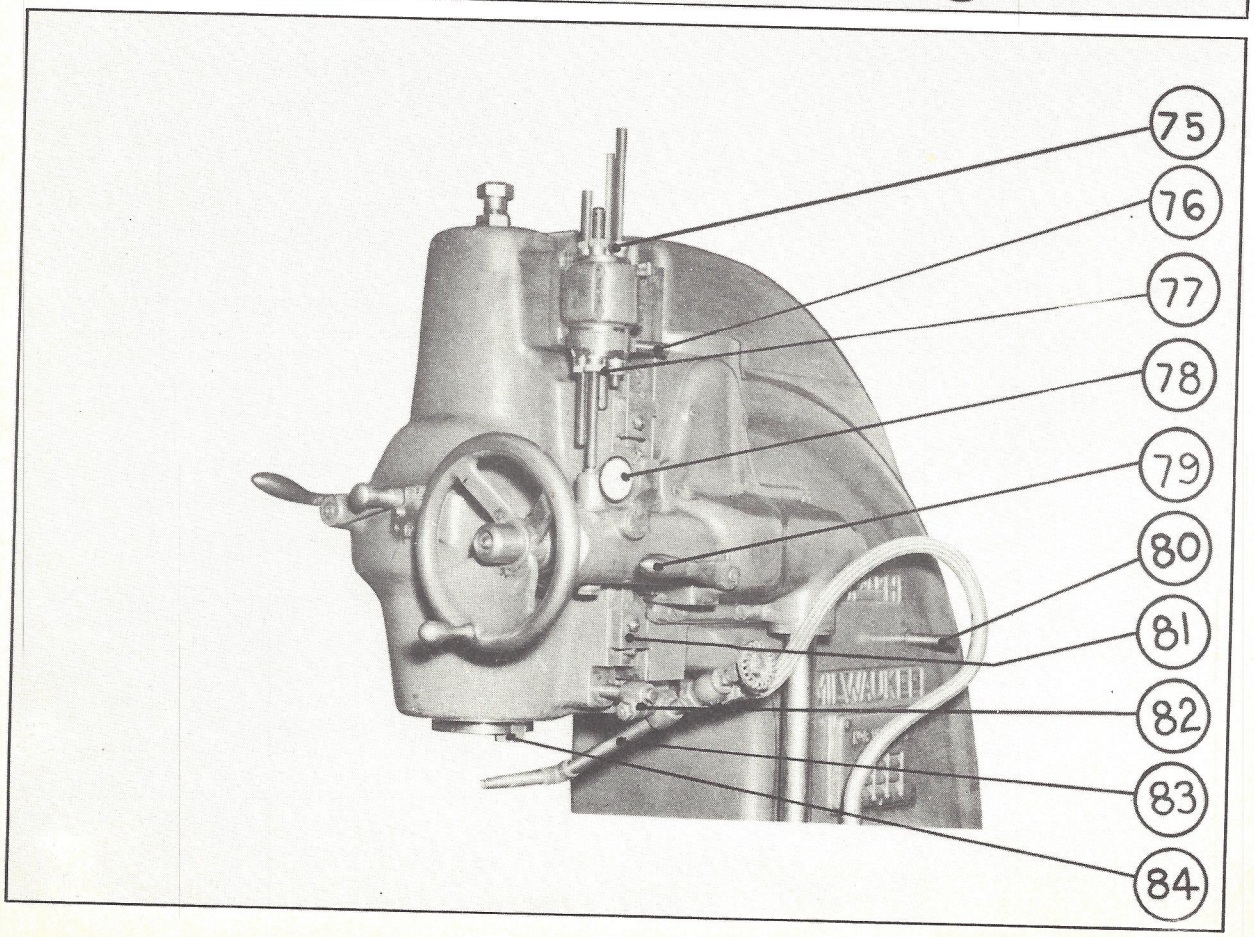
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